



Vegetation monitoring - Southwest Alaska Network

2012 Annual Report

Natural Resource Data Series NPS/SWAN/NRDS—2013/521



ON THE COVER

A white spruce-black spruce (*Picea glauca*-*P. mariana*) stand occupies an old burn on the western shore of Two Lakes, Lake Clark National Park and Preserve. Photograph by Amy Miller.

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Executive summary

This report summarizes the results of vegetation sampling in Lake Clark National Park and Preserve (LACL) and Katmai National Park and Preserve (KATM) in 2012.

Five new spruce woodland monitoring plots (0.25 ha) were established in Lake Clark (LACL) and Katmai (KATM) National Parks and Preserves in 2012, and twenty existing plots were resampled for the purpose of refining baseline estimates. The new plots were located east and west of Two Lakes (LACL), in an old burn; on the western shore of Nonvianuk Lake (KATM); and south of Malone Lake (KATM), near the southern extent of trees on the Alaska Peninsula. The new sites, combined with previously established sites, comprise a total of 25 low-elevation woodland plots across LACL and KATM. In sum, the woodland sites provide data on species composition and stand structure (basal area, density, biomass, condition), including age structure. Tree cores collected from up to 20 of these sites will also be used to assess the sensitivity of white spruce to temperature under a separately funded project.

The twenty sites that were resampled in 2012 consisted of a mix of white spruce woodland (9), open spruce forest (8), and mid- and high elevation tundra (3). Stem diameters were remeasured at all woodland and forest plots in order to improve estimates of basal area and aboveground biomass. Basal area estimates increased by roughly 3%-60% over the original estimates due to the inclusion of smaller-diameter stems. Stem density estimates remained unchanged in forest plots, but increased in many woodland plots. Species cover was remeasured at most sites, yielding estimates of interannual variability of between 0% and 33%. Frequency data were more variable, due to the high number of species that were present at low abundance. Soil temperature loggers were downloaded and replaced at 15 sites; sensor depths were increased to 20 cm to support more stable temperature readings.

At 15 of the 22 forest and woodland sites, including both previously established and new sites, we also sampled for epiphytic lichens using the U.S. Forest Service's Forest Inventory and Analysis (FIA) off-frame sampling protocol. The sampling yielded 408 collections, two-thirds of which came from LACL. Species of interest include *Normandina pulchella*, a potential range extension found at Currant Creek (LACL); *Hypogymnia pulverata*, a rare lichen found at four forest locations in KATM; and *Erioderma pedicillatum*, a globally endangered lichen known from Scandinavia, southeastern Canada, and the upper Cook Inlet region of Alaska. It was found in 2009 at a forest site in KATM that was resampled in 2012.

Acknowledgments

We thank NPS employees E. Booher, L. Schoemaker, B. Chilcott, and M. Shephard for help in the field. KATM and LACL resource, law enforcement, and administrative staff provided logistical support. NPS data gurus T. Shepherd and R. Frith provided invaluable assistance with data compilation and management. C. Parker, University of Alaska Fairbanks, provided determinations for vascular plant collections. R. Sherriff, Humboldt State University, assisted with field work and the processing of tree cores for a related project on the climate sensitivity of white spruce (CESU Task Agreement P10AC00401).

Introduction

Monitoring objectives for vegetation composition and structure are to document trends in the structure (e.g., height, density), composition (e.g., species richness and diversity), mortality and species turnover of selected mid- to late-successional vegetation types in the three largest parks in the SWAN. Major vegetation types include white spruce woodland and forest communities, low and dwarf shrub tundra, and alpine environments. This report summarizes the results of vegetation sampling in Lake Clark NPP (LACL) and Katmai NPP (KATM) for the 2012 field season.

Methods

Sampling sites

Five new white spruce (*Picea glauca*) woodland monitoring plots were established in LACL and KATM in 2012, and twenty pre-existing plots were resampled for the purpose of refining baseline estimates of stand structure and developing estimates of variance for species cover (Figure 1; Table 1). A total of 105 plots have now been established in the two parks (2007-2012).

Field methods and plot layout are described in detail in Miller et al. (2010a). Sites are drawn from a generalized random-tessellation stratified (GRTS) sample and are revisited using a rotating panel design. At each new site, we established a 50 m × 50 m (0.25 ha) monitoring plot and intensively sampled the inner 30 m × 30 m. We mapped and measured the diameter of all trees at breast height (1.37 m; DBH) and height of all trees ≥ 12 cm diameter. We measured vascular and nonvascular species occurrence in nested quadrats (0.25 m²; 1 m²; 4 m²), and vascular species cover by point-intercept in each of four height classes (<0.5 m; 0.5-1.0 m; >1-4 m; >4 m). Camp locations and site descriptions can be found in earlier reports (Miller et al. 2010b, 2011, 2012). All field work was conducted by a crew of three between 30 June and 1 August, 2012.

The new 2012 plots were located in white spruce woodland east and west of Two Lakes (LACL) in an old burn; on the western shore of Nonvianuk Lake (KATM); and south of Malone Lake (KATM), near the southern extent of spruce on the Alaska Peninsula (Figure 2). The sites at Two Lakes fall in the Stony River Morainal Valley subsection of the Alaska Range. The subsection is characterized by glacial deposits and small shallow lakes, and is dominated by black spruce (*Picea mariana*) and low shrub woodlands, primarily dwarf birch (*Betula glandulosa*; *B. nana*) and birch hybrids. Discontinuous permafrost and wildfire produce a mosaic of successional stages. The sites at Nonvianuk are in the Lakes Region Spruce Covered Moraines subsection of the Alaska Peninsula, and those at Malone are in the Lowland Outwash and Drift Deposits subsection of the Bristol Bay Lowlands. The Lakes Region Spruce Covered Moraines subsection is shaped by glacial and colluvial deposits and supports extensive stands of white spruce (*Picea glauca*). Crowberry (*Empetrum nigrum*) is dominant in the understory. The Lowland Outwash and Drift Deposits subsection is characterized by undifferentiated outwash that supports dry and moist tundra communities. Southern treeline occurs on the Alaska Peninsula just south of Malone Lake, roughly at Boundary Creek.

The new sites, combined with previously established sites, comprise a total of 25 low-elevation white spruce woodland plots that span a 300-km expanse traversed by the two parks. The sites vary in species composition and stand structure (basal area, density, biomass, condition) across the north-south gradient, and include a range of stand ages. Tree cores collected from up to 20 of these sites will be used to assess the sensitivity of white spruce to temperature under a separately funded project with Humboldt State University (CESU Task Agreement P10AC00401).

The twenty sites that were resampled in 2012 consisted of a mix of white spruce woodland (9), open spruce forest (8), and mid- and high elevation tundra (3). At plots that were established between 2007 and 2009, we had initially measured stem diameters only on trees ≥ 4 cm DBH, and we had tallied all trees < 4 cm. In 2012, we measured stem diameters on all trees that were at least 1.37 m tall, including multiple stems of birch (*Betula neoalaskana*) originating from a single base. The resampling in 2012 was intended to provide a refined baseline estimate of basal area and aboveground biomass for plots established in 2009, consistent with data collected in 2010-2011. At a subset of these sites, we remeasured species cover (14 plots), and frequency (12 plots; Table 1) to derive estimates of variance for species composition. As of the 2011-2012 field seasons, 25% of the 105 plots in LACL and KATM had been sampled at least twice.

We sampled epiphytic lichens at 15 of the 22 forest and woodland sites using 34.7 m radius plots centered on the 50 m $\times$ 50 m plot center points (Table 1). Methods followed the U.S. Forest Service Forest Inventory and Analysis (FIA) off-frame protocol for lichen communities (<http://www.fia.fs.fed.us/library/field-guides-methods-proc/>). The FIA lichen community data record the presence and abundance of fruticose and foliose lichens (macrolichens) growing on live and dead trees and shrubs. Survey time at the FIA plots was limited to 2 hours.

Data analysis

Field data were entered directly into an SQL database with MS Access front end (2012), or were uploaded from preexisting MS Excel files (2007-2011). Data uploads were completed for most plot variables by 5 June 2013. QA/QC of the 2007-2012 data is expected to continue into 2014; data contained in this report have undergone a preliminary quality check for logical errors, but have yet to be checked systematically against field data forms. Basal area and biomass calculations are outlined in Miller et al. (2010b).

Selected plot variables (basal area by species and condition class; species occurrence; cover by growth form and height class) were summarized within plots using PROC UNIVARIATE and PROC SURVEYMEANS in SAS (SAS Institute, Cary, NC; Miller et al. 2010a), or by using automated QA/QC queries within the SQL database. Frequency distributions for stem diameter classes were calculated using PROC FREQ for all species and condition classes. Data were compared across sampling events (years) to estimate interannual variability in plot variables, and to identify potential sources of error in the data set.

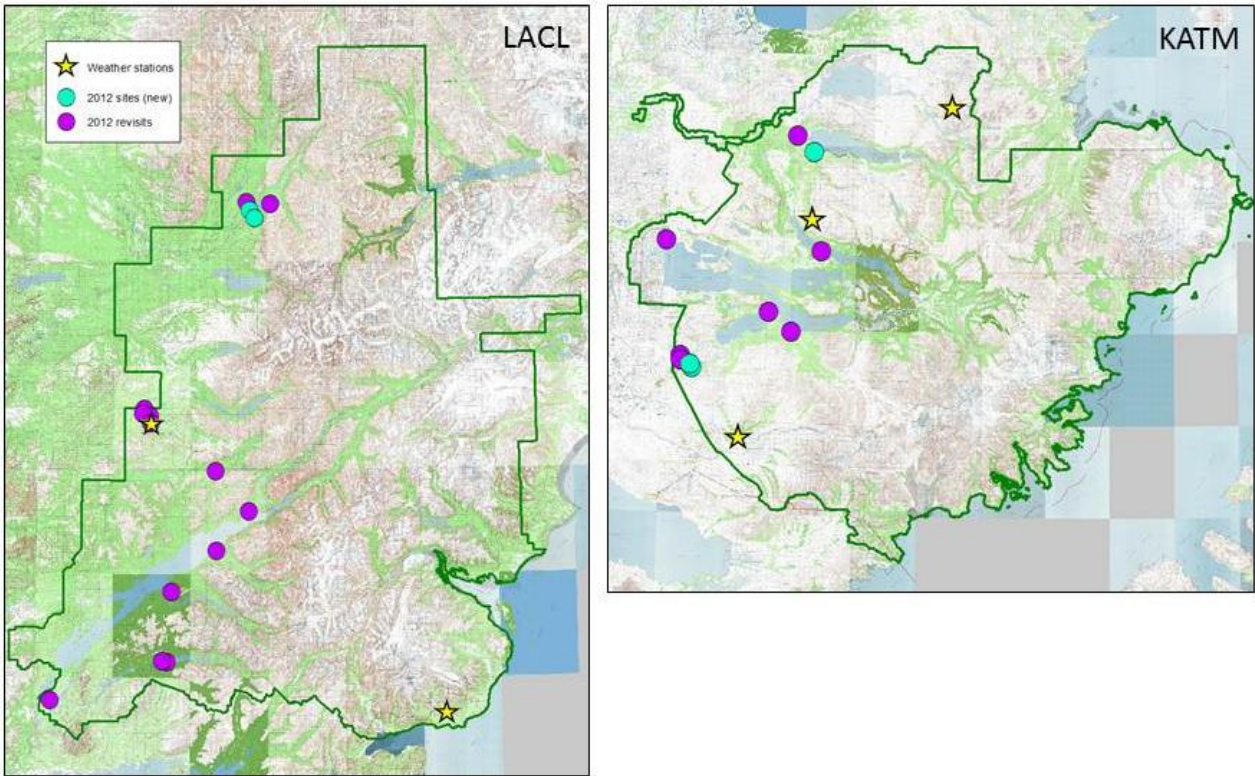


Figure 1. 2012 sampling locations in LACL and KATM. New sites established in 2012 are shown in cyan. Previously established sites were resampled for revised baseline estimates of tree/sapling basal area and for repeated measures of other variables, including species cover. Map scale 1:835,000.

Data downloads

HOBO temperature dataloggers (HOBO Pro v2; Onset Computer Corporation, Bourne, MA) were downloaded and reinstalled at 15 sites (Table 1). All loggers were buried at 20 cm depth in 2012, a 10 cm increase in depth over previous installations. The increase in sensor depth is expected to result in more stable soil temperature readings, buffered from diurnal fluctuations in air temperature but representative of temperatures in the rooting zone. Loggers were permanently removed from one site (LACL-2010-01-S997 – Upper Tazimina); newly installed at three sites (LACL-2010-01-024 – Upper Tazimina; LACL-2010-01-S994 – Lachbuna; LACL-2010-01-S996 – Tlikakila); and replaced at five others (KATM-2009-01-S050 – Naknek; KATM-2009-02-050 – Upper Coville; KATM-2011-03-003 – Pfaff; LACL-2010-01-S993 – Currant Cr.; LACL-2010-03S-999 – Tanalian Mt.). The loggers that were replaced we were either unable to locate, or we found that they had been excavated and damaged by bears (e.g., Naknek).

Time-lapse cameras (Canon EOS 1000D) installed at the Snipe (LACL), Contact (KATM), and Upper Colville (KATM) RAWs were downloaded during annual station maintenance in June. As of September 2012, one full year of images had been acquired from the Coville and Contact Creek RAWs cameras, and two full years from the Snipe camera. Soil temperature data and images and derived data from the time-lapse cameras are not included in this report.

Table 1. Plot locations and major vegetation types sampled in LACL and KATM in 2012. Datum = NAD83. The 25 plots are listed in ascending order by establishment date, elevation class and vegetation type. All but three plots were forest or woodland types, dominated by *Picea glauca*. HOBO soil temperature loggers were installed at sites indicated by a dagger (†). Off-frame FIA epiphytic lichen plots were sampled at sites indicated by a (§). Plots that have been sampled more than once are shaded gray.

Plot id	Establ.	Elevation class	Vegetation type	General location	Latitude (N)	Longitude (W)	Elevation (m)
LACL_2007_02_006†	2007	450-900 m	Low shrub - treeline	Snipe	60.6280	-154.3271	628
LACL_2007_02_017§	2007	450-900 m	Spruce woodland	Snipe	60.64522	-154.3529	580
LACL_2008_02_014†§	2008	450-900 m	Spruce woodland	Snipe	60.63264	-154.3635	545
KATM_2009_01_S050†	2009	<450 m	Spruce woodland	Naknek	58.73486	-156.3303	40
KATM_2009_01_S035†	2009	<450 m	Spruce woodland	Nonvianuk	59.0256	-155.6512	200
KATM_2009_01_S012§	2009	<450 m	Spruce woodland	Long	58.4238	-156.2341	74
KATM_2009_01_S027†	2009	<450 m	Spruce woodland	Long	58.41150	-156.2339	85
KATM_2009_01_S996†§	2009	<450 m	Beetle kill spruce	Brooks Camp	58.5481	-155.7835	22
KATM_2009_01_S999†§	2009	<450 m	Beetle kill spruce	Coville	58.7135	-155.5157	66
KATM_2009_01_S995†§	2009	<450 m	Beetle kill spruce	Valley 10K Road	58.4955	-155.6619	79
LACL_2010_01_024§	2010	<450 m	Spruce woodland	Upper Tazimina	60.03927	-154.2622	230
LACL_2010_01_030	2010	<450 m	Spruce woodland	Two Lakes	61.14088	-153.8517	435
LACL_2010_01_S994§	2010	<450 m	Spruce woodland	Upper Tazimina	60.49619	-154.0095	400
LACL_2010_01_S993†§	2010	<450 m	Beetle kill spruce	Currant Creek	60.30519	-154.0020	80
LACL_2010_01_S995†§	2010	<450 m	Beetle kill spruce	Upper Tazimina	60.03830	-154.2407	225
LACL_2010_01_S996†§	2010	<450 m	Beetle kill spruce	Tlikakila River	60.39818	-153.8410	80
LACL_2010_01_S998†§	2010	<450 m	Beetle kill spruce	Lachbuna	60.49587	-154.0056	400
LACL_2010_01_S999†§	2010	<450 m	Beetle kill spruce	Two Lakes	61.13662	-153.7335	350
LACL_2011_01_033§	2011	<450 m	Spruce woodland	Pickerel Lakes	59.9437	-154.8039	107
LACL_2010_02_999†	2010	450-900 m	Low/dwarf shrub	Snipe	60.6101	-154.3220	693
LACL_2010_03S_999†	2010	>900 m	Dwarf shrub - alpine	Tanalian Mountain	60.2060	-154.2186	945
LACL_2012_01_162	2012	<450 m	Spruce woodland	Two Lakes	61.122701	-153.83698	365
LACL_2012_01_S992	2012	<450 m	Spruce woodland	Two Lakes	61.102755	-153.80977	444
KATM_2012_01_S041	2012	<450 m	Spruce woodland	Nonvianuk	58.983498	-155.563488	220
KATM_2012_01_S994§	2012	<450 m	Spruce woodland	Malone	58.391003	-156.172915	130
KATM_2012_01_S190	2012	<450 m	Spruce woodland	Malone	58.39942	-156.184199	96

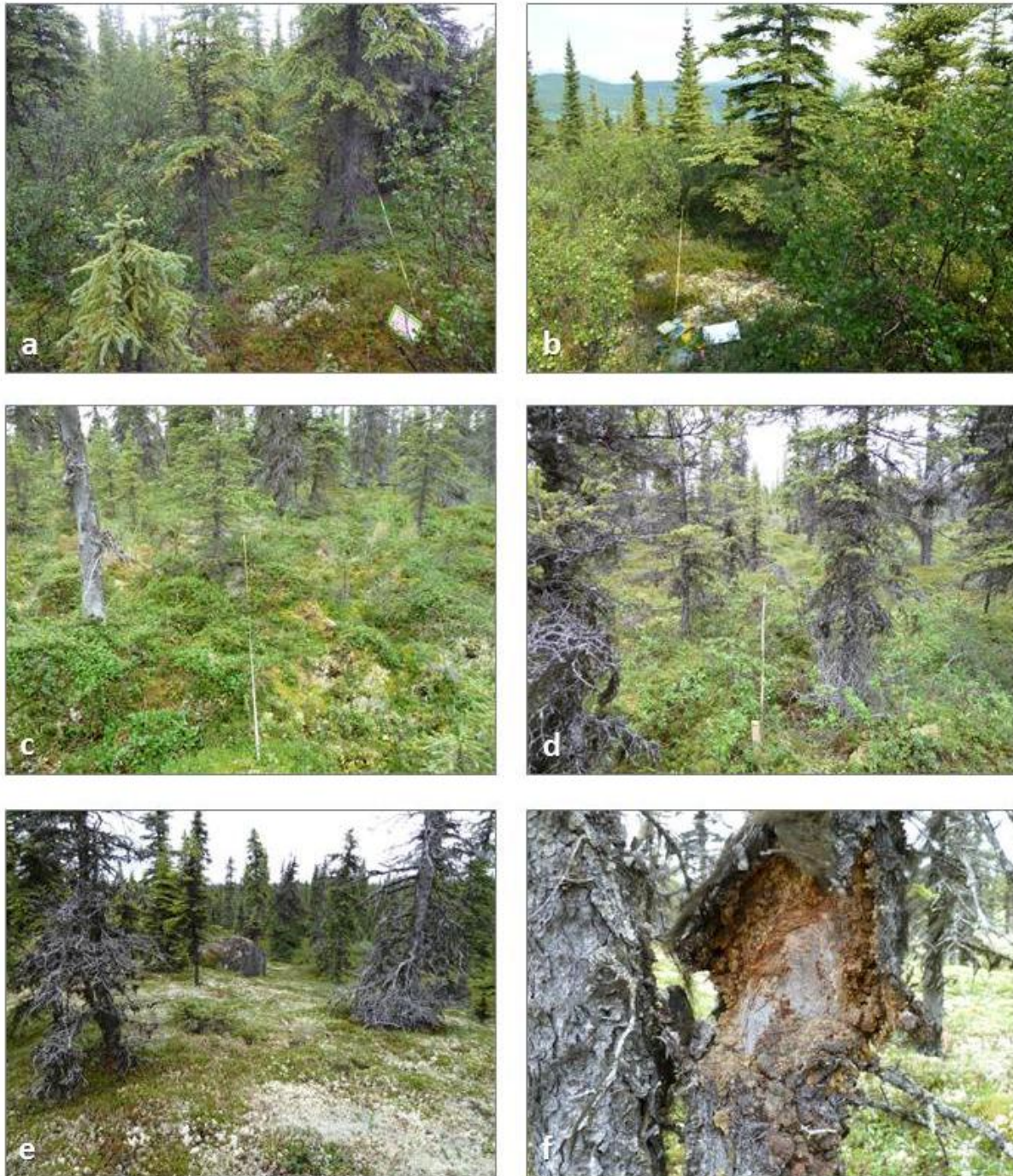


Figure 2. Photos of monitoring plots established in 2012. (a) LACL-2012-01-S162 and (b) LACL-2012-01-S992, located in an old burn at Two Lakes. The oldest living trees appeared to be approximately 60-65 years of age. (c) KATM-2012-01-S041, located in spruce woodland west of Nonvianuk. (d) KATM-2012-01-S190 and (e) KATM-2012-01-S994, located in spruce woodland south of Malone Lake, near the southern extent of white spruce (western treeline). (f) Extensive scarring on white spruce at KATM-2012-01-S994, a site near western treeline. The cause of damage is unknown, but could be due to a stem canker (e.g., *Leucostoma kunzei*) or tumor.

Results and Discussion

Stem diameters and stem counts in forest and woodland plots

Stem diameters were remeasured at a number of forest and woodland plots in order to refine baseline estimates of basal area and aboveground biomass. Basal area estimates in woodland plots originally sampled in 2009 increased by an average of 34% (10%-60%) due to the inclusion of smaller-diameter (<4 cm) stems and/or large-diameter standing CWD on the second sampling date (Figures 3-4; Table 2). Basal area estimates were generally comparable between sampling dates in forest plots, varying on average by only 3%. Increases in basal area for standing dead trees, and concomitant decreases in live trees, were recorded at two sites in KATM that have experienced recent spruce beetle-related mortality (KATM-2009-01-S995, Valley 10K Road; KATM-2009-01-S996, Brooks).

Most sites showed the highest frequency of stems in the smallest size (diameter) classes (e.g., ≤ 4 cm), as would be expected for a mature population with continuous mortality. However, several sites including Coville, Lake Brooks, Valley 10K Road (forest), and Snipe (woodland), had a greater proportion of stems in the larger size classes (Figures 3-4), suggesting either an older cohort that initiated following a past disturbance, or a more recent limit to regeneration. A fifth site in the Bay of Isles sampled in 2009 also showed only 5% of trees in diameter classes ≤ 4 cm (data not shown). Tree-ring data from these five sites show establishment dates at Coville, Bay of Isles, and Valley 10K Road concentrated in the 1870s-1880s, and at Brooks in the 1830s (R. Sherriff, unpublished data). The cohort at Snipe also established in the 1880s. While the cause of these establishment events is unknown, it is likely that in the forested stands they could have followed spruce beetle outbreaks in the 1810s and 1870s (Sherriff et al. 2011; Berg et al. 2006).

The reason for the low frequency of smaller size classes at Valley 10K Road (Figure 3) and Bay of Isles (data not shown) is less clear. Understory dominance by bluejoint (*Calamagrostis canadensis*), or lack of nurse logs and/or exposed substrate could be partly responsible (Boucher and Mead 2006; Boggs et al. 2008). Although whole-plot estimates of downed, large-diameter (>7.6 cm) coarse woody debris (CWD) indicated relatively high CWD volumes at both Valley 10K Road (7.1 m³/ha) and Bay of Isles (6.9 m³/ha), the downed wood was almost entirely in the early stages of decay (e.g., recently fallen with bark intact or sloughing) and so as yet would not be likely to support seedling establishment.

In contrast to the larger size classes observed at forest sites, woodland sites at Two Lakes and Pickerel supported trees that were almost entirely ≤ 10 cm in diameter and ranged in age from 60-90 years. We found burn poles in both areas of LACL, suggesting that the cohorts established post-fire. We collected stem disks from the Two Lakes sites in 2012. The disks are being stored at Humboldt State University until they can be cross-dated to estimate the age of the burn.

We did not expect stem counts to change markedly between sampling dates, as smaller-diameter stems had been tallied, but not measured, prior to 2012. However, data downloaded from the SQL data set showed stem counts varying on average 18% (3%-60%) between sampling dates in woodland plots (Table 3). We will examine these data in greater detail when we begin to QA/QC the SQL data set. In addition to the fact that we may not have inventoried completely on one of the sampling dates (e.g., as with LACL-2010-01-S994), or that there may have been error

associated with sampling along the 30 m × 30 m plot perimeter, it is also possible that not all of the original stem counts were entered, or that there was an incomplete transfer of data from the original data set into SQL. Variation between sampling dates was generally much lower for stem counts in forest plots (3%; Table 3).

Species cover estimates

We remeasured species cover at 14 sites in 2012, twelve of which (forest and woodland) are shown in Appendix A. Differences in mean percent cover were generally small between years, with the exception of litter, which tended to be highly variable (Appendix A; Tables A1-A3). Within sites, the most stable cover estimates were often for dominant species (e.g., *Picea glauca* and *Calamagrostis canadensis* in forest sites; *Betula nana*, *Ledum palustre* ssp. *decumbens*, and *Vaccinium uliginosum* in woodlands). Estimates of interannual variability, approximated by the standard deviation calculated across years, ranged from 0% to 33%.

Cover estimates for plots established in 2012 are shown in Appendix A, Table A4.

We completed our fifth year of data collection at a treeline site at Snipe Lake (LACL-2007-02-006) and recorded short-term changes in cover of several dominant species (Figure 5). An outbreak of autumnal moths that began in 2010 has resulted in a decrease in dwarf birch (*Betula nana*) cover, evident in stems between 50 cm and 100 cm tall. The marginal increase in cover below 50 cm could be due to sprouting from the base of the shrub, which we observed in 2012 (Figure 6). We also completed a third year of sampling at a woodland site at Snipe (LACL-2008-02-014), but found little variation in species cover across years at that location (data not shown).

Species occurrence and frequency estimates

We remeasured frequency (species presence/absence) at 12 of the above 14 sites (Appendix B; Tables B1-B2). For species that occurred in <20% of quadrats, detectability appeared to be a common problem. Most lichen and moss taxa were recorded in only 1-2 quadrats per plot, and often in only one of the sampling years. In some cases, taxa were recorded in multiple quadrats in one sampling event, but were recorded as absent in the other. Late emergence of plants, lack of identifiable features or inflorescences, cryptic taxa, and/or mis-identifications in the field are possible explanations for the differences in frequency estimates recorded between years. These discrepancies highlight the importance of repeated, high-frequency sampling to capture interannual variability in species composition. See Miller et al. (2012) for a discussion of potential sources of error in the measurement of species occurrence.

Frequency estimates for plots established in 2012 are shown in Appendix B, Table B3.

Cover estimates by growth form

We repeated ocular cover estimates by growth form and substrate type at 7 of the 14 sites outlined above (Appendix C; Table C1). Cover estimates were relatively stable for some growth forms (e.g., dwarf shrub, tree), but were more often highly variable between sampling events. The cover values have been used primarily in ordination and will likely be retained for descriptive applications, but not for documenting change through time.

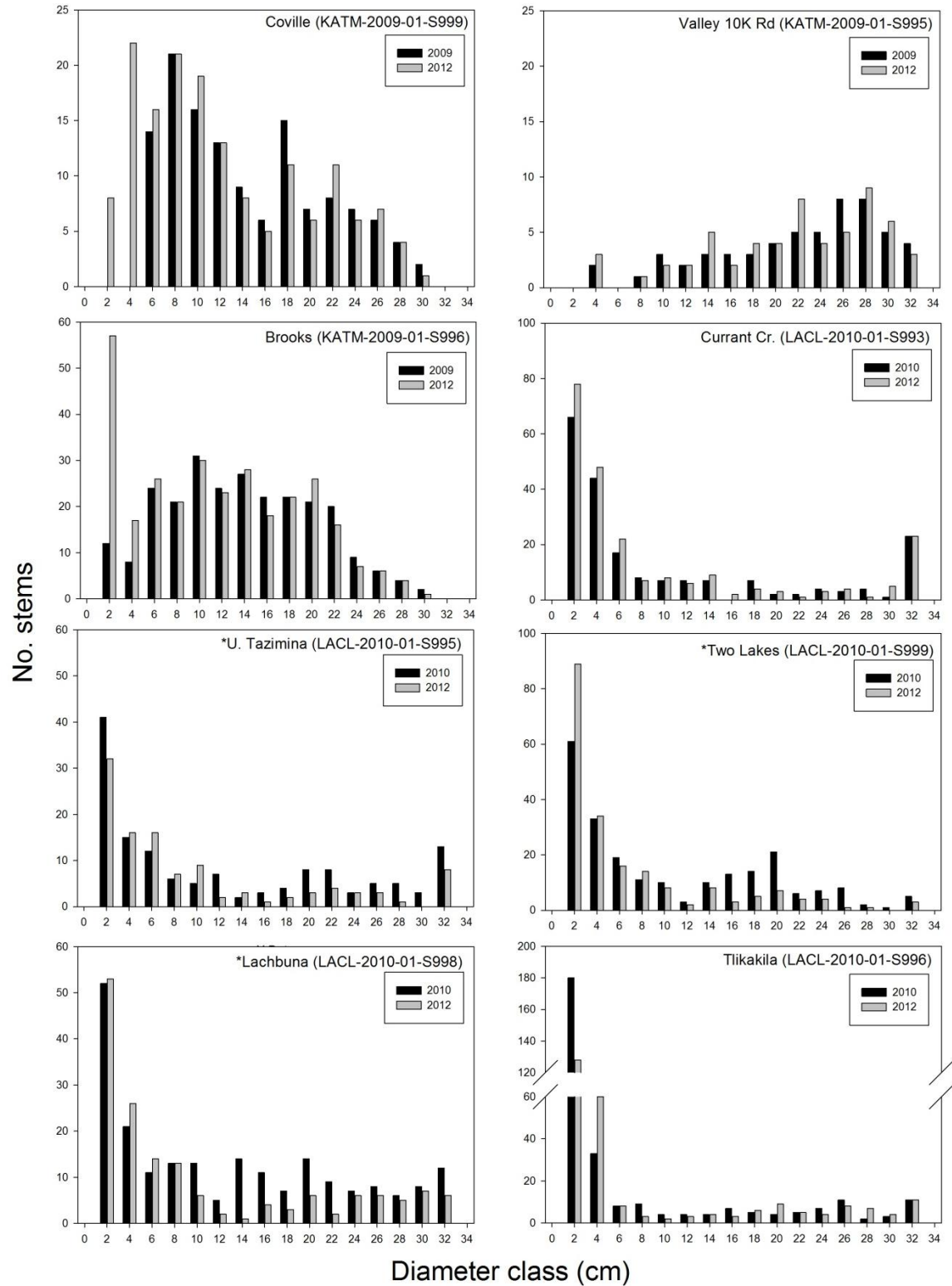


Figure 3. Frequency distributions for stem diameter (DBH) classes in forest monitoring plots (2009-2012). Scale of the Y-axis varies among sites. High stem counts in the 0-2 cm and 2-4 cm DBH classes at the Tiikakila site (LACL-2010-01-S996) reflect the presence of multi-stemmed individuals of resin birch (*Betula neoalaskana*). In 2012, only one half of the plot was sampled at sites marked with an asterisk (*).

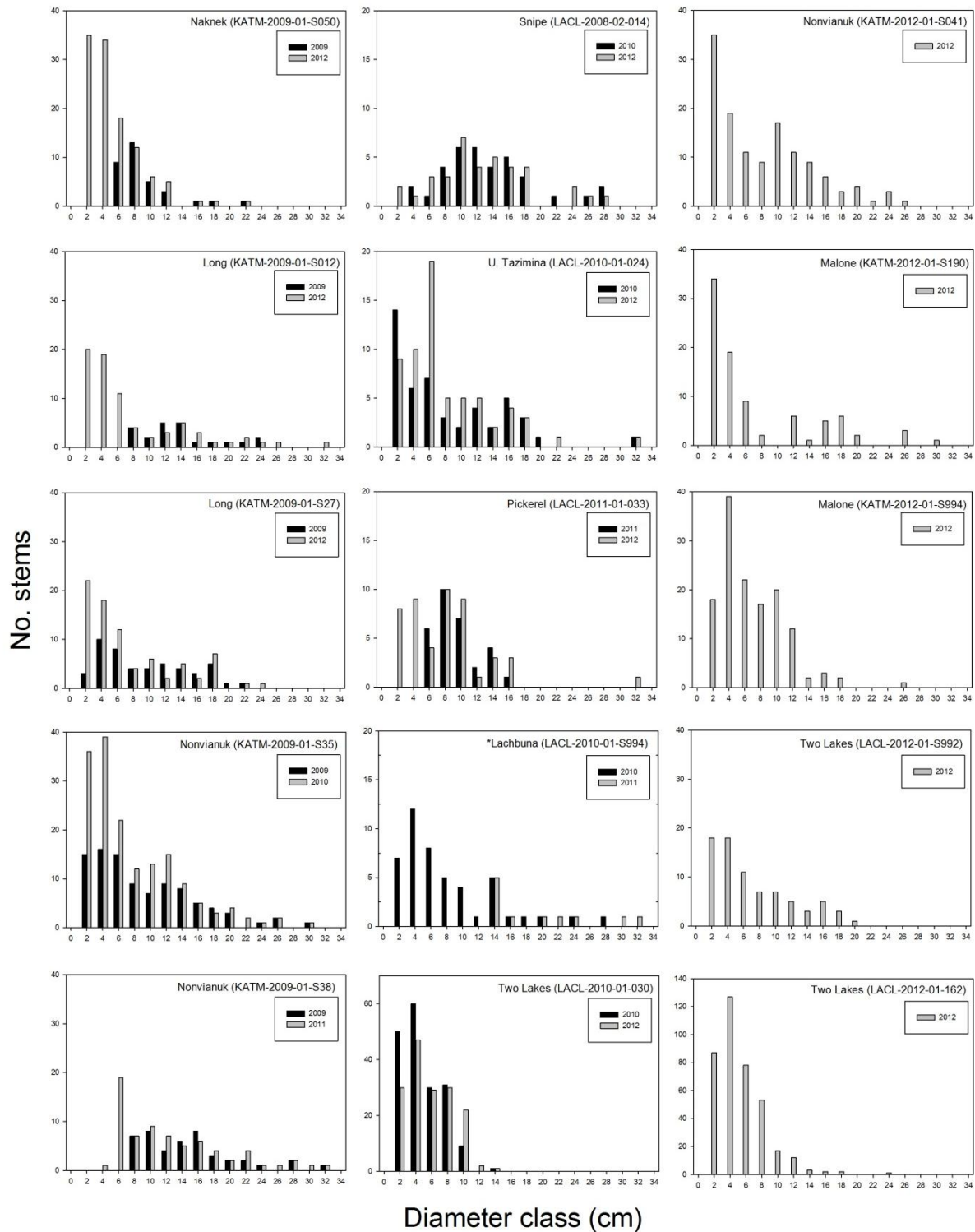


Figure 4. Frequency distributions for stem diameter (DBH) classes in woodland monitoring plots (2009-2012). Scale of the Y-axis varies among sites. Sites established in 2012 are shown to the right. Trees < 4 cm DBH were not consistently sampled prior to 2012. Trees <12 cm DBH were not measured at the Lachbuna site (LACL-2010-01-S994; marked with an asterisk (*)) on the second sampling date.

Table 2. Basal area estimates (m²/ha) for plots sampled in 2011-2012. Plots that have been sampled more than once are shaded gray. Plots indicated by asterisks are those for which the inventory was incomplete on one of the sampling dates (*), or only one half of the plot was inventoried in 2012 (**). In the latter case (**), basal area estimates shown below are for only one half of the plot. Methods were changed in 2010 to include the measurement of stem diameter (DBH) on all trees regardless of size, and in 2012 to include standing CWD >1.37 m tall and to enumerate multiple stems on individual trees.

Plot id	Basal area - live								Basal area - dead					
	<i>P. glauca</i>		<i>P. mariana</i>		<i>P. balsamifera</i>		<i>B. neoalaskana</i>		<i>P. glauca</i>		<i>P. mariana</i>		<i>B. neoalaskana</i>	
	2009-10	2012	2009-10	2012	2009-10	2012	2009-10	2012	2009-10	2012	2009-10	2012	2009-10	2012
LACL_2008_02_014	5.90	5.85	0	0	0	0	0	0	0.01	<0.01	0	0	0	0
KATM_2009_01_S050*	2.17	2.99	0	0	0	0	0	0	0.11	0.15	0	0	0	0
KATM_2009_01_S035*	6.28	8.26	0	0	0	0	0	0	2.45	2.98	0	0	0	0
KATM_2009_01_S012*	3.44	4.71	0	0	0	0	0	0	0.16	0.97	0	0	0	0
KATM_2009_01_S027*	4.06	4.37	0	0	0	0	0	0	0.47	0.61	0	0	0	0
KATM_2009_01_S996	17.86	1.41	0	0	0	0	0.47	0.62	27.67	41.67	0	0	0.02	<0.01
KATM_2009_01_S999	0.52	1.09	0	0	0	0	3.58	3.72	21.7	20.42	0	0	0.42	0.10
KATM_2009_01_S995	21.36	13.49	0	0	0	0	0.41	0.41	12.81	21.26	0	0	0	0
LACL_2010_01_024	2.43	2.80	0	0	0	0	0	0	1.81	1.77	0	0	0	0
LACL_2010_01_030*	0.48	0.78	2.79	3.41	0	0	0	0	0	0	0.03	0.01	0	0
LACL_2010_01_S994*	3.38	2.78	0	0	0	0	0	0	0.20	1.40	0	0	0	0
LACL_2010_01_S993	28.27	34.01	0	0	5.43	5.63	<0.01	0	3.91	1.45	0	0	0	0
LACL_2010_01_S995**	6.36	4.72	0	0	0.47	.66	0	0	10.87	11.53	0	0	0	0
LACL_2010_01_S996	21.96	22.00	0.16	0.09	0	0	6.40	6.30	2.09	2.72	0	0.04	2.17	2.90
LACL_2010_01_S998**	20.94	19.85	0	0	1.28	1.44	0	0	4.65	4.57	0	0	0	0
LACL_2010_01_S999**	14.84	11.28	0	0	1.08	1.05	0	<0.01	1.27	1.77	0	0	0	0
LACL_2011_01_033*	1.68	1.93	0.43	0.47	0	0	0	0	0	0.98	0	0	0	0
LACL_2012_01_162	N/A	8.84	N/A	0.344	N/A	0	N/A	0	N/A	0.16	N/A	0	N/A	0
LACL_2012_01_S992	N/A	2.97	N/A	1.208	N/A	0	N/A	0.08	N/A	0	N/A	0	N/A	0
KATM_2012_01_S041	N/A	7.41	N/A	0	N/A	0	N/A	0	N/A	2.7	N/A	0	N/A	0
KATM_2012_01_S994	N/A	5.87	N/A	0	N/A	0	N/A	0	N/A	0.3	N/A	0	N/A	0
KATM_2012_01_S190	N/A	4.59	N/A	0	N/A	0	N/A	0	N/A	2.12	N/A	0	N/A	0

Table 3. Stem counts for plots sampled in 2011-2012. Plots that have been sampled more than once are shaded gray. Plots indicated by asterisks are those for which the inventory was incomplete on one of the sampling dates (*), or only one half of the plot was inventoried in 2012 (**). In the latter case (**), stem counts are shown for only one half of the plot, for comparison across years.

Plot id	Stem counts - live								Stem counts - dead					
	<i>P. glauca</i>		<i>P. mariana</i>		<i>P. balsamifera</i>		<i>B. neoalaskana</i>		<i>P. glauca</i>		<i>P. mariana</i>		<i>B. neoalaskana</i>	
	2009-10	2012	2009-10	2012	2009-10	2012	2009-10	2012	2009-10	2012	2009-10	2012	2009-10	2012
LACL_2008_02_014	34	36	0	0	0	0	0	0	1	1	0	0	0	0
KATM_2009_01_S050	79	107	0	0	0	0	0	0	1	6	0	0	0	0
KATM_2009_01_S035	107	128	0	0	0	0	0	0	22	36	0	0	0	0
KATM_2009_01_S012	47	70	0	0	0	0	0	0	3	4	0	0	0	0
KATM_2009_01_S027	57	75	0	0	0	0	0	0	2	5	0	0	0	0
KATM_2009_01_S996	99	46	0	0	0	0	45	46	140	209	0	0	2	1
KATM_2009_01_S999	7	12	0	0	0	0	65	82	64	58	0	0	4	6
KATM_2009_01_S995	45	31	0	0	0	0	1	1	20	36	0	0	0	0
LACL_2010_01_024	42	56	0	0	0	0	0	0	6	8	0	0	0	0
LACL_2010_01_030	52	54	124	105	0	0	0	0	0	0	5	2	0	0
LACL_2010_01_S994*	44	10	0	0	0	0	0	0	3	1	0	0	0	0
LACL_2010_01_S993	167	199	0	0	21	18	1	0	10	7	0	0	0	0
LACL_2010_01_S995**	35	34	0	0	16	20	0	0	17	19	0	0	0	0
LACL_2010_01_S996	47	41	4	8	0	0	217	188	13	8	0	1	16	19
LACL_2010_01_S998**	48	46	0	0	14	15	0	0	16	22	0	0	0	0
LACL_2010_01_S999**	98	94	0	0	11	12	0	1	13	11	0	0	0	0
LACL_2011_01_033*	26	39	4	7	0	0	0	0	0	2	0	0	0	0
LACL_2012_01_162	N/A	371	N/A	7	N/A	0	N/A	0	N/A	4	N/A	0	N/A	0
LACL_2012_01_S992	N/A	35	N/A	39	N/A	0	N/A	4	N/A	0	N/A	0	N/A	0
KATM_2012_01_S041	N/A	109	N/A	0	N/A	0	N/A	0	N/A	20	N/A	0	N/A	0
KATM_2012_01_S994	N/A	122	N/A	0	N/A	0	N/A	0	N/A	14	N/A	0	N/A	0
KATM_2012_01_S190	N/A	79	N/A	0	N/A	0	N/A	0	N/A	9	N/A	0	N/A	0



Figure 5. Defoliator damage at Snipe Lake. Dwarf birch (*Betula nana*) at Snipe Lake in 2008 (left), prior to an outbreak of autumnal moths, and in 2012 (center), after two years of defoliator damage. New growth at the base of the plant in 2012 (right) probably contributed to stable cover estimates below 50 cm, even though percent cover of taller stems decreased (Fig. 6a).

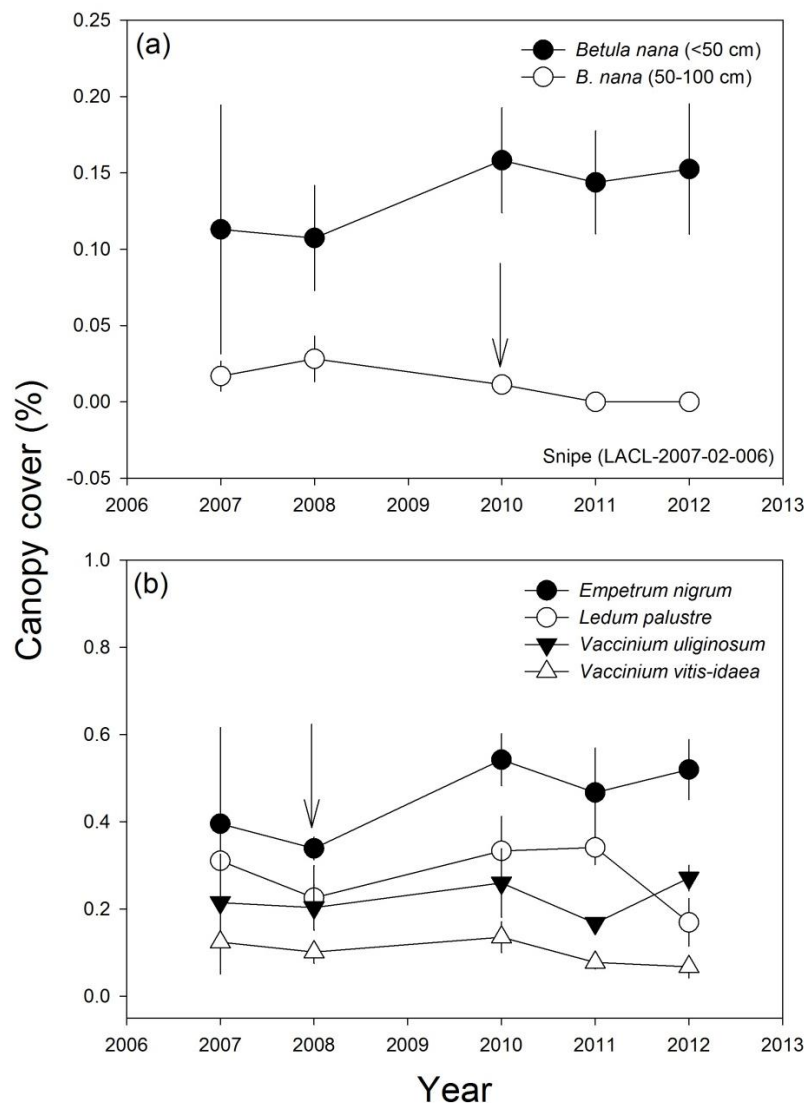


Figure 6. Interannual variability in canopy cover for selected taxa at a treeline site at Snipe Lake.

(a) Reduction in dwarf birch (*Betula nana*) cover in the 50-100 cm height class due to caterpillar defoliation. Arrow indicates the first year of a multi-year autumnal moth outbreak. Sprouting above the root crown has maintained cover in the <50 cm height class.

(b) Recovery of crowberry (*Empetrum nigrum*) following frost damage in the winter of 2007-2008. Arrow indicates the year in which widespread dieback in aboveground stems of evergreen species such as crowberry, Labrador tea (*Ledum palustre*) and lowbush cranberry (*Vaccinium vitis-idaea*) was observed. Whereas cover of live crowberry appears to have increased since 2008, cover of lowbush cranberry has remained stable. Labrador tea showed a decline in 2012, potentially due to a mix of caterpillar damage and an unknown pathogen.

Epiphytic lichen inventories

Off-frame FIA lichen inventories yielded 152 specimen collections from five sites in KATM and 256 collections from ten sites in LACL. Determinations have been completed for >90% of the 2012 collections from LACL and KATM, and when completed, the data set will be uploaded to the FIA database, as well as to the SWAN data archives. The data will be used to explore relationships between lichen communities and large-scale environmental factors, and for monitoring changes in forest condition. Notable lichen collections from 2012 included *Normandina pulchella*, *Erioderma pedicellatum*, and *Hypogymnia pulverata*, described below.

Normandina pulchella (Borrer) Nyl. was found at Currant Creek (LACL; *J. Walton* JKW16763b). The collection could represent a range extension to the west or a range filler between populations in SE Alaska and a population in Denali NP. Outside of Alaska, it occurs on the east and west coasts of North America, and coastlines of Europe and South Africa.

Erioderma pedicellatum (Hue) P.M. Jørg, is a globally endangered foliose cyanolichen known from Scandinavia, southeastern Canada, and the upper Cook Inlet region of Alaska. A small population of *Erioderma* was found in a beetle-killed mature white spruce forest near Lake Colville, representing the southern and westernmost site known in North America (*J. Walton* 13503, NPS Accession # 0492, Catalog # 47584, *J. Walton* 13504, NPS Accession # 0492, Catalog # 47585).

Hypogymnia pulverata (Nyl. ex Crombie) Elix, is an epiphytic foliose macrolichen considered common in the southern hemisphere but rare in North America. The species is known from three wide-ranging locations in Quebec, Oregon, and Alaska. The 2012 collections were from forested locations near Lake Coville, Lake Brooks, and from a woodland site near Malone Lake (*J. Walton* #JKW17046, #JKW16999, #JKW16958, #JKW17090).

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Appendix A

Table A1. Species cover in beetle-kill spruce plots at two sampling dates (2009-2012). Height classes are 1 = <50 cm; 2 = 50-100 cm; 3 = 100-400 cm; 4 = >400 cm. Mean percent cover for each year is estimated by point-intercept and averaged over three 30 m transects, where 1.00 = 100%. Grand mean and standard deviation (SD) are calculated across the two sampling dates. Standard deviations >5% are in boldface.

Plot id	Species	Height class	Mean cover (2009)	Mean cover (2012)	Grand mean	SD
KATM_2009_01_S995	Calamagrostis canadensis	1	0.152542	0.163842	0.16	0.01
KATM_2009_01_S995	Calamagrostis canadensis	2	0.067797	0.039548	0.05	0.02
KATM_2009_01_S995	Chamerion angustifolium	1	0.00565	0	0.00	0.00
KATM_2009_01_S995	Cornus suecica	1	0.00565	0.011299	0.01	0.00
KATM_2009_01_S995	Downed wood	1	0.045198	0.011299	0.03	0.02
KATM_2009_01_S995	Empetrum nigrum	1	0.118644	0.050847	0.08	0.05
KATM_2009_01_S995	Equisetum arvense	1	0.248588	0.180791	0.21	0.05
KATM_2009_01_S995	Equisetum arvense	2	0.022599	0.016949	0.02	0.00
KATM_2009_01_S995	Equisetum scirpoides	1	0.00565	0	0.00	0.00
KATM_2009_01_S995	Lichen	1	0.016949	0.011299	0.01	0.00
KATM_2009_01_S995	Litter	1	0.519774	0.514124	0.52	0.00
KATM_2009_01_S995	Moss	1	0.870056	0.909605	0.89	0.03
KATM_2009_01_S995	Orthilia secunda	1	0.039548	0.00565	0.02	0.02
KATM_2009_01_S995	Petasites frigida	1	0	0.00565	0.00	0.00
KATM_2009_01_S995	Picea glauca	1	0.011299	0	0.01	0.01
KATM_2009_01_S995	Picea glauca	2	0.016949	0.011299	0.01	0.00
KATM_2009_01_S995	Picea glauca	3	0.141243	0.169492	0.16	0.02
KATM_2009_01_S995	Picea glauca	4	0.231638	0.242938	0.24	0.01
KATM_2009_01_S995	Salix arbusculoides	3	0	0.022599	0.01	0.02
KATM_2009_01_S995	Salix barclayi	1	0.011299	0.011299	0.01	0.00
KATM_2009_01_S995	Salix barclayi	2	0.022599	0.016949	0.02	0.00
KATM_2009_01_S995	Salix barclayi	3	0.220339	0.271186	0.25	0.04
KATM_2009_01_S995	Salix barclayi	4	0	0.016949	0.01	0.01

Plot id	Species	Height class	Mean cover (2009)	Mean cover (2012)	Grand mean	SD
KATM_2009_01_S995	Salix pulchra	2	0.016949	0	0.01	0.01
KATM_2009_01_S995	Salix pulchra	3	0.124294	0	0.06	0.09
KATM_2009_01_S995	Spiraea stevenii	1	0.00565	0.00565	0.01	0.00
KATM_2009_01_S995	Trientalis europaea	1	0	0.00565	0.00	0.00
KATM_2009_01_S995	Vaccinium vitis-idaea	1	0.022599	0	0.01	0.02
KATM_2009_01_S995	Viburnum edule	1	0	0.00565	0.00	0.00
KATM_2009_01_S996	Betula nana	1	0	0.00565	0.00	0.00
KATM_2009_01_S996	Betula neoalaskana	1	0.005682	0.016949	0.01	0.01
KATM_2009_01_S996	Betula neoalaskana	2	0.017045	0.022599	0.02	0.00
KATM_2009_01_S996	Betula neoalaskana	3	0.25	0.242938	0.25	0.00
KATM_2009_01_S996	Betula neoalaskana	4	0.056818	0.067797	0.06	0.01
KATM_2009_01_S996	Downed wood	1	0.011364	0	0.01	0.01
KATM_2009_01_S996	Empetrum nigrum	1	0.153409	0.084746	0.12	0.05
KATM_2009_01_S996	Lichen	1	0.011364	0.011299	0.01	0.00
KATM_2009_01_S996	Litter	1	0.335227	0.180791	0.26	0.11
KATM_2009_01_S996	Moss	1	0.892045	0.971751	0.93	0.06
KATM_2009_01_S996	Picea glauca	1	0.034091	0.028249	0.03	0.00
KATM_2009_01_S996	Picea glauca	2	0.011364	0.011299	0.01	0.00
KATM_2009_01_S996	Picea glauca	3	0.1875	0.180791	0.18	0.00
KATM_2009_01_S996	Picea glauca	4	0.454545	0.355932	0.41	0.07
KATM_2009_01_S996	Salix pulchra	1	0.005682	0.00565	0.01	0.00
KATM_2009_01_S996	Salix pulchra	2	0.005682	0.016949	0.01	0.01
KATM_2009_01_S996	Salix pulchra	3	0.005682	0.011299	0.01	0.00
KATM_2009_01_S996	Vaccinium vitis-idaea	1	0.301136	0.20904	0.26	0.07
LACL_2010_01_S993	Alnus incana	1	0.00565	0.00565	0.00	0.00
LACL_2010_01_S993	Alnus incana	2	0.00565	0.00565	0.00	0.00
LACL_2010_01_S993	Alnus incana	3	0.248588	0.254237	0.25	0.00
LACL_2010_01_S993	Calamagrostis canadensis	1	0.073446	0.028249	0.05	0.03

Plot id	Species	Height class	Mean cover (2009)	Mean cover (2012)	Grand mean	SD
LACL_2010_01_S993	Calamagrostis canadensis	2	0.011299	0.028249	0.02	0.01
LACL_2010_01_S993	Downed wood	1	0.101695	0.045198	0.07	0.04
LACL_2010_01_S993	Downed wood	2	0.050847	0.039548	0.05	0.01
LACL_2010_01_S993	Downed wood	3	0.033898	0	0.02	0.02
LACL_2010_01_S993	Empetrum nigrum	1	0.062147	0.045198	0.05	0.01
LACL_2010_01_S993	Geocaulon lividum	1	0	0.00565	0.00	0.00
LACL_2010_01_S993	Linnaea borealis	1	0.056497	0.090395	0.07	0.02
LACL_2010_01_S993	Litter	1	0.903955	0.751412	0.83	0.11
LACL_2010_01_S993	Lycopodium annotinum	1	0	0.033898	0.02	0.02
LACL_2010_01_S993	Moss	1	0.446328	0.502825	0.47	0.04
LACL_2010_01_S993	Orthilia secunda	1	0	0.00565	0.00	0.00
LACL_2010_01_S993	Picea glauca	1	0.00565	0.033898	0.02	0.02
LACL_2010_01_S993	Picea glauca	2	0.056497	0.028249	0.04	0.02
LACL_2010_01_S993	Picea glauca	3	0.350282	0.316384	0.33	0.02
LACL_2010_01_S993	Picea glauca	4	0.242938	0.19209	0.22	0.04
LACL_2010_01_S993	Populus balsamifera	3	0.028249	0.016949	0.02	0.01
LACL_2010_01_S993	Populus balsamifera	4	0.186441	0.141243	0.16	0.03
LACL_2010_01_S993	Pyrola grandiflora	1	0.00565	0	0.00	0.00
LACL_2010_01_S993	Ribes triste	1	0	0.067797	0.03	0.05
LACL_2010_01_S993	Ribes triste	2	0	0.011299	0.01	0.01
LACL_2010_01_S993	Rosa acicularis	1	0.011299	0	0.01	0.01
LACL_2010_01_S993	Rosa acicularis	2	0.00565	0	0.00	0.00
LACL_2010_01_S993	Trientalis europaea	1	0	0.00565	0.00	0.00
LACL_2010_01_S993	Viburnum edule	1	0.045198	0.050847	0.05	0.00
LACL_2010_01_S993	Viburnum edule	2	0.045198	0.039548	0.04	0.00
LACL_2010_01_S993	Viburnum edule	3	0.00565	0	0.00	0.00
LACL_2010_01_S995	Artemisia tilesii	1	0.00565	0	0.00	0.00
LACL_2010_01_S995	Calamagrostis canadensis	1	0.457627	0.728814	0.59	0.19

Plot id	Species	Height class	Mean cover (2009)	Mean cover (2012)	Grand mean	SD
LACL_2010_01_S995	Calamagrostis canadensis	2	0.163842	0.480226	0.32	0.22
LACL_2010_01_S995	Calamagrostis canadensis	3	0	0.00565	0.00	0.00
LACL_2010_01_S995	Chamerion angustifolium	1	0.016949	0.022599	0.02	0.00
LACL_2010_01_S995	Chamerion angustifolium	2	0.00565	0	0.00	0.00
LACL_2010_01_S995	Cornus suecica	1	0.231638	0.141243	0.19	0.06
LACL_2010_01_S995	Downed wood	1	0.022599	0.028249	0.03	0.00
LACL_2010_01_S995	Downed wood	2	0.016949	0.016949	0.02	0.00
LACL_2010_01_S995	Dryopteris expansa	1	0.011299	0.00565	0.01	0.00
LACL_2010_01_S995	Dryopteris expansa	2	0.00565	0.00565	0.01	0.00
LACL_2010_01_S995	Equisetum arvense	1	0.19774	0.20904	0.20	0.01
LACL_2010_01_S995	Galium boreale	1	0	0.011299	0.01	0.01
LACL_2010_01_S995	Geranium erianthum	1	0	0.00565	0.00	0.00
LACL_2010_01_S995	Gymnocarpium dryopteris	1	0.20339	0.276836	0.24	0.05
LACL_2010_01_S995	Linnaea borealis	1	0.062147	0.062147	0.06	0.00
LACL_2010_01_S995	Litter	1	0.887006	0.79096	0.84	0.07
LACL_2010_01_S995	Moss	1	0.632768	0.316384	0.47	0.22
LACL_2010_01_S995	Orthilia secunda	1	0	0.011299	0.01	0.01
LACL_2010_01_S995	Picea glauca	1	0.00565	0	0.00	0.00
LACL_2010_01_S995	Picea glauca	2	0	0.016949	0.01	0.01
LACL_2010_01_S995	Picea glauca	3	0.259887	0.225989	0.24	0.02
LACL_2010_01_S995	Picea glauca	4	0.457627	0.259887	0.36	0.14
LACL_2010_01_S995	Populus balsamifera	2	0.00565	0	0.00	0.00
LACL_2010_01_S995	Populus balsamifera	3	0.033898	0.028249	0.03	0.00
LACL_2010_01_S995	Populus balsamifera	4	0.050847	0.090395	0.07	0.03
LACL_2010_01_S995	Ribes triste	1	0.039548	0.011299	0.03	0.02
LACL_2010_01_S995	Ribes triste	2	0.050847	0	0.03	0.04
LACL_2010_01_S995	Rosa acicularis	1	0.090395	0.135593	0.11	0.03
LACL_2010_01_S995	Rosa acicularis	2	0.056497	0.056497	0.06	0.00

Plot id	Species	Height class	Mean cover (2009)	Mean cover (2012)	Grand mean	SD
LACL_2010_01_S995	Rubus arcticus	1	0	0.011299	0.01	0.01
LACL_2010_01_S995	Salix barclayi	1	0	0.00565	0.00	0.00
LACL_2010_01_S995	Salix barclayi	2	0	0.028249	0.01	0.02
LACL_2010_01_S995	Salix barclayi	3	0	0.00565	0.00	0.00
LACL_2010_01_S995	Salix pulchra	1	0.00565	0	0.00	0.00
LACL_2010_01_S995	Salix pulchra	2	0.045198	0.028249	0.04	0.01
LACL_2010_01_S995	Salix pulchra	3	0.079096	0.011299	0.05	0.05
LACL_2010_01_S995	Sanguisorba canadensis	1	0	0.00565	0.00	0.00
LACL_2010_01_S995	Viburnum edule	1	0.062147	0.158192	0.11	0.07
LACL_2010_01_S995	Viburnum edule	2	0.062147	0.050847	0.06	0.01
LACL_2010_01_S995	Viburnum edule	3	0.00565	0.011299	0.01	0.00
LACL_2010_01_S996	Betula neoalaskana	1	0.00565	0.00565	0.01	0.00
LACL_2010_01_S996	Betula neoalaskana	2	0.011299	0.011299	0.01	0.00
LACL_2010_01_S996	Betula neoalaskana	3	0.107345	0.107345	0.11	0.00
LACL_2010_01_S996	Betula neoalaskana	4	0.305085	0.327684	0.32	0.02
LACL_2010_01_S996	Calamagrostis canadensis	1	0.016949	0.011299	0.01	0.00
LACL_2010_01_S996	Calamagrostis canadensis	2	0	0.016949	0.01	0.01
LACL_2010_01_S996	Chamerion angustifolium	1	0	0.011299	0.01	0.01
LACL_2010_01_S996	Downed wood	1	0.016949	0.039548	0.03	0.02
LACL_2010_01_S996	Downed wood	2	0	0.028249	0.01	0.02
LACL_2010_01_S996	Downed wood	3	0	0.00565	0.00	0.00
LACL_2010_01_S996	Empetrum nigrum	1	0.039548	0.039548	0.04	0.00
LACL_2010_01_S996	Equisetum sylvaticum	1	0	0.011299	0.01	0.01
LACL_2010_01_S996	Ledum palustre	1	0.146893	0.20904	0.18	0.04
LACL_2010_01_S996	Lichen	1	0.00565	0.00565	0.01	0.00
LACL_2010_01_S996	Linnaea borealis	1	0.090395	0.20339	0.15	0.08
LACL_2010_01_S996	Litter	1	0.920904	0.632768	0.78	0.20
LACL_2010_01_S996	Moss	1	0.587571	0.457627	0.52	0.09

Plot id	Species	Height class	Mean cover (2009)	Mean cover (2012)	Grand mean	SD
LACL_2010_01_S996	Picea glauca	1	0.028249	0	0.01	0.02
LACL_2010_01_S996	Picea glauca	2	0.062147	0.033898	0.05	0.02
LACL_2010_01_S996	Picea glauca	3	0.20339	0.158192	0.18	0.03
LACL_2010_01_S996	Picea glauca	4	0.259887	0.225989	0.24	0.02
LACL_2010_01_S996	Poa arctica ssp. arctica	1	0	0.00565	0.00	0.00
LACL_2010_01_S996	Ribes triste	1	0	0.011299	0.01	0.01
LACL_2010_01_S996	Rosa acicularis	1	0.050847	0.079096	0.06	0.02
LACL_2010_01_S996	Rosa acicularis	2	0.045198	0.067797	0.06	0.02
LACL_2010_01_S996	Rosa acicularis	3	0.00565	0.016949	0.01	0.01
LACL_2010_01_S996	Salix sp.	3	0	0.00565	0.00	0.00
LACL_2010_01_S996	Spiraea stevenii	1	0.00565	0	0.00	0.00
LACL_2010_01_S996	Stellaria longipes	1	0	0.011299	0.01	0.01
LACL_2010_01_S996	Trientalis europaea	1	0.028249	0.011299	0.02	0.01
LACL_2010_01_S996	Vaccinium vitis-idaea	1	0.242938	0.242938	0.24	0.00

Table A2. Species cover in mature closed spruce plots at two sampling dates (2009-2012). Height classes are as for Table A1. Mean percent cover for each year is estimated by point-intercept and averaged over three 30 m transects, where 1.00 = 100%. Grand mean and standard deviation (SD) are calculated across the two sampling dates. Standard deviations >5% are in boldface.

Plot id	Species	Height class	Mean cover (2010)	Mean cover (2012)	Grand mean	SD
LACL_2010_01_S998	<i>Anthoxanthum monticola</i> ssp. <i>alpinum</i>	1	0	0.00565	0.00	0.00
LACL_2010_01_S998	<i>Aster alpinus</i>	1	0.00565	0	0.00	0.00
LACL_2010_01_S998	<i>Astragalus alpinus</i>	1	0	0.00565	0.00	0.00
LACL_2010_01_S998	<i>Calamagrostis canadensis</i>	1	0.101695	0.135593	0.12	0.02
LACL_2010_01_S998	<i>Calamagrostis canadensis</i>	2	0.00565	0.00565	0.01	0.00
LACL_2010_01_S998	<i>Chamerion angustifolium</i>	1	0.00565	0.00565	0.01	0.00
LACL_2010_01_S998	<i>Cornus suecica</i>	1	0.163842	0.163842	0.16	0.00
LACL_2010_01_S998	Downed wood	1	0.033898	0.022599	0.03	0.01
LACL_2010_01_S998	Downed wood	2	0.016949	0.011299	0.01	0.00
LACL_2010_01_S998	<i>Empetrum nigrum</i>	1	0.146893	0.112994	0.13	0.02
LACL_2010_01_S998	<i>Equisetum arvense</i>	1	0.011299	0	0.01	0.01
LACL_2010_01_S998	<i>Festuca altaica</i>	1	0	0.00565	0.00	0.00
LACL_2010_01_S998	<i>Heuchera glabra</i>	1	0.011299	0	0.01	0.01
LACL_2010_01_S998	Lichen	1	0.079096	0.050847	0.06	0.02
LACL_2010_01_S998	<i>Linnaea borealis</i>	1	0.067797	0.084746	0.08	0.01
LACL_2010_01_S998	Litter	1	0.706215	0.435028	0.57	0.19
LACL_2010_01_S998	<i>Lycopodium lagopus</i>	1	0.011299	0	0.01	0.01
LACL_2010_01_S998	Moss	1	0.740113	0.745763	0.74	0.00
LACL_2010_01_S998	<i>Orthilia secunda</i>	1	0.00565	0	0.00	0.00
LACL_2010_01_S998	<i>Petasites frigida</i>	1	0.00565	0	0.00	0.00
LACL_2010_01_S998	<i>Picea glauca</i>	1	0.00565	0.00565	0.01	0.00
LACL_2010_01_S998	<i>Picea glauca</i>	2	0.016949	0.022599	0.02	0.00
LACL_2010_01_S998	<i>Picea glauca</i>	3	0.220339	0.19774	0.21	0.02
LACL_2010_01_S998	<i>Picea glauca</i>	4	0.384181	0.39548	0.39	0.01
LACL_2010_01_S998	<i>Populus balsamifera</i>	1	0	0.011299	0.01	0.01
LACL_2010_01_S998	<i>Populus balsamifera</i>	2	0.00565	0.00565	0.01	0.00
LACL_2010_01_S998	<i>Populus balsamifera</i>	3	0.011299	0.016949	0.01	0.00

Plot id	Species	Height class	Mean cover (2010)	Mean cover (2012)	Grand mean	SD
LACL_2010_01_S998	<i>Populus balsamifera</i>	4	0.011299	0.011299	0.01	0.00
LACL_2010_01_S998	<i>Pyrola grandiflora</i>	1	0.022599	0.011299	0.02	0.01
LACL_2010_01_S998	<i>Ribes triste</i>	1	0.00565	0	0.00	0.00
LACL_2010_01_S998	<i>Rosa acicularis</i>	1	0.039548	0.028249	0.03	0.01
LACL_2010_01_S998	<i>Rosa acicularis</i>	2	0.011299	0.00565	0.01	0.00
LACL_2010_01_S998	<i>Salix bebbiana</i>	2	0.00565	0.011299	0.01	0.00
LACL_2010_01_S998	<i>Salix bebbiana</i>	3	0	0.011299	0.01	0.01
LACL_2010_01_S998	<i>Salix glauca</i>	1	0.00565	0	0.00	0.00
LACL_2010_01_S998	<i>Salix pulchra</i>	1	0.00565	0.016949	0.01	0.01
LACL_2010_01_S998	<i>Salix pulchra</i>	2	0.016949	0.00565	0.01	0.01
LACL_2010_01_S998	<i>Vaccinium uliginosum</i>	1	0.00565	0.00565	0.01	0.00
LACL_2010_01_S998	<i>Vaccinium vitis-idaea</i>	1	0.028249	0.039548	0.03	0.01
LACL_2010_01_S999	<i>Anemone richardsonii</i>	1	0	0.00565	0.00	0.00
LACL_2010_01_S999	<i>Artemisia tilesii</i>	1	0.011299	0.011299	0.01	0.00
LACL_2010_01_S999	Bare ground	1	0.00565	0.00565	0.01	0.00
LACL_2010_01_S999	<i>Calamagrostis canadensis</i>	1	0.050847	0.084746	0.07	0.02
LACL_2010_01_S999	<i>Calamagrostis canadensis</i>	2	0.016949	0	0.01	0.01
LACL_2010_01_S999	<i>Chamerion angustifolium</i>	1	0.011299	0.00565	0.01	0.00
LACL_2010_01_S999	<i>Chamerion latifolium</i>	1	0	0.011299	0.01	0.01
LACL_2010_01_S999	<i>Cornus suecica</i>	1	0.124294	0.152542	0.14	0.02
LACL_2010_01_S999	Downed wood	1	0.062147	0.011299	0.04	0.04
LACL_2010_01_S999	Downed wood	2	0.011299	0	0.01	0.01
LACL_2010_01_S999	<i>Empetrum nigrum</i>	1	0.056497	0.039548	0.05	0.01
LACL_2010_01_S999	<i>Equisetum arvense</i>	1	0.248588	0.214689	0.23	0.02
LACL_2010_01_S999	<i>Equisetum arvense</i>	2	0.016949	0	0.01	0.01
LACL_2010_01_S999	<i>Hedysarum alpinum</i>	1	0.011299	0.00565	0.01	0.00
LACL_2010_01_S999	<i>Ledum palustre</i>	1	0	0.00565	0.00	0.00
LACL_2010_01_S999	Lichen	1	0.011299	0.00565	0.01	0.00
LACL_2010_01_S999	<i>Linnaea borealis</i>	1	0.096045	0.141243	0.12	0.03
LACL_2010_01_S999	Litter	1	0.774011	0.367232	0.57	0.29

Plot id	Species	Height class	Mean cover (2010)	Mean cover (2012)	Grand mean	SD
LACL_2010_01_S999	Lycopodium annotinum	1	0.00565	0.00565	0.01	0.00
LACL_2010_01_S999	Moss	1	0.819209	0.870056	0.84	0.04
LACL_2010_01_S999	Orthilia secunda	1	0	0.00565	0.00	0.00
LACL_2010_01_S999	Picea glauca	1	0.022599	0.011299	0.02	0.01
LACL_2010_01_S999	Picea glauca	2	0.062147	0.028249	0.05	0.02
LACL_2010_01_S999	Picea glauca	3	0.367232	0.231638	0.30	0.10
LACL_2010_01_S999	Picea glauca	4	0.497175	0.271186	0.38	0.16
LACL_2010_01_S999	Populus balsamifera	1	0.00565	0	0.00	0.00
LACL_2010_01_S999	Populus balsamifera	2	0.011299	0	0.01	0.01
LACL_2010_01_S999	Populus balsamifera	3	0.016949	0.011299	0.01	0.00
LACL_2010_01_S999	Populus balsamifera	4	0.022599	0.022599	0.02	0.00
LACL_2010_01_S999	Ribes triste	1	0	0.011299	0.01	0.01
LACL_2010_01_S999	Rosa acicularis	1	0.073446	0.096045	0.08	0.02
LACL_2010_01_S999	Rosa acicularis	2	0.045198	0.011299	0.03	0.02
LACL_2010_01_S999	Rosa acicularis	3	0	0.00565	0.00	0.00
LACL_2010_01_S999	Rubus arcticus	1	0	0.00565	0.00	0.00
LACL_2010_01_S999	Salix glauca	1	0.011299	0.00565	0.01	0.00
LACL_2010_01_S999	Salix glauca	2	0.050847	0.022599	0.04	0.02
LACL_2010_01_S999	Salix glauca	3	0.090395	0.050847	0.07	0.03
LACL_2010_01_S999	Salix pulchra	1	0	0.016949	0.01	0.01
LACL_2010_01_S999	Salix pulchra	2	0.00565	0.039548	0.02	0.02
LACL_2010_01_S999	Salix pulchra	3	0	0.016949	0.01	0.01
LACL_2010_01_S999	Vaccinium uliginosum	1	0.050847	0.096045	0.07	0.03
LACL_2010_01_S999	Vaccinium vitis-idaea	1	0.20904	0.129944	0.17	0.06

Table A3. Species cover in spruce woodland plots at two sampling dates (2009-2012). Height classes are as in Table A1. Mean percent cover for each year is estimated by point-intercept and averaged over three 30 m transects, where 1.00 = 100%. Grand mean and standard deviation (SD) are calculated across the two sampling dates. Standard deviations >5% are in boldface.

Plot id	Species	Height class	Mean cover (2009)	Mean cover (2012)	Grand mean	SD
KATM_2009_01_S027	Artemisia arctica	1	0.00565	0	0.00	0.00
KATM_2009_01_S027	Betula nana	1	0.033898	0.033898	0.03	0.00
KATM_2009_01_S027	Downed wood	1	0.011299	0.016949	0.01	0.00
KATM_2009_01_S027	Empetrum nigrum	1	0.502825	0.429379	0.47	0.05
KATM_2009_01_S027	Ledum palustre	1	0.124294	0.163842	0.14	0.03
KATM_2009_01_S027	Lichen	1	0.276836	0.276836	0.28	0.00
KATM_2009_01_S027	Litter	1	0.429379	0.338983	0.38	0.06
KATM_2009_01_S027	Moss	1	0.627119	0.644068	0.64	0.01
KATM_2009_01_S027	Picea glauca	1	0.011299	0.00565	0.01	0.00
KATM_2009_01_S027	Picea glauca	2	0.045198	0.033898	0.04	0.01
KATM_2009_01_S027	Picea glauca	3	0.056497	0.056497	0.06	0.00
KATM_2009_01_S027	Picea glauca	4	0.028249	0.016949	0.02	0.01
KATM_2009_01_S027	Salix arctica	1	0.011299	0	0.01	0.01
KATM_2009_01_S027	Salix glauca	1	0.00565	0.011299	0.01	0.00
KATM_2009_01_S027	Salix pulchra	1	0.011299	0	0.01	0.01
KATM_2009_01_S027	Vaccinium uliginosum	1	0.028249	0.033898	0.03	0.00
KATM_2009_01_S027	Vaccinium vitis-idaea	1	0.112994	0.101695	0.11	0.01
LACL_2008_02_014	Betula nana	1	0.146893	0.129944	0.14	0.01
LACL_2008_02_014	Betula nana	2	0.118644	0.129944	0.12	0.01
LACL_2008_02_014	Betula nana	3	0.011299	0.022599	0.02	0.01
LACL_2008_02_014	Carex lugens	1	0.011299	0.011299	0.01	0.00
LACL_2008_02_014	Empetrum nigrum	1	0.40113	0.39548	0.40	0.00
LACL_2008_02_014	Ledum palustre	1	0.152542	0.163842	0.16	0.01
LACL_2008_02_014	Lichen	1	0.412429	0.372881	0.39	0.03
LACL_2008_02_014	Litter	1	0.497175	0.096045	0.30	0.28
LACL_2008_02_014	Moss	1	0.627119	0.59322	0.61	0.02
LACL_2008_02_014	Picea glauca	1	0.056497	0.033898	0.05	0.02

Plot id	Species	Height class	Mean cover (2009)	Mean cover (2012)	Grand mean	SD
LACL_2008_02_014	Picea glauca	2	0.056497	0.028249	0.04	0.02
LACL_2008_02_014	Picea glauca	3	0.039548	0.033898	0.04	0.00
LACL_2008_02_014	Picea glauca	4	0.011299	0.028249	0.02	0.01
LACL_2008_02_014	Salix pulchra	1	0.00565	0	0.00	0.00
LACL_2008_02_014	Salix pulchra	2	0.00565	0.00565	0.01	0.00
LACL_2008_02_014	Salix pulchra	3	0.00565	0.00565	0.01	0.00
LACL_2008_02_014	Vaccinium uliginosum	1	0.180791	0.180791	0.18	0.00
LACL_2008_02_014	Vaccinium vitis-idaea	1	0.129944	0.067797	0.10	0.04
LACL_2010_01_024	Betula nana	1	0.163842	0.124294	0.14	0.03
LACL_2010_01_024	Betula nana	2	0.220339	0.169492	0.19	0.04
LACL_2010_01_024	Betula nana	3	0.084746	0.011299	0.05	0.05
LACL_2010_01_024	Calamagrostis canadensis	1	0.011299	0	0.01	0.01
LACL_2010_01_024	Cornus suecica	1	0.011299	0.039548	0.03	0.02
LACL_2010_01_024	Downed wood	1	0.022599	0.022599	0.02	0.00
LACL_2010_01_024	Downed wood	2	0.011299	0.016949	0.01	0.00
LACL_2010_01_024	Downed wood	3	0.022599	0	0.01	0.02
LACL_2010_01_024	Empetrum nigrum	1	0.169492	0.214689	0.19	0.03
LACL_2010_01_024	Ledum palustre	1	0.480226	0.423729	0.45	0.04
LACL_2010_01_024	Lichen	1	0.271186	0.214689	0.24	0.04
LACL_2010_01_024	Litter	1	0.785311	0.316384	0.55	0.33
LACL_2010_01_024	Moss	1	0.734463	0.615819	0.68	0.08
LACL_2010_01_024	Picea glauca	1	0.011299	0.011299	0.01	0.00
LACL_2010_01_024	Picea glauca	2	0.056497	0.045198	0.05	0.01
LACL_2010_01_024	Picea glauca	3	0.084746	0.067797	0.08	0.01
LACL_2010_01_024	Picea glauca	4	0.033898	0.039548	0.04	0.00
LACL_2010_01_024	Rubus chamaemorus	1	0.016949	0.00565	0.01	0.01
LACL_2010_01_024	Salix pulchra	1	0.00565	0.022599	0.01	0.01
LACL_2010_01_024	Salix pulchra	2	0.039548	0.033898	0.04	0.00
LACL_2010_01_024	Salix pulchra	3	0.028249	0	0.01	0.02

Plot id	Species	Height class	Mean cover (2009)	Mean cover (2012)	Grand mean	SD
LACL_2010_01_024	Saussurea angustifolia	1	0.00565	0	0.00	0.00
LACL_2010_01_024	Spiraea stevenii	1	0.00565	0	0.00	0.00
LACL_2010_01_024	Vaccinium uliginosum	1	0.050847	0.050847	0.05	0.00
LACL_2010_01_024	Vaccinium vitis-idaea	1	0.254237	0.096045	0.18	0.11
LACL_2010_01_030	Arctostaphylos alpina	1	0.00565	0.011299	0.01	0.00
LACL_2010_01_030	Bare ground	1	0.00565	0.00565	0.01	0.00
LACL_2010_01_030	Betula nana	1	0.067797	0.101695	0.08	0.02
LACL_2010_01_030	Betula nana	2	0.062147	0.084746	0.07	0.02
LACL_2010_01_030	Betula nana	3	0.011299	0	0.01	0.01
LACL_2010_01_030	Betula x dugleana	1	0.00565	0.011299	0.01	0.00
LACL_2010_01_030	Betula x dugleana	2	0	0.00565	0.00	0.00
LACL_2010_01_030	Betula x dugleana	3	0.00565	0	0.00	0.00
LACL_2010_01_030	Cryptogamic crust	1	0.00565	0.00565	0.01	0.00
LACL_2010_01_030	Ledum palustre	1	0.248588	0.254237	0.25	0.00
LACL_2010_01_030	Lichen	1	0.740113	0.644068	0.69	0.07
LACL_2010_01_030	Litter	1	0.661017	0.378531	0.52	0.20
LACL_2010_01_030	Moss	1	0.163842	0.062147	0.11	0.07
LACL_2010_01_030	Picea glauca	1	0.033898	0.045198	0.04	0.01
LACL_2010_01_030	Picea glauca	2	0.039548	0.050847	0.05	0.01
LACL_2010_01_030	Picea glauca	3	0.00565	0.050847	0.03	0.03
LACL_2010_01_030	Picea mariana	1	0.231638	0.276836	0.25	0.03
LACL_2010_01_030	Picea mariana	2	0.129944	0.146893	0.14	0.01
LACL_2010_01_030	Picea mariana	3	0.112994	0.090395	0.10	0.02
LACL_2010_01_030	Salix glauca	1	0.00565	0.00565	0.01	0.00
LACL_2010_01_030	Salix glauca	2	0.00565	0.00565	0.01	0.00
LACL_2010_01_030	Salix glauca	3	0.00565	0	0.00	0.00
LACL_2010_01_030	Salix pulchra	1	0.00565	0	0.00	0.00
LACL_2010_01_030	Vaccinium uliginosum	1	0.20339	0.242938	0.22	0.03
LACL_2010_01_030	Vaccinium vitis-idaea	1	0.20339	0.101695	0.15	0.07

Plot id	Species	Height class	Mean cover (2009)	Mean cover (2012)	Grand mean	SD
LACL_2011_01_033	Arctostaphylos alpina	1	0.00565	0	0.00	0.00
LACL_2011_01_033	Bare ground	1	0.00565	0	0.00	0.00
LACL_2011_01_033	Betula nana	1	0.067797	0.096045	0.08	0.02
LACL_2011_01_033	Betula nana	2	0.028249	0.056497	0.04	0.02
LACL_2011_01_033	Betula nana	3	0.022599	0.00565	0.01	0.01
LACL_2011_01_033	Betula neoalaskana	3	0.022599	0	0.01	0.02
LACL_2011_01_033	Betula x dupleana	1	0.011299	0	0.01	0.01
LACL_2011_01_033	Betula x dupleana	2	0.011299	0.033898	0.02	0.02
LACL_2011_01_033	Betula x dupleana	3	0	0.039548	0.02	0.03
LACL_2011_01_033	Downed wood	1	0.016949	0	0.01	0.01
LACL_2011_01_033	Empetrum nigrum	1	0.135593	0.090395	0.11	0.03
LACL_2011_01_033	Festuca altaica	1	0.00565	0	0.00	0.00
LACL_2011_01_033	Ledum palustre	1	0.480226	0.468927	0.47	0.01
LACL_2011_01_033	Lichen	1	0.892655	0.858757	0.88	0.02
LACL_2011_01_033	Litter	1	0.491525	0.129944	0.31	0.26
LACL_2011_01_033	Moss	1	0.135593	0.056497	0.10	0.06
LACL_2011_01_033	Picea glauca	1	0	0.016949	0.01	0.01
LACL_2011_01_033	Picea glauca	2	0.011299	0.022599	0.02	0.01
LACL_2011_01_033	Picea glauca	3	0.039548	0.033898	0.04	0.00
LACL_2011_01_033	Picea mariana	2	0.00565	0	0.00	0.00
LACL_2011_01_033	Salix bebbiana	2	0	0.011299	0.01	0.01
LACL_2011_01_033	Salix bebbiana	3	0	0.011299	0.01	0.01
LACL_2011_01_033	Salix glauca	2	0.011299	0.00565	0.01	0.00
LACL_2011_01_033	Vaccinium uliginosum	1	0.254237	0.186441	0.22	0.05
LACL_2011_01_033	Vaccinium vitis-idaea	1	0.367232	0.248588	0.31	0.08

Table A4. Species cover in spruce woodland plots established in 2012. Height classes are as in Table A1. Means ($\pm$ 1 SE) are expressed as percent cover estimated by point-intercept and averaged over three 30 m transects, where 1.00 = 100% cover.

Plot id	Sample date	Species	Height class	Mean	SE
LACL_2012_01_162	7/20/2012	Betula x dugleana	1	0.00565	0.00565
LACL_2012_01_162	7/20/2012	Betula x dugleana	3	0.011299	0.011299
LACL_2012_01_162	7/20/2012	Betula nana	1	0.135593	0.044843
LACL_2012_01_162	7/20/2012	Betula nana	2	0.19774	0.00565
LACL_2012_01_162	7/20/2012	Betula nana	3	0.096045	0.034366
LACL_2012_01_162	7/20/2012	Ledum palustre	1	0.016949	0.009786
LACL_2012_01_162	7/20/2012	Lichen	1	0.293785	0.062147
LACL_2012_01_162	7/20/2012	Litter	1	0.310734	0.066609
LACL_2012_01_162	7/20/2012	Moss	1	0.451977	0.066609
LACL_2012_01_162	7/20/2012	Picea glauca	1	0.022599	0.00565
LACL_2012_01_162	7/20/2012	Picea glauca	2	0.141243	0.02037
LACL_2012_01_162	7/20/2012	Picea glauca	3	0.282486	0.028249
LACL_2012_01_162	7/20/2012	Picea glauca	4	0.050847	0.050847
LACL_2012_01_162	7/20/2012	Picea mariana	1	0.00565	0.00565
LACL_2012_01_162	7/20/2012	Picea mariana	3	0.00565	0.00565
LACL_2012_01_162	7/20/2012	Vaccinium vitis-idaea	1	0.378531	0.014948
LACL_2012_01_S992	7/19/2012	Betula x dugleana	1	0.033898	0.033898
LACL_2012_01_S992	7/19/2012	Betula x dugleana	2	0.045198	0.037048
LACL_2012_01_S992	7/19/2012	Betula x dugleana	3	0.050847	0.042654
LACL_2012_01_S992	7/19/2012	Betula nana	1	0.084746	0.048928
LACL_2012_01_S992	7/19/2012	Betula nana	2	0.107345	0.046245
LACL_2012_01_S992	7/19/2012	Betula nana	3	0.062147	0.022599
LACL_2012_01_S992	7/19/2012	Betula neoalaskana	3	0.011299	0.011299
LACL_2012_01_S992	7/19/2012	Betula sp.	3	0.00565	0.00565
LACL_2012_01_S992	7/19/2012	Chamerion angustifolium	1	0.00565	0.00565
LACL_2012_01_S992	7/19/2012	Ledum palustre	1	0.220339	0.077671
LACL_2012_01_S992	7/19/2012	Lichen	1	0.333333	0.058985
LACL_2012_01_S992	7/19/2012	Litter	1	0.412429	0.063669

Plot id	Sample date	Species	Height class	Mean	SE
LACL_2012_01_S992	7/19/2012	Moss	1	0.288136	0.093349
LACL_2012_01_S992	7/19/2012	Picea glauca	1	0.011299	0.011299
LACL_2012_01_S992	7/19/2012	Picea glauca	2	0.079096	0.040741
LACL_2012_01_S992	7/19/2012	Picea glauca	3	0.073446	0.039548
LACL_2012_01_S992	7/19/2012	Picea mariana	1	0.056497	0.029895
LACL_2012_01_S992	7/19/2012	Picea mariana	2	0.028249	0.014948
LACL_2012_01_S992	7/19/2012	Picea mariana	3	0.011299	0.011299
LACL_2012_01_S992	7/19/2012	Salix glauca	1	0.00565	0.00565
LACL_2012_01_S992	7/19/2012	Salix glauca	2	0.016949	0.016949
LACL_2012_01_S992	7/19/2012	Vaccinium uliginosum	1	0.20339	0.019571
LACL_2012_01_S992	7/19/2012	Vaccinium vitis-idaea	1	0.316384	0.024627
KATM_2012_01_S041	7/31/2012	Arctostaphylos alpina	1	0.011299	0.011299
KATM_2012_01_S041	7/31/2012	Betula nana	1	0.214689	0.081481
KATM_2012_01_S041	7/31/2012	Betula nana	2	0.016949	0.016949
KATM_2012_01_S041	7/31/2012	Downed wood	1	0.011299	0.00565
KATM_2012_01_S041	7/31/2012	Empetrum nigrum	1	0.333333	0.034366
KATM_2012_01_S041	7/31/2012	Ledum palustre	1	0.090395	0.039548
KATM_2012_01_S041	7/31/2012	Lichen	1	0.141243	0.037048
KATM_2012_01_S041	7/31/2012	Litter	1	0.180791	0.048271
KATM_2012_01_S041	7/31/2012	Moss	1	0.971751	0.02037
KATM_2012_01_S041	7/31/2012	Picea glauca	2	0.016949	0.009786
KATM_2012_01_S041	7/31/2012	Picea glauca	3	0.118644	0.061111
KATM_2012_01_S041	7/31/2012	Picea glauca	4	0.039548	0.02037
KATM_2012_01_S041	7/31/2012	Salix glauca	1	0.00565	0.00565
KATM_2012_01_S041	7/31/2012	Salix glauca	3	0.011299	0.011299
KATM_2012_01_S041	7/31/2012	Salix pulchra	1	0.028249	0.014948
KATM_2012_01_S041	7/31/2012	Vaccinium uliginosum	1	0.056497	0.022599
KATM_2012_01_S041	7/31/2012	Vaccinium vitis-idaea	1	0.146893	0.037048
KATM_2012_01_S190	7/25/2012	Betula nana	1	0.158192	0.050216
KATM_2012_01_S190	7/25/2012	Downed wood	1	0.022599	0.011299

Plot id	Sample date	Species	Height class	Mean	SE
KATM_2012_01_S190	7/25/2012	Empetrum nigrum	1	0.259887	0.073446
KATM_2012_01_S190	7/25/2012	Ledum palustre	1	0.186441	0.048928
KATM_2012_01_S190	7/25/2012	Lichen	1	0.158192	0.037048
KATM_2012_01_S190	7/25/2012	Litter	1	0.344633	0.024627
KATM_2012_01_S190	7/25/2012	Moss	1	0.853107	0.044126
KATM_2012_01_S190	7/25/2012	Picea glauca	1	0.00565	0.00565
KATM_2012_01_S190	7/25/2012	Picea glauca	2	0.016949	0.009786
KATM_2012_01_S190	7/25/2012	Salix glauca	1	0.00565	0.00565
KATM_2012_01_S190	7/25/2012	Salix pulchra	1	0.028249	0.02037
KATM_2012_01_S190	7/25/2012	Vaccinium uliginosum	1	0.028249	0.014948
KATM_2012_01_S190	7/25/2012	Vaccinium vitis-idaea	1	0.220339	0.048928
KATM_2012_01_S994	7/26/2012	Betula nana	1	0.056497	0.024627
KATM_2012_01_S994	7/26/2012	Empetrum nigrum	1	0.40113	0.029895
KATM_2012_01_S994	7/26/2012	Ledum palustre	1	0.033898	0.019571
KATM_2012_01_S994	7/26/2012	Lichen	1	0.480226	0.125825
KATM_2012_01_S994	7/26/2012	Loiseleuria procumbens	1	0.062147	0.00565
KATM_2012_01_S994	7/26/2012	Litter	1	0.418079	0.00565
KATM_2012_01_S994	7/26/2012	Moss	1	0.446328	0.164134
KATM_2012_01_S994	7/26/2012	Picea glauca	1	0.039548	0.00565
KATM_2012_01_S994	7/26/2012	Picea glauca	2	0.039548	0.02037
KATM_2012_01_S994	7/26/2012	Picea glauca	3	0.112994	0.014948
KATM_2012_01_S994	7/26/2012	Picea glauca	4	0.039548	0.02037
KATM_2012_01_S994	7/26/2012	Salix arctica	1	0.00565	0.00565
KATM_2012_01_S994	7/26/2012	Salix glauca	1	0.00565	0.00565
KATM_2012_01_S994	7/26/2012	Salix glauca	2	0.011299	0.011299
KATM_2012_01_S994	7/26/2012	Vaccinium uliginosum	1	0.067797	0.02589
KATM_2012_01_S994	7/26/2012	Vaccinium vitis-idaea	1	0.039548	0.014948

Appendix B

Table B1. Species frequency in beetle-kill spruce plots at two sampling dates. Number of quadrats (4 m²) in which species were present is shown for each sampling year. Values can be converted to percentages by dividing by 15. Standard deviations (SD) >20% are in boldface.

Plot id	Species	2010	2012	SD
LACL_2010_01_S998	<i>Aconitum delphiniifolium</i> DC.	1	0	0.71
LACL_2010_01_S998	<i>Anthoxanthum monticola</i> (Bigelow) Veldkamp ssp. <i>alpinum</i> (Sw. ex Willd.) Soreng	1	3	1.41
LACL_2010_01_S998	<i>Artemisia tilesii</i> Ledeb.	1	3	1.41
LACL_2010_01_S998	Aster alpinus L.	3	0	2.12
LACL_2010_01_S998	<i>Astragalus alpinus</i> L.	0	2	1.41
LACL_2010_01_S998	<i>Aulacomnium palustre</i> (Hedwig) Schwaegr.	5	7	1.41
LACL_2010_01_S998	<i>Aulacomnium turgidum</i> (Wahlenb.) Schwaegr.	1	0	0.71
LACL_2010_01_S998	<i>Betula nana</i> L.	2	3	0.71
LACL_2010_01_S998	<i>Calamagrostis canadensis</i> (Michx.) Beauv.	13	13	0.00
LACL_2010_01_S998	<i>Cephalozia connivens</i> (Dicks.) Lindb.	0	1	0.71
LACL_2010_01_S998	<i>Ceratodon purpureus</i> (Hedwig) Bridel subsp. <i>purpureus</i>	0	1	0.71
LACL_2010_01_S998	<i>Cetraria islandica</i> subsp. <i>crispiformis</i> (Räsänen) Kärnefelt	1	1	0.00
LACL_2010_01_S998	<i>Chamerion angustifolium</i> (L.) Holub subsp. <i>angustifolium</i>	10	10	0.00
LACL_2010_01_S998	Cladonia arbuscula subsp. beringiana Ahti	0	3	2.12
LACL_2010_01_S998	<i>Cladonia cenotea</i> (Ach.) Schaerer	1	0	0.71
LACL_2010_01_S998	<i>Cladonia chlorophaea</i> (Flörke ex Sommerf.) Sprengel	4	2	1.41
LACL_2010_01_S998	<i>Cladonia cornuta</i> (L.) Hoffm. subsp. <i>cornuta</i>	2	1	0.71
LACL_2010_01_S998	<i>Cladonia crispata</i> (Ach.) Flotow var. <i>crispata</i>	2	1	0.71
LACL_2010_01_S998	Cladonia furcata (Hudson) Schrader	5	0	3.54
LACL_2010_01_S998	<i>Cladonia gracilis</i> subsp. <i>elongata</i> (Jacq.) Vainio	1	0	0.71
LACL_2010_01_S998	<i>Cladonia gracilis</i> subsp. <i>turbinata</i> (Ach.) Ahti	1	1	0.00
LACL_2010_01_S998	<i>Cladonia gracilis</i> subsp. <i>vulnerata</i> Ahti	1	2	0.71
LACL_2010_01_S998	<i>Cladonia rangiferina</i> (L.) F. H. Wigg.	2	1	0.71
LACL_2010_01_S998	Cladonia scabriuscula (Delise) Nyl.	1	5	2.83
LACL_2010_01_S998	<i>Cladonia stygia</i> (Fr.) Ruoss	1	0	0.71
LACL_2010_01_S998	<i>Cladonia sulphurina</i> (Michaux) Fr.	2	2	0.00

Plot id	Species	2010	2012	SD
LACL_2010_01_S998	<i>Cornus suecica</i> L.	15	15	0.00
LACL_2010_01_S998	<i>Dicranum fragilifolium</i> Lindberg	0	1	0.71
LACL_2010_01_S998	<i>Dicranum fuscescens</i> Turner var. <i>fuscescens</i>	0	1	0.71
LACL_2010_01_S998	<i>Dicranum scoparium</i> Hedwig	2	5	2.12
LACL_2010_01_S998	<i>Dicranum tauricum</i> Sapiegin	2	0	1.41
LACL_2010_01_S998	<i>Empetrum nigrum</i> L.	6	8	1.41
LACL_2010_01_S998	<i>Equisetum arvense</i> L.	4	4	0.00
LACL_2010_01_S998	<i>Eurhynchiastrum pulchellum</i> (Hedwig) Ignatov & Huttunen var. <i>pulchellum</i>	0	2	1.41
LACL_2010_01_S998	<i>Festuca altaica</i> Trin.	5	2	2.12
LACL_2010_01_S998	<i>Flavocetraria cucullata</i> (Bellardi) Kärnefelt & Thell	2	2	0.00
LACL_2010_01_S998	<i>Goodyera repens</i> (L.) R. Br.	1	1	0.00
LACL_2010_01_S998	<i>Hylocomium splendens</i> (Hedwig) Schimper in B.S.G.	15	15	0.00
LACL_2010_01_S998	<i>Hypogymnia austerodes</i> (Nyl.) Rasanen	1	0	0.71
LACL_2010_01_S998	<i>Hypogymnia physodes</i> (L.) Nyl.	1	0	0.71
LACL_2010_01_S998	<i>Linnaea borealis</i> L.	12	12	0.00
LACL_2010_01_S998	<i>Lobaria linita</i> (Ach.) Rabenh.	2	1	0.71
LACL_2010_01_S998	<i>Lycopodium lagopus</i> (Laestadius ex C. Hartman) Zinserl. ex Kuzen	0	1	0.71
LACL_2010_01_S998	<i>Mertensia paniculata</i> (Aiton) G. Don	0	1	0.71
LACL_2010_01_S998	<i>Moehringia lateriflora</i> (L.) Fenzi	0	8	5.66
LACL_2010_01_S998	<i>Moneses uniflora</i> (L.) Gray	2	4	1.41
LACL_2010_01_S998	<i>Nephroma parile</i> (Ach.) Ach.	1	0	0.71
LACL_2010_01_S998	<i>Orthilia secunda</i> (L.) House	10	9	0.71
LACL_2010_01_S998	<i>Parmelia sulcata</i> Taylor	0	1	0.71
LACL_2010_01_S998	<i>Peltigera aphthosa</i> (L.) Willd.	1	4	2.12
LACL_2010_01_S998	<i>Peltigera canina</i> (L.) Willd.	3	4	0.71
LACL_2010_01_S998	<i>Peltigera horizontalis</i> (Huds.) Baumg.	0	1	0.71
LACL_2010_01_S998	<i>Peltigera leucophlebia</i> (Nyl.) Gyelnik	8	6	1.41
LACL_2010_01_S998	<i>Peltigera malacea</i> (Ach.) Funck	1	2	0.71
LACL_2010_01_S998	<i>Peltigera polydactyla</i> (Necker) Hoffm.	0	1	0.71
LACL_2010_01_S998	<i>Peltigera praetextata</i> (Flörke ex Sommerf.) Zopf	0	1	0.71

Plot id	Species	2010	2012	SD
LACL_2010_01_S998	<i>Peltigera scabrosa</i> Th. Fr.	0	1	0.71
LACL_2010_01_S998	<i>Petasites frigidus</i> (L.) Franch.	1	2	0.71
LACL_2010_01_S998	<i>Picea glauca</i> (Moench) Voss	6	7	0.71
LACL_2010_01_S998	Pleurozium schreberi (Bridel) Mitten	4	7	2.12
LACL_2010_01_S998	Poa arctica R. Br. subsp. arctica	0	9	6.36
LACL_2010_01_S998	Polytrichum commune Hedwig var. commune	3	8	3.54
LACL_2010_01_S998	Polytrichum juniperinum Hedwig	5	0	3.54
LACL_2010_01_S998	<i>Polytrichum strictum</i> Bridel	1	1	0.00
LACL_2010_01_S998	Populus balsamifera L.	3	6	2.12
LACL_2010_01_S998	Ptilidium ciliare (L.) Hampe	8	3	3.54
LACL_2010_01_S998	Ptilium crista-castrensis (Hedwig) De Not.	9	14	3.54
LACL_2010_01_S998	<i>Ptychostomum creberrimum</i> (Taylor) J. R. Spence & H. P. Ramsay	0	1	0.71
LACL_2010_01_S998	<i>Pyrola grandiflora</i> Radius	9	9	0.00
LACL_2010_01_S998	<i>Rhytidiadelphus triquetrus</i> (Hedwig) Warnstorf	1	0	0.71
LACL_2010_01_S998	<i>Rosa acicularis</i> Lindl.	5	5	0.00
LACL_2010_01_S998	<i>Rubus arcticus</i> L.	9	10	0.71
LACL_2010_01_S998	<i>Salix bebbiana</i> Sarg.	0	2	1.41
LACL_2010_01_S998	<i>Salix pulchra</i> Cham.	4	4	0.00
LACL_2010_01_S998	<i>Sanionia uncinata</i> (Hedwig) Loeske	1	2	0.71
LACL_2010_01_S998	<i>Shepherdia canadensis</i> (L.) Nutt.	0	1	0.71
LACL_2010_01_S998	<i>Solidago multiradiata</i> Aiton	2	3	0.71
LACL_2010_01_S998	<i>Timmia austriaca</i> Hedwig	3	3	0.00
LACL_2010_01_S998	Trientalis europaea L. subsp. arctica (Fisch. ex Hook.) Hultén	0	4	2.83
LACL_2010_01_S998	<i>Tuckermannopsis sepincola</i> (Ehrh.) Hale	1	0	0.71
LACL_2010_01_S998	<i>Vaccinium uliginosum</i> L.	1	3	1.41
LACL_2010_01_S998	<i>Vaccinium vitis-idaea</i> L.	13	13	0.00
LACL_2010_01_S998	<i>Vulpicida pinastri</i> (Scop.) J.-E. Mattsson & M. J. Lai	3	1	1.41
LACL_2010_01_S996	<i>Aulacomnium palustre</i> (Hedwig) Schwaegr.	3	5	1.41
LACL_2010_01_S996	<i>Betula neoalaskana</i> Sarg.	5	6	0.71
LACL_2010_01_S996	Brachythecium salebrosum (F. Weber & D. Mohr) Schimp.	5	0	3.54

Plot id	Species	2010	2012	SD
LACL_2010_01_S996	<i>Calamagrostis canadensis</i> (Michx.) Beauv.	9	9	0.00
LACL_2010_01_S996	<i>Ceratodon purpureus</i> (Hedwig) Bridel subsp. <i>purpureus</i>	1	0	0.71
LACL_2010_01_S996	<i>Chamerion angustifolium</i> (L.) Holub subsp. <i>angustifolium</i>	3	3	0.00
LACL_2010_01_S996	<i>Cladonia chlorophaea</i> (Flörke ex Sommerf.) Sprengel	2	1	0.71
LACL_2010_01_S996	<i>Cladonia coniocraea</i> (Flörke) Sprengel	0	1	0.71
LACL_2010_01_S996	<i>Cladonia crispata</i> (Ach.) Flotow var. <i>crispata</i>	0	1	0.71
LACL_2010_01_S996	<i>Cladonia cyanipes</i> (Sommerf.) Nyl.	1	0	0.71
LACL_2010_01_S996	<i>Cladonia furcata</i> (Hudson) Schrader	0	1	0.71
LACL_2010_01_S996	<i>Cladonia gracilis</i> subsp. <i>turbinata</i> (Ach.) Ahti	1	0	0.71
LACL_2010_01_S996	<i>Cladonia ochrochlora</i> Flörke	0	2	1.41
LACL_2010_01_S996	<i>Cladonia umbricola</i> Tønsberg & Ahti	2	1	0.71
LACL_2010_01_S996	<i>Dichodontium pellucidum</i> (Hedwig) Schimper	1	1	0.00
LACL_2010_01_S996	<i>Dicranum fragilifolium</i> Lindberg	0	2	1.41
LACL_2010_01_S996	<i>Dicranum polysetum</i> Swartz	8	8	0.00
LACL_2010_01_S996	<i>Dicranum scoparium</i> Hedwig	0	1	0.71
LACL_2010_01_S996	<i>Dicranum tauricum</i> Sapjegin	1	0	0.71
LACL_2010_01_S996	<i>Empetrum nigrum</i> L.	5	6	0.71
LACL_2010_01_S996	<i>Equisetum arvense</i> L.	8	0	5.66
LACL_2010_01_S996	<i>Equisetum sylvaticum</i> L.	3	9	4.24
LACL_2010_01_S996	<i>Geocaulon lividum</i> (Richardson) Fernald	1	1	0.00
LACL_2010_01_S996	<i>Goodyera repens</i> (L.) R. Br.	4	3	0.71
LACL_2010_01_S996	<i>Hylocomium splendens</i> (Hedwig) Schimper in B.S.G.	15	15	0.00
LACL_2010_01_S996	<i>Hypogymnia bitteri</i> (Lynge) Ahti	1	0	0.71
LACL_2010_01_S996	<i>Ledum palustre</i> subsp. <i>decumbens</i> (Ait.) Hultén	13	14	0.71
LACL_2010_01_S996	<i>Linnaea borealis</i> L.	15	15	0.00
LACL_2010_01_S996	<i>Lycopodium lagopus</i> (Laestadius ex C. Hartman) Zinserl. ex Kuzen	1	1	0.00
LACL_2010_01_S996	<i>Moneses uniflora</i> (L.) Gray	0	1	0.71
LACL_2010_01_S996	<i>Orthilia secunda</i> (L.) House	2	6	2.83
LACL_2010_01_S996	<i>Parmelia sulcata</i> Taylor	1	0	0.71
LACL_2010_01_S996	<i>Peltigera leucophlebia</i> (Nyl.) Gyelnik	1	2	0.71

Plot id	Species	2010	2012	SD
LACL_2010_01_S996	<i>Peltigera polydactyla</i> (Necker) Hoffm.	0	1	0.71
LACL_2010_01_S996	<i>Picea glauca</i> (Moench) Voss	5	4	0.71
LACL_2010_01_S996	<i>Picea mariana</i> (Mill.) Britton, Sterns & Poggenb.	0	1	0.71
LACL_2010_01_S996	<i>Plagiothecium laetum</i> Bruch, Schimper & W. Gümbel	1	2	0.71
LACL_2010_01_S996	<i>Pleurozium schreberi</i> (Bridel) Mitten	12	12	0.00
LACL_2010_01_S996	<i>Poa arctica</i> R. Br. subsp. <i>arctica</i>	0	1	0.71
LACL_2010_01_S996	<i>Pohlia cruda</i> (Hedwig) Lindberg	1	0	0.71
LACL_2010_01_S996	<i>Pohlia nutans</i> (Hedwig) Lindberg	0	1	0.71
LACL_2010_01_S996	<i>Polytrichum commune</i> Hedwig var. <i>commune</i>	3	4	0.71
LACL_2010_01_S996	<i>Polytrichum juniperinum</i> Hedwig	1	0	0.71
LACL_2010_01_S996	<i>Ptilidium ciliare</i> (L.) Hampe	3	4	0.71
LACL_2010_01_S996	<i>Ptilium crista-castrensis</i> (Hedwig) De Not.	1	2	0.71
LACL_2010_01_S996	<i>Rhytidiadelphus triquetrus</i> (Hedwig) Warnstorf	1	1	0.00
LACL_2010_01_S996	<i>Ribes triste</i> Pall.	2	4	1.41
LACL_2010_01_S996	<i>Rosa acicularis</i> Lindl.	15	15	0.00
LACL_2010_01_S996	<i>Sanionia uncinata</i> (Hedwig) Loeske	2	3	0.71
LACL_2010_01_S996	<i>Sciuro-hypnum latifolium</i> (Kindberg) Ignatov & Huttunen	0	4	2.83
LACL_2010_01_S996	<i>Sphagnum girgensohnii</i> Russow	1	2	0.71
LACL_2010_01_S996	<i>Spiraea stevenii</i> (C.K. Schneid.) Rydb.	0	1	0.71
LACL_2010_01_S996	<i>Stellaria longipes</i> Goldie sens strict.	0	4	2.83
LACL_2010_01_S996	<i>Trientalis europaea</i> L. subsp. <i>arctica</i> (Fisch. ex Hook.) Hultén	9	10	0.71
LACL_2010_01_S996	<i>Vaccinium vitis-idaea</i> L.	15	15	0.00
LACL_2010_01_S995	<i>Aconitum delphiniifolium</i> DC.	1	0	0.71
LACL_2010_01_S995	<i>Aulacomnium palustre</i> (Hedwig) Schwaegr.	1	4	2.12
LACL_2010_01_S995	<i>Brachythecium albicans</i> (Hedwig) Schimper	0	12	8.49
LACL_2010_01_S995	<i>Brachythecium erythrorrhizon</i> Schimper in B.S.G.	9	0	6.36
LACL_2010_01_S995	<i>Brachythecium oedipodium</i> (Mitt.) Jaeg.	1	0	0.71
LACL_2010_01_S995	<i>Calamagrostis canadensis</i> (Michx.) Beauv.	15	15	0.00
LACL_2010_01_S995	<i>Campylophyllum sommerfeltii</i> (Myrin) Hedenäs	1	0	0.71
LACL_2010_01_S995	<i>Chamerion angustifolium</i> (L.) Holub subsp. <i>angustifolium</i>	15	15	0.00

Plot id	Species	2010	2012	SD
LACL_2010_01_S995	Cladonia arbuscula subsp. beringiana Ahti	1	0	0.71
LACL_2010_01_S995	Cladonia chlorophaea (Flörke ex Sommerf.) Sprengel	1	0	0.71
LACL_2010_01_S995	Cladonia ochrochlora Flörke	0	1	0.71
LACL_2010_01_S995	Cladonia umbricola Tønsberg & Ahti	3	0	2.12
LACL_2010_01_S995	Cornus suecica L.	15	15	0.00
LACL_2010_01_S995	Dicranum fragilifolium Lindberg	1	1	0.00
LACL_2010_01_S995	Dicranum scoparium Hedwig	2	0	1.41
LACL_2010_01_S995	Dicranum tauricum Sapjegin	1	0	0.71
LACL_2010_01_S995	Dicranum undulatum Bridel	1	0	0.71
LACL_2010_01_S995	Dryopteris expansa (C. Presl) Fraser-Jenkins & Jermy	2	1	0.71
LACL_2010_01_S995	Equisetum arvense L.	15	10	3.54
LACL_2010_01_S995	Eurhynchiastrum pulchellum (Hedwig) Ignatov & Huttunen var. pulchellum	1	0	0.71
LACL_2010_01_S995	Galium boreale L.	0	1	0.71
LACL_2010_01_S995	Geranium erianthum DC.	0	2	1.41
LACL_2010_01_S995	Gymnocarpium dryopteris (L.) Newm.	15	15	0.00
LACL_2010_01_S995	Hylocomium splendens (Hedwig) Schimper in B.S.G.	15	15	0.00
LACL_2010_01_S995	Linnaea borealis L.	13	14	0.71
LACL_2010_01_S995	Lycopodium annotinum L.	1	1	0.00
LACL_2010_01_S995	Moehringia lateriflora (L.) Fenzi	0	6	4.24
LACL_2010_01_S995	Nephroma bellum (Sprengel) Tuck.	1	0	0.71
LACL_2010_01_S995	Orthilia secunda (L.) House	0	2	1.41
LACL_2010_01_S995	Peltigera horizontalis (Huds.) Baumg.	1	0	0.71
LACL_2010_01_S995	Peltigera neopolydactyla (Gyelnik) Gyelnik	0	1	0.71
LACL_2010_01_S995	Peltigera polydactyla (Necker) Hoffm.	1	0	0.71
LACL_2010_01_S995	Peltigera praetextata (Flörke ex Sommerf.) Zopf	3	0	2.12
LACL_2010_01_S995	Picea glauca (Moench) Voss	3	1	1.41
LACL_2010_01_S995	Plagiomnium medium (Bruch & Schimper in B.S.G.) T. Kop.	1	3	1.41
LACL_2010_01_S995	Plagiothecium laetum Bruch, Schimper & W. Gümbel	0	1	0.71
LACL_2010_01_S995	Poa arctica R. Br. subsp. arctica	0	4	2.83
LACL_2010_01_S995	Pohlia nutans (Hedwig) Lindberg	1	0	0.71

Plot id	Species	2010	2012	SD
LACL_2010_01_S995	Polytrichum juniperinum Hedwig	1	0	0.71
LACL_2010_01_S995	Populus balsamifera L.	2	1	0.71
LACL_2010_01_S995	Ptilidium ciliare (L.) Hampe	4	1	2.12
LACL_2010_01_S995	Ptilium crista-castrensis (Hedwig) De Not.	12	14	1.41
LACL_2010_01_S995	Pyrola grandiflora Radius	2	2	0.00
LACL_2010_01_S995	Rhytidiadelphus squarrosus (Hedwig) Warnstorf	0	12	8.49
LACL_2010_01_S995	Rhytidiadelphus triquetrus (Hedwig) Warnstorf	1	6	3.54
LACL_2010_01_S995	Ribes triste Pall.	7	4	2.12
LACL_2010_01_S995	Rosa acicularis Lindl.	14	14	0.00
LACL_2010_01_S995	Rubus arcticus L.	7	13	4.24
LACL_2010_01_S995	Rubus arcticus L. ssp. arcticus	7	0	4.95
LACL_2010_01_S995	Salix barclayi Anderss.	0	1	0.71
LACL_2010_01_S995	Salix pulchra Cham.	5	4	0.71
LACL_2010_01_S995	Sanguisorba canadensis L.	0	2	1.41
LACL_2010_01_S995	Sanionia uncinata (Hedwig) Loeske	3	1	1.41
LACL_2010_01_S995	Sphagnum girgensohnii Russow	1	1	0.00
LACL_2010_01_S995	Spiraea stevenii (C.K. Schneid.) Rydb.	1	0	0.71
LACL_2010_01_S995	Timmia austriaca Hedwig	1	0	0.71
LACL_2010_01_S995	Trientalis europaea L. subsp. arctica (Fisch. ex Hook.) Hultén	3	5	1.41
LACL_2010_01_S995	Vaccinium uliginosum L.	0	1	0.71
LACL_2010_01_S995	Vaccinium vitis-idaea L.	7	4	2.12
LACL_2010_01_S995	Viburnum edule (Michx.) Raf.	7	10	2.12
LACL_2010_01_S993	Alnus incana (L.) Moench	3	0	2.12
LACL_2010_01_S993	Aulacomnium palustre (Hedwig) Schwaegr.	1	0	0.71
LACL_2010_01_S993	Brachythecium albicans (Hedwig) Schimper	0	6	4.24
LACL_2010_01_S993	Brachythecium erythrorrhizon Schimper in B.S.G.	7	0	4.95
LACL_2010_01_S993	Brachythecium nelsonii Grout	1	0	0.71
LACL_2010_01_S993	Calamagrostis canadensis (Michx.) Beauv.	15	15	0.00
LACL_2010_01_S993	Cladonia gracilis subsp. turbinata (Ach.) Ahti	1	0	0.71
LACL_2010_01_S993	Cladonia scabriuscula (Delise) Nyl.	0	1	0.71

Plot id	Species	2010	2012	SD
LACL_2010_01_S993	Dichodontium pellucidum (Hedwig) Schimper	0	2	1.41
LACL_2010_01_S993	Dicranum scoparium Hedwig	0	4	2.83
LACL_2010_01_S993	Dicranum undulatum Bridel	4	0	2.83
LACL_2010_01_S993	Empetrum nigrum L.	4	3	0.71
LACL_2010_01_S993	Eurhynchiastrum pulchellum (Hedwig) Ignatov & Huttunen var. pulchellum	1	3	1.41
LACL_2010_01_S993	Geocaulon lividum (Richardson) Fernald	0	1	0.71
LACL_2010_01_S993	Goodyera repens (L.) R. Br.	1	4	2.12
LACL_2010_01_S993	Huperzia selago (L.) Bernh.	2	0	1.41
LACL_2010_01_S993	Hylocomium splendens (Hedwig) Schimper in B.S.G.	14	15	0.71
LACL_2010_01_S993	Linnaea borealis L.	14	15	0.71
LACL_2010_01_S993	Lycopodium annotinum L.	0	2	1.41
LACL_2010_01_S993	Orthilia secunda (L.) House	1	2	0.71
LACL_2010_01_S993	Peltigera aphthosa (L.) Willd.	0	1	0.71
LACL_2010_01_S993	Peltigera leucophlebia (Nyl.) Gyelnik	1	0	0.71
LACL_2010_01_S993	Picea glauca (Moench) Voss	8	8	0.00
LACL_2010_01_S993	Plagiomnium medium (Bruch & Schimper in B.S.G.) T. Kop.	0	1	0.71
LACL_2010_01_S993	Platanthera obtusata (Banks ex Pursh) Lindl.	0	3	2.12
LACL_2010_01_S993	Pleurozium schreberi (Bridel) Mitten	3	4	0.71
LACL_2010_01_S993	Polytrichum commune Hedwig var. commune	0	1	0.71
LACL_2010_01_S993	Populus balsamifera L.	4	5	0.71
LACL_2010_01_S993	Ptilidium ciliare (L.) Hampe	2	2	0.00
LACL_2010_01_S993	Ptilium crista-castrensis (Hedwig) De Not.	4	4	0.00
LACL_2010_01_S993	Pyrola grandiflora Radius	3	7	2.83
LACL_2010_01_S993	Rhytidiadelphus triquetrus (Hedwig) Warnstorf	7	9	1.41
LACL_2010_01_S993	Ribes triste Pall.	2	10	5.66
LACL_2010_01_S993	Rosa acicularis Lindl.	5	6	0.71
LACL_2010_01_S993	Salix L.	0	1	0.71
LACL_2010_01_S993	Sanionia uncinata (Hedwig) Loeske	3	3	0.00
LACL_2010_01_S993	Sciuro-hypnum latifolium (Kindberg) Ignatov & Huttunen	0	1	0.71
LACL_2010_01_S993	Sorbus scopulina Greene	1	1	0.00

Plot id	Species	2010	2012	SD
LACL_2010_01_S993	<i>Timmia austriaca</i> Hedwig	1	1	0.00
LACL_2010_01_S993	<i>Trientalis europaea</i> L. subsp. <i>arctica</i> (Fisch. ex Hook.) Hultén	6	7	0.71
LACL_2010_01_S993	<i>Vaccinium vitis-idaea</i> L.	1	2	0.71
LACL_2010_01_S993	<i>Viburnum edule</i> (Michx.) Raf.	12	8	2.83
KATM_2009_01_S996	<i>Aulacomnium palustre</i> (Hedwig) Schwaegr.	8	10	1.41
KATM_2009_01_S996	<i>Betula nana</i> L.	0	3	2.12
KATM_2009_01_S996	<i>Betula x dugleana</i> Lepage	5	0	3.54
KATM_2009_01_S996	<i>Betula neoalaskana</i> Sarg.	6	7	0.71
KATM_2009_01_S996	<i>Brachythecium albicans</i> (Hedwig) Schimper	0	3	2.12
KATM_2009_01_S996	<i>Brachythecium nelsonii</i> Grout	2	0	1.41
KATM_2009_01_S996	<i>Calamagrostis canadensis</i> (Michx.) Beauv.	3	4	0.71
KATM_2009_01_S996	<i>Cladonia arbuscula</i> subsp. <i>beringiana</i> Ahti	1	2	0.71
KATM_2009_01_S996	<i>Cladonia chlorophaea</i> (Flörke ex Sommerf.) Sprengel	2	0	1.41
KATM_2009_01_S996	<i>Cladonia crispata</i> (Ach.) Flotow var. <i>crispata</i>	0	1	0.71
KATM_2009_01_S996	<i>Cladonia furcata</i> (Hudson) Schrader	0	1	0.71
KATM_2009_01_S996	<i>Cladonia gracilis</i> subsp. <i>vulnerata</i> Ahti	0	1	0.71
KATM_2009_01_S996	<i>Cladonia scabruscula</i> (Delise) Nyl.	2	0	1.41
KATM_2009_01_S996	<i>Cladonia stygia</i> (Fr.) Ruoss	1	0	0.71
KATM_2009_01_S996	<i>Dicranum scoparium</i> Hedwig	10	7	2.12
KATM_2009_01_S996	<i>Empetrum nigrum</i> L.	14	13	0.71
KATM_2009_01_S996	<i>Eurhynchiastrum pulchellum</i> (Hedwig) Ignatov & Huttunen var. <i>pulchellum</i>	0	1	0.71
KATM_2009_01_S996	<i>Hylocomium splendens</i> (Hedwig) Schimper in B.S.G.	14	12	1.41
KATM_2009_01_S996	<i>Moneses uniflora</i> (L.) Gray	5	6	0.71
KATM_2009_01_S996	<i>Nephroma arcticum</i> (L.) Torss.	2	0	1.41
KATM_2009_01_S996	<i>Orthilia secunda</i> (L.) House	1	0	0.71
KATM_2009_01_S996	<i>Parmelia sulcata</i> Taylor	0	2	1.41
KATM_2009_01_S996	<i>Peltigera aphthosa</i> (L.) Willd.	1	0	0.71
KATM_2009_01_S996	<i>Peltigera britannica</i> (Gyelnik) Holt.-Hartw. & Tønberg	7	6	0.71
KATM_2009_01_S996	<i>Peltigera canina</i> (L.) Willd.	0	3	2.12
KATM_2009_01_S996	<i>Peltigera collina</i> (Ach.) Schrader	2	1	0.71

Plot id	Species	2010	2012	SD
KATM_2009_01_S996	<i>Peltigera leucophlebia</i> (Nyl.) Gyelnik	0	1	0.71
KATM_2009_01_S996	<i>Peltigera malacea</i> (Ach.) Funck	5	6	0.71
KATM_2009_01_S996	<i>Peltigera membranacea</i> (Ach.) Nyl.	0	1	0.71
KATM_2009_01_S996	<i>Peltigera neopolydactyla</i> (Gyelnik) Gyelnik	0	1	0.71
KATM_2009_01_S996	<i>Peltigera polydactyla</i> (Necker) Hoffm.	2	0	1.41
KATM_2009_01_S996	<i>Peltigera praetextata</i> (Flörke ex Sommerf.) Zopf	3	0	2.12
KATM_2009_01_S996	<i>Peltigera scabrosa</i> Th. Fr.	1	0	0.71
KATM_2009_01_S996	<i>Picea glauca</i> (Moench) Voss	14	14	0.00
KATM_2009_01_S996	<i>Plagiothecium laetum</i> Bruch, Schimper & W. Gümbel	0	1	0.71
KATM_2009_01_S996	<i>Pleurozium schreberi</i> (Bridel) Mitten	14	12	1.41
KATM_2009_01_S996	<i>Poa alpina</i> Linnaeus	0	1	0.71
KATM_2009_01_S996	<i>Polytrichum commune</i> Hedwig var. <i>commune</i>	14	14	0.00
KATM_2009_01_S996	<i>Polytrichum strictum</i> Bridel	4	2	1.41
KATM_2009_01_S996	<i>Ptilidium ciliare</i> (L.) Hampe	0	1	0.71
KATM_2009_01_S996	<i>Ptilium crista-castrensis</i> (Hedwig) De Not.	14	14	0.00
KATM_2009_01_S996	<i>Rhizomnium pseudopunctatum</i> (Bruch & Schimp.) T. Kop.	0	1	0.71
KATM_2009_01_S996	<i>Rhytidiadelphus loreus</i> (Hedwig) Warnstorf	6	4	1.41
KATM_2009_01_S996	<i>Salix pulchra</i> Cham.	10	10	0.00
KATM_2009_01_S996	<i>Sanionia uncinata</i> (Hedwig) Loeske	6	1	3.54
KATM_2009_01_S996	<i>Sciuro-hypnum latifolium</i> (Kindberg) Ignatov & Huttunen	0	1	0.71
KATM_2009_01_S996	<i>Sphagnum girgensohnii</i> Russow	6	6	0.00
KATM_2009_01_S996	<i>Vaccinium vitis-idaea</i> L.	15	15	0.00
KATM_2009_01_S995	<i>Arnica frigida</i> C.A. Mey. Ex Iljin	1	1	0.00
KATM_2009_01_S995	<i>Aulacomnium palustre</i> (Hedwig) Schwaegr.	6	9	2.12
KATM_2009_01_S995	<i>Aulacomnium turgidum</i> (Wahlenb.) Schwaegr.	1	0	0.71
KATM_2009_01_S995	<i>Betula</i> × <i>dugleana</i> Lepage	0	1	0.71
KATM_2009_01_S995	<i>Betula neoalaskana</i> Sarg.	3	0	2.12
KATM_2009_01_S995	<i>Brachythecium albicans</i> (Hedwig) Schimper	0	2	1.41
KATM_2009_01_S995	<i>Brachythecium calcareum</i> Kindberg	2	0	1.41
KATM_2009_01_S995	<i>Calamagrostis canadensis</i> (Michx.) Beauv.	14	15	0.71

Plot id	Species	2010	2012	SD
KATM_2009_01_S995	Ceratodon purpureus (Hedwig) Bridel subsp. purpureus	1	0	0.71
KATM_2009_01_S995	Chamerion angustifolium (L.) Holub subsp. angustifolium	8	9	0.71
KATM_2009_01_S995	Cladonia chlorophaea (Flörke ex Sommerf.) Sprengel	2	3	0.71
KATM_2009_01_S995	Cladonia coniocraea (Flörke) Sprengel	1	1	0.00
KATM_2009_01_S995	Cladonia furcata (Hudson) Schrader	4	1	2.12
KATM_2009_01_S995	Cladonia ochrochlora Flörke	1	0	0.71
KATM_2009_01_S995	Cladonia scabriuscula (Delise) Nyl.	1	0	0.71
KATM_2009_01_S995	Cornus suecica L.	4	5	0.71
KATM_2009_01_S995	Dicranum fuscescens Turner var. fuscescens	2	0	1.41
KATM_2009_01_S995	Dicranum scoparium Hedwig	2	4	1.41
KATM_2009_01_S995	Dicranum undulatum Bridel	0	1	0.71
KATM_2009_01_S995	Diplophyllum taxifolium (Wahlenberg) Dumortier	1	0	0.71
KATM_2009_01_S995	Empetrum nigrum L.	11	9	1.41
KATM_2009_01_S995	Equisetum arvense L.	15	15	0.00
KATM_2009_01_S995	Equisetum scirpoides Michx.	0	1	0.71
KATM_2009_01_S995	Eurhynchiastrum pulchellum (Hedwig) Ignatov & Huttunen var. pulchellum	1	2	0.71
KATM_2009_01_S995	Hylocomium splendens (Hedwig) Schimper in B.S.G.	15	15	0.00
KATM_2009_01_S995	Hypnum plicatum (Lindberg) Jaeg.	1	0	0.71
KATM_2009_01_S995	Lobaria linita (Ach.) Rabenh.	1	0	0.71
KATM_2009_01_S995	Lycopodium lagopus (Laestadius ex C. Hartman) Zinserl. ex Kuzen	1	1	0.00
KATM_2009_01_S995	Moneses uniflora (L.) Gray	2	3	0.71
KATM_2009_01_S995	Oncophorus wahlenbergii Bridel	0	1	0.71
KATM_2009_01_S995	Orthilia secunda (L.) House	15	15	0.00
KATM_2009_01_S995	Peltigera britannica (Gyelnik) Holt.-Hartw. & Tønsberg	10	5	3.54
KATM_2009_01_S995	Peltigera didactyla (With.) J. R. Laundon	1	0	0.71
KATM_2009_01_S995	Peltigera extenuata (Vainio) Lojka	0	1	0.71
KATM_2009_01_S995	Peltigera membranacea (Ach.) Nyl.	0	9	6.36
KATM_2009_01_S995	Peltigera neopolydactyla (Gyelnik) Gyelnik	1	0	0.71
KATM_2009_01_S995	Peltigera polydactyla (Necker) Hoffm.	0	1	0.71
KATM_2009_01_S995	Peltigera praetextata (Flörke ex Sommerf.) Zopf	10	0	7.07

Plot id	Species	2010	2012	SD
KATM_2009_01_S995	Petasites frigidus (L.) Franch.	1	2	0.71
KATM_2009_01_S995	Picea glauca (Moench) Voss	5	3	1.41
KATM_2009_01_S995	Plagiomnium medium (Bruch & Schimper in B.S.G.) T. Kop.	2	1	0.71
KATM_2009_01_S995	Pleurozium schreberi (Bridel) Mitten	14	15	0.71
KATM_2009_01_S995	Poa alpina L.	0	2	1.41
KATM_2009_01_S995	Poa pratensis L. subsp. alpigena (Fries. ex Blytt) Hiitonen	3	1	1.41
KATM_2009_01_S995	Pohlia nutans (Hedwig) Lindberg	1	1	0.00
KATM_2009_01_S995	Polytrichum commune Hedwig var. commune	5	8	2.12
KATM_2009_01_S995	Polytrichum juniperinum Hedwig	1	0	0.71
KATM_2009_01_S995	Polytrichum strictum Bridel	1	1	0.00
KATM_2009_01_S995	Ptilium crista-castrensis (Hedwig) De Not.	9	10	0.71
KATM_2009_01_S995	Rhytidiadelphus loreus (Hedwig) Warnstorf	3	6	2.12
KATM_2009_01_S995	Rhytidiadelphus triquetrus (Hedwig) Warnstorf	11	12	0.71
KATM_2009_01_S995	Salix arbusculoides Anderss.	1	1	0.00
KATM_2009_01_S995	Salix barclayi Anderss.	11	10	0.71
KATM_2009_01_S995	Salix pulchra Cham.	7	0	4.95
KATM_2009_01_S995	Sanionia uncinata (Hedwig) Loeske	5	1	2.83
KATM_2009_01_S995	Scapania (Dum.) Dum.	1	0	0.71
KATM_2009_01_S995	Spiraea stevenii (C.K. Schneid.) Rydb.	6	6	0.00
KATM_2009_01_S995	Trientalis europaea L. subsp. arctica (Fisch. ex Hook.) Hultén	2	2	0.00
KATM_2009_01_S995	Vaccinium uliginosum L.	1	1	0.00
KATM_2009_01_S995	Vaccinium vitis-idaea L.	7	5	1.41

Table B2. Species frequency in spruce woodland plots at two sampling dates. Number of quadrats (4 m²) in which species were present is shown for each sampling year. Values can be converted to percentages by dividing by 15. Standard deviations (SD) >20% are in boldface.

Plot id	Species	2010	2012	SD
LACL_2011_01_033	Andromeda polifolia L.	3	4	0.71
LACL_2011_01_033	Arctostaphylos alpina (L.) Spreng.	5	5	0.00
LACL_2011_01_033	Betula × dugleana Lepage	2	1	0.71
LACL_2011_01_033	Betula nana L.	13	13	0.00
LACL_2011_01_033	Betula neoalaskana Sarg.	0	1	0.71
LACL_2011_01_033	Calamagrostis canadensis (Michx.) Beauv.	0	1	0.71
LACL_2011_01_033	Calamagrostis lapponica (Wahlenb.) Hartm.	0	2	1.41
LACL_2011_01_033	Cetraria islandica subsp. crispiformis (Räsänen) Kärnefelt	5	9	2.83
LACL_2011_01_033	Cetraria laevigata Rass.	11	5	4.24
LACL_2011_01_033	Cladonia amaurocraea (Flörke) Schaerer	2	6	2.83
LACL_2011_01_033	Cladonia arbuscula subsp. beringiana Ahti	15	15	0.00
LACL_2011_01_033	Cladonia borealis S. Stenroos	1	1	0.00
LACL_2011_01_033	Cladonia cervicornis subsp. verticillata (Hoffm.) Ahti	1	0	0.71
LACL_2011_01_033	Cladonia chlorophaea (Flörke ex Sommerf.) Sprengel	3	1	1.41
LACL_2011_01_033	Cladonia cornuta (L.) Hoffm. subsp. cornuta	2	3	0.71
LACL_2011_01_033	Cladonia crispata (Ach.) Flotow var. crispata	9	5	2.83
LACL_2011_01_033	Cladonia deformis (L.) Hoffm.	0	1	0.71
LACL_2011_01_033	Cladonia gracilis subsp. vulnerata Ahti	12	13	0.71
LACL_2011_01_033	Cladonia macrophylla (Schaerer) Stenh.	1	0	0.71
LACL_2011_01_033	Cladonia maxima (Asahina) Ahti	0	1	0.71
LACL_2011_01_033	Cladonia phyllophora Hoffm.	1	1	0.00
LACL_2011_01_033	Cladonia scabruscula (Delise) Nyl.	2	0	1.41
LACL_2011_01_033	Cladonia squamosa Hoffm.	1	2	0.71
LACL_2011_01_033	Cladonia stellaris (Opiz) Pouzar & Vězda	4	11	4.95
LACL_2011_01_033	Cladonia stygia (Fr.) Ruoss	15	15	0.00
LACL_2011_01_033	Cladonia sulphurina (Michaux) Fr.	1	0	0.71
LACL_2011_01_033	Cladonia uncialis (L.) F. H. Wigg.	8	0	5.66
LACL_2011_01_033	Dicranum groenlandicum Bridel	0	1	0.71

Plot id	Species	2010	2012	SD
LACL_2011_01_033	Dicranum scoparium Hedwig	12	11	0.71
LACL_2011_01_033	Dicranum undulatum Bridel	4	8	2.83
LACL_2011_01_033	Empetrum nigrum L.	14	14	0.00
LACL_2011_01_033	Festuca altaica Trin.	6	6	0.00
LACL_2011_01_033	Flavocetraria cucullata (Bellardi) Kärnefelt & Thell	15	15	0.00
LACL_2011_01_033	Flavocetraria nivalis (L.) Kärnefelt & Thell	2	2	0.00
LACL_2011_01_033	Hylocomium splendens (Hedwig) Schimper in B.S.G.	1	1	0.00
LACL_2011_01_033	Hypnum plicatulum (Lindberg) Jaeg.	1	1	0.00
LACL_2011_01_033	Hypogymnia physodes (L.) Nyl.	2	0	1.41
LACL_2011_01_033	Ledum palustre subsp. decumbens (Ait.) Hultén	14	14	0.00
LACL_2011_01_033	Lobaria linita (Ach.) Rabenh.	1	1	0.00
LACL_2011_01_033	Lupinus nootkatensis Donn ex Sims	1	1	0.00
LACL_2011_01_033	Nephroma arcticum (L.) Torss.	2	3	0.71
LACL_2011_01_033	Parmeliopsis ambigua (Wulfen) Nyl.	2	4	1.41
LACL_2011_01_033	Parmeliopsis hyperopta (Ach.) Arnold	3	2	0.71
LACL_2011_01_033	Peltigera aphthosa (L.) Willd.	10	9	0.71
LACL_2011_01_033	Peltigera malacea (Ach.) Funck	6	7	0.71
LACL_2011_01_033	Peltigera polydactyla (Necker) Hoffm.	2	1	0.71
LACL_2011_01_033	Peltigera scabrosa Th. Fr.	7	8	0.71
LACL_2011_01_033	Picea glauca (Moench) Voss	4	3	0.71
LACL_2011_01_033	Pleurozium schreberi (Bridel) Mitten	6	4	1.41
LACL_2011_01_033	Pohlia cruda (Hedwig) Lindberg	1	0	0.71
LACL_2011_01_033	Pohlia nutans (Hedwig) Lindberg	0	1	0.71
LACL_2011_01_033	Polytrichum commune Hedwig var. commune	1	0	0.71
LACL_2011_01_033	Polytrichum hyperboreum R. Brown	1	0	0.71
LACL_2011_01_033	Polytrichum juniperinum Hedwig	0	1	0.71
LACL_2011_01_033	Polytrichum piliferum Hedwig	1	1	0.00
LACL_2011_01_033	Polytrichum strictum Bridel	5	5	0.00
LACL_2011_01_033	Ptilidium ciliare (L.) Hampe	6	4	1.41
LACL_2011_01_033	Ptilium crista-castrensis (Hedwig) De Not.	1	1	0.00

Plot id	Species	2010	2012	SD
LACL_2011_01_033	Salix bebbiana Sarg.	2	1	0.71
LACL_2011_01_033	Sanionia uncinata (Hedwig) Loeske	1	1	0.00
LACL_2011_01_033	Salix glauca L.	0	2	1.41
LACL_2011_01_033	Salix pulchra Cham.	0	1	0.71
LACL_2011_01_033	Stereocaulon paschale (L.) Hoffm.	5	6	0.71
LACL_2011_01_033	Tuckermannopsis sepincola (Ehrh.) Hale	10	8	1.41
LACL_2011_01_033	Vaccinium uliginosum L.	12	13	0.71
LACL_2011_01_033	Vaccinium vitis-idaea L.	15	15	0.00
LACL_2011_01_033	Vulpicida pinastri (Scop.) J.-E. Mattsson & M. J. Lai	1	1	0.00
LACL_2010_01_030	Arctostaphylos alpina (L.) Spreng.	8	9	0.71
LACL_2010_01_030	Betula nana L.	15	13	1.41
LACL_2010_01_030	Betula × dugleana Lepage	4	7	2.12
LACL_2010_01_030	Chamerion angustifolium (L.) Holub subsp. angustifolium	0	1	0.71
LACL_2010_01_030	Festuca altaica Trin.	2	6	2.83
LACL_2010_01_030	Geocaulon lividum (Richardson) Fernald	1	2	0.71
LACL_2010_01_030	Ledum palustre subsp. decumbens (Ait.) Hultén	15	15	0.00
LACL_2010_01_030	Pedicularis labradorica Wirsing	1	4	2.12
LACL_2010_01_030	Picea glauca (Moench) Voss	7	8	0.71
LACL_2010_01_030	Picea mariana (Mill.) Britton, Sterns & Poggenb.	9	11	1.41
LACL_2010_01_030	Salix glauca L.	2	2	0.00
LACL_2010_01_030	Vaccinium uliginosum L.	15	15	0.00
LACL_2010_01_030	Vaccinium vitis-idaea L.	15	15	0.00
LACL_2010_01_024	Aulacomnium palustre (Hedwig) Schwaegr.	13	12	0.71
LACL_2010_01_024	Betula nana L.	14	14	0.00
LACL_2010_01_024	Calamagrostis canadensis (Michx.) Beauv.	11	10	0.71
LACL_2010_01_024	Carex brunnescens (Pers.) Poir.	0	2	1.41
LACL_2010_01_024	Cetraria islandica subsp. crispiformis (Räsänen) Kärnefelt	5	3	1.41
LACL_2010_01_024	Cetraria laevigata Rass.	2	0	1.41
LACL_2010_01_024	Chamerion angustifolium (L.) Holub subsp. angustifolium	1	1	0.00
LACL_2010_01_024	Cladonia arbuscula subsp. beringiana Ahti	13	12	0.71

Plot id	Species	2010	2012	SD
LACL_2010_01_024	Cladonia cenotea (Ach.) Schaerer	1	2	0.71
LACL_2010_01_024	Cladonia chlorophaea (Flörke ex Sommerf.) Sprengel	5	4	0.71
LACL_2010_01_024	Cladonia cornuta (L.) Hoffm. subsp. cornuta	3	2	0.71
LACL_2010_01_024	Cladonia crispata (Ach.) Flotow var. crispata	0	1	0.71
LACL_2010_01_024	Cladonia cyanipes (Sommerf.) Nyl.	1	3	1.41
LACL_2010_01_024	Cladonia deformis (L.) Hoffm.	3	3	0.00
LACL_2010_01_024	Cladonia gracilis subsp. turbinata (Ach.) Ahti	1	0	0.71
LACL_2010_01_024	Cladonia gracilis subsp. vulnerata Ahti	13	13	0.00
LACL_2010_01_024	Cladonia scabriuscula (Delise) Nyl.	1	1	0.00
LACL_2010_01_024	Cladonia stellaris (Opiz) Pouzar & Vězda	1	2	0.71
LACL_2010_01_024	Cladonia stygia (Fr.) Ruoss	13	14	0.71
LACL_2010_01_024	Cladonia sulphurina (Michaux) Fr.	3	3	0.00
LACL_2010_01_024	Cornus suecica L.	10	10	0.00
LACL_2010_01_024	Dicranum fuscescens Turner var. fuscescens	2	0	1.41
LACL_2010_01_024	Dicranum scoparium Hedwig	1	4	2.12
LACL_2010_01_024	Empetrum nigrum L.	15	15	0.00
LACL_2010_01_024	Hylocomium splendens (Hedwig) Schimper in B.S.G.	12	13	0.71
LACL_2010_01_024	Hypnum plicatulum (Lindberg) Jaeg.	1	1	0.00
LACL_2010_01_024	Ledum palustre subsp. decumbens (Ait.) Hultén	15	15	0.00
LACL_2010_01_024	Nephroma arcticum (L.) Torss.	2	1	0.71
LACL_2010_01_024	Parmeliopsis ambigua (Wulfen) Nyl.	12	12	0.00
LACL_2010_01_024	Parmeliopsis hyperopta (Ach.) Arnold	12	13	0.71
LACL_2010_01_024	Peltigera aphthosa (L.) Willd.	8	9	0.71
LACL_2010_01_024	Peltigera leucophlebia (Nyl.) Gyelnik	1	0	0.71
LACL_2010_01_024	Peltigera polydactyla (Necker) Hoffm.	3	3	0.00
LACL_2010_01_024	Peltigera scabrosa Th. Fr.	12	12	0.00
LACL_2010_01_024	Picea glauca (Moench) Voss	2	4	1.41
LACL_2010_01_024	Pleurozium schreberi (Bridel) Mitten	15	14	0.71
LACL_2010_01_024	Pohlia nutans (Hedwig) Lindberg	0	2	1.41
LACL_2010_01_024	Polytrichum commune Hedwig var. commune	12	10	1.41

Plot id	Species	2010	2012	SD
LACL_2010_01_024	Polytrichum strictum Bridel	8	10	1.41
LACL_2010_01_024	Ptilium crista-castrensis (Hedwig) De Not.	8	6	1.41
LACL_2010_01_024	Rubus chamaemorus L.	9	11	1.41
LACL_2010_01_024	Salix barclayi Anderss.	0	1	0.71
LACL_2010_01_024	Salix pulchra Cham.	4	3	0.71
LACL_2010_01_024	Sanionia uncinata (Hedwig) Loeske	0	1	0.71
LACL_2010_01_024	Sphagnum girgensohnii Russow	6	6	0.00
LACL_2010_01_024	Spiraea stevenii (C.K. Schneid.) Rydb.	4	4	0.00
LACL_2010_01_024	Trientalis europaea L. subsp. arctica (Fisch. ex Hook.) Hultén	0	1	0.71
LACL_2010_01_024	Tuckermannopsis sepincola (Ehrh.) Hale	13	13	0.00
LACL_2010_01_024	Vaccinium oxycoccos L.	1	2	0.71
LACL_2010_01_024	Vaccinium uliginosum L.	9	8	0.71
LACL_2010_01_024	Vaccinium vitis-idaea L.	15	15	0.00
LACL_2010_01_024	Vulpicida pinastris (Scop.) J.-E. Mattsson & M. J. Lai	12	14	1.41
LACL_2008_02_014	Anastrophyllum minutum (Schreb.) R. M. Schust. var. minutum	2	2	0.00
LACL_2008_02_014	Aulacomnium palustre (Hedwig) Schwaegr.	5	4	0.71
LACL_2008_02_014	Betula nana L.	15	15	0.00
LACL_2008_02_014	Calypogeia neesiana (C. Massal. & Carestia) Müll. Frib.	1	0	0.71
LACL_2008_02_014	Carex lugens T. Holm	6	5	0.71
LACL_2008_02_014	Ceratodon purpureus (Hedwig) Bridel subsp. purpureus	0	1	0.71
LACL_2008_02_014	Cetraria islandica subsp. crispiformis (Räsänen) Kärnefelt	9	11	1.41
LACL_2008_02_014	Cetraria laevigata Rass.	4	1	2.12
LACL_2008_02_014	Cladonia amaurocraea (Flörke) Schaerer	0	4	2.83
LACL_2008_02_014	Cladonia arbuscula subsp. beringiana Ahti	12	12	0.00
LACL_2008_02_014	Cladonia bellidiflora (Ach.) Schaerer	1	2	0.71
LACL_2008_02_014	Cladonia borealis S. Stenroos	0	2	1.41
LACL_2008_02_014	Cladonia chlorophaea (Flörke ex Sommerf.) Sprengel	4	5	0.71
LACL_2008_02_014	Cladonia cornuta (L.) Hoffm. subsp. cornuta	6	4	1.41
LACL_2008_02_014	Cladonia crispata (Ach.) Flotow var. crispata	5	7	1.41
LACL_2008_02_014	Cladonia cyanipes (Sommerf.) Nyl.	1	3	1.41

Plot id	Species	2010	2012	SD
LACL_2008_02_014	Cladonia deformis (L.) Hoffm.	2	6	2.83
LACL_2008_02_014	Cladonia gracilis subsp. turbinata (Ach.) Ahti	0	1	0.71
LACL_2008_02_014	Cladonia gracilis subsp. vulnerata Ahti	9	10	0.71
LACL_2008_02_014	Cladonia phyllophora Hoffm.	2	0	1.41
LACL_2008_02_014	Cladonia pleurota (Flörke) Schaerer	3	1	1.41
LACL_2008_02_014	Cladonia squamosa Hoffm.	0	1	0.71
LACL_2008_02_014	Cladonia stellaris (Opiz) Pouzar & Vězda	2	3	0.71
LACL_2008_02_014	Cladonia stygia (Fr.) Ruoss	15	13	1.41
LACL_2008_02_014	Cladonia sulphurina (Michaux) Fr.	5	2	2.12
LACL_2008_02_014	Cladonia uncialis (L.) F. H. Wigg.	6	3	2.12
LACL_2008_02_014	Cladonia verticillata (Hoffm.) Schaerer	0	1	0.71
LACL_2008_02_014	Dicranum fuscescens Turner var. fuscescens	0	4	2.83
LACL_2008_02_014	Dicranum groenlandicum Bridel	0	4	2.83
LACL_2008_02_014	Dicranum scoparium Hedwig	13	6	4.95
LACL_2008_02_014	Dicranum undulatum Bridel	8	5	2.12
LACL_2008_02_014	Empetrum nigrum L.	15	15	0.00
LACL_2008_02_014	Flavocetraria cucullata (Bellardi) Kärnefelt & Thell	0	2	1.41
LACL_2008_02_014	Hylocomium splendens (Hedwig) Schimper in B.S.G.	10	9	0.71
LACL_2008_02_014	Ledum palustre subsp. decumbens (Ait.) Hultén	15	15	0.00
LACL_2008_02_014	Lophozia ventricosa (Dicks.) Dumort.	3	4	0.71
LACL_2008_02_014	Lycopodium lagopus (Laestadius ex C. Hartman) Zinserl. ex Kuzen	3	3	0.00
LACL_2008_02_014	Nephroma arcticum (L.) Torss.	2	2	0.00
LACL_2008_02_014	Parmeliopsis ambigua (Wulfen) Nyl.	11	11	0.00
LACL_2008_02_014	Parmeliopsis hyperopta (Ach.) Arnold	11	12	0.71
LACL_2008_02_014	Pedicularis labradorica Wirsing	1	1	0.00
LACL_2008_02_014	Peltigera aphthosa (L.) Willd.	11	12	0.71
LACL_2008_02_014	Peltigera leucophlebia (Nyl.) Gyelnik	2	4	1.41
LACL_2008_02_014	Peltigera malacea (Ach.) Funck	9	8	0.71
LACL_2008_02_014	Peltigera polydactyla (Necker) Hoffm.	1	8	4.95
LACL_2008_02_014	Peltigera scabrosa Th. Fr.	8	10	1.41

Plot id	Species	2010	2012	SD
LACL_2008_02_014	<i>Picea glauca</i> (Moench) Voss	5	6	0.71
LACL_2008_02_014	<i>Pleurozium schreberi</i> (Bridel) Mitten	15	13	1.41
LACL_2008_02_014	<i>Pohlia nutans</i> (Hedwig) Lindberg	2	3	0.71
LACL_2008_02_014	<i>Polytrichum commune</i> Hedwig var. <i>commune</i>	15	12	2.12
LACL_2008_02_014	<i>Polytrichum juniperinum</i> Hedwig	0	1	0.71
LACL_2008_02_014	<i>Polytrichum strictum</i> Bridel	8	10	1.41
LACL_2008_02_014	<i>Ptilidium ciliare</i> (L.) Hampe	2	0	1.41
LACL_2008_02_014	<i>Ptilium crista-castrensis</i> (Hedwig) De Not.	1	0	0.71
LACL_2008_02_014	<i>Rubus chamaemorus</i> L.	5	2	2.12
LACL_2008_02_014	<i>Salix glauca</i> L.	2	1	0.71
LACL_2008_02_014	<i>Sphagnum girgensohnii</i> Russow	2	2	0.00
LACL_2008_02_014	<i>Spiraea stevenii</i> (C.K. Schneid.) Rydb.	0	1	0.71
LACL_2008_02_014	<i>Stereocaulon paschale</i> (L.) Hoffm.	8	8	0.00
LACL_2008_02_014	<i>Tritomaria scitula</i> (T. Taylor) E. H. Jørgensen	1	0	0.71
LACL_2008_02_014	<i>Tuckermannopsis sepincola</i> (Ehrh.) Hale	9	12	2.12
LACL_2008_02_014	<i>Vaccinium uliginosum</i> L.	14	14	0.00
LACL_2008_02_014	<i>Vaccinium vitis-idaea</i> L.	15	15	0.00
LACL_2008_02_014	<i>Vulpicida pinastri</i> (Scop.) J.-E. Mattsson & M. J. Lai	13	13	0.00
LACL_2007_02_006	<i>Anastrophyllum minutum</i> (Schreb.) R. M. Schust. var. <i>minutum</i>	0	2	1.41
LACL_2007_02_006	<i>Anthoxanthum monticola</i> (Bigelow) Veldkamp ssp. <i>alpinum</i> (Sw. ex Willd.) Soreng	9	10	0.71
LACL_2007_02_006	<i>Arctostaphylos alpina</i> (L.) Spreng.	1	1	0.00
LACL_2007_02_006	<i>Aulacomnium palustre</i> (Hedwig) Schwaegr.	4	4	0.00
LACL_2007_02_006	<i>Aulacomnium turgidum</i> (Wahlenb.) Schwaegr.	4	4	0.00
LACL_2007_02_006	<i>Betula nana</i> L.	14	14	0.00
LACL_2007_02_006	<i>Buxbaumia aphylla</i> Hedwig	0	1	0.71
LACL_2007_02_006	<i>Calamagrostis lapponica</i> (Wahlenb.) Hartm.	0	4	2.83
LACL_2007_02_006	<i>Carex lugens</i> T. Holm	10	12	1.41
LACL_2007_02_006	<i>Cetraria islandica</i> subsp. <i>crispiformis</i> (Räsänen) Kärnefelt	2	14	8.49
LACL_2007_02_006	<i>Cetraria laevigata</i> Rass.	11	0	7.78
LACL_2007_02_006	<i>Cladonia arbuscula</i> subsp. <i>beringiana</i> Ahti	11	14	2.12

Plot id	Species	2010	2012	SD
LACL_2007_02_006	Cladonia bellidiflora (Ach.) Schaerer	2	2	0.00
LACL_2007_02_006	Cladonia borealis S. Stenroos	1	4	2.12
LACL_2007_02_006	Cladonia chlorophaea (Flörke ex Sommerf.) Sprengel	7	5	1.41
LACL_2007_02_006	Cladonia cornuta (L.) Hoffm. subsp. cornuta	4	1	2.12
LACL_2007_02_006	Cladonia crispata (Ach.) Flotow var. crispata	9	4	3.54
LACL_2007_02_006	Cladonia deformis (L.) Hoffm.	0	1	0.71
LACL_2007_02_006	Cladonia gracilis subsp. turbinata (Ach.) Ahti	1	3	1.41
LACL_2007_02_006	Cladonia gracilis subsp. vulnerata Ahti	12	12	0.00
LACL_2007_02_006	Cladonia macroceras (Delise) Hav.	0	1	0.71
LACL_2007_02_006	Cladonia rangiferina (L.) F. H. Wigg.	4	0	2.83
LACL_2007_02_006	Cladonia squamosa Hoffm.	2	1	0.71
LACL_2007_02_006	Cladonia stellaris (Opiz) Pouzar & Vězda	4	3	0.71
LACL_2007_02_006	Cladonia stygia (Fr.) Ruoss	11	11	0.00
LACL_2007_02_006	Cladonia sulphurina (Michaux) Fr.	0	1	0.71
LACL_2007_02_006	Cladonia uncialis (L.) F. H. Wigg.	1	6	3.54
LACL_2007_02_006	Cladonia subulata (L.) F.H. Wigg.	2	0	1.41
LACL_2007_02_006	Cladonia uncialis (L.) F. H. Wigg.	6	0	4.24
LACL_2007_02_006	Dicranum fuscescens Turner var. fuscescens	3	0	2.12
LACL_2007_02_006	Dicranum groenlandicum Bridel	4	0	2.83
LACL_2007_02_006	Dicranum scoparium Hedwig	6	11	3.54
LACL_2007_02_006	Dicranum undulatum Bridel	2	0	1.41
LACL_2007_02_006	Empetrum nigrum L.	15	14	0.71
LACL_2007_02_006	Flavocetraria cucullata (Bellardi) Kärnefelt & Thell	13	12	0.71
LACL_2007_02_006	Flavocetraria nivalis (L.) Kärnefelt & Thell	1	1	0.00
LACL_2007_02_006	Hylocomium splendens (Hedwig) Schimper in B.S.G.	9	10	0.71
LACL_2007_02_006	Hypnum plicatulum (Lindberg) Jaeg.	0	2	1.41
LACL_2007_02_006	Jungermannia L.	1	0	0.71
LACL_2007_02_006	Ledum palustre subsp. decumbens (Ait.) Hultén	15	15	0.00
LACL_2007_02_006	Lobaria linita (Ach.) Rabenh.	1	1	0.00
LACL_2007_02_006	Loiseleuria procumbens (L.) Desv.	3	1	1.41

Plot id	Species	2010	2012	SD
LACL_2007_02_006	Lophozia ventricosa (Dicks.) Dumort.	2	2	0.00
LACL_2007_02_006	Lycopodium lagopus (Laestadius ex C. Hartman) Zinserl. ex Kuzen	1	1	0.00
LACL_2007_02_006	Melanohalea septentrionalis (Lynge) O. Blanco et al.	0	1	0.71
LACL_2007_02_006	Nephroma arcticum (L.) Torss.	2	3	0.71
LACL_2007_02_006	Parmelia omphalodes (L.) Ach. subsp. omphalodes	1	0	0.71
LACL_2007_02_006	Parmeliopsis ambigua (Wulfen) Nyl.	7	8	0.71
LACL_2007_02_006	Parmeliopsis hyperopta (Ach.) Arnold	8	10	1.41
LACL_2007_02_006	Pedicularis labradorica Wirsing	2	4	1.41
LACL_2007_02_006	Peltigera aphthosa (L.) Willd.	7	6	0.71
LACL_2007_02_006	Peltigera leucophlebia (Nyl.) Gyelnik	0	1	0.71
LACL_2007_02_006	Peltigera malacea (Ach.) Funck	1	1	0.00
LACL_2007_02_006	Peltigera polydactyla (Necker) Hoffm.	1	2	0.71
LACL_2007_02_006	Peltigera scabrosa Th. Fr.	2	4	1.41
LACL_2007_02_006	Petasites frigidus (L.) Franch.	1	1	0.00
LACL_2007_02_006	Picea glauca (Moench) Voss	5	6	0.71
LACL_2007_02_006	Pleurozium schreberi (Bridel) Mitten	10	13	2.12
LACL_2007_02_006	Pohlia cruda (Hedwig) Lindberg	1	0	0.71
LACL_2007_02_006	Pohlia nutans (Hedwig) Lindberg	4	4	0.00
LACL_2007_02_006	Polytrichum commune Hedwig var. commune	10	12	1.41
LACL_2007_02_006	Polytrichum strictum Bridel	5	6	0.71
LACL_2007_02_006	Psoroma hypnorum (Vahl) Gray	0	1	0.71
LACL_2007_02_006	Ptilidium ciliare (L.) Hampe	1	1	0.00
LACL_2007_02_006	Ptilium crista-castrensis (Hedwig) De Not.	1	1	0.00
LACL_2007_02_006	Rubus chamaemorus L.	2	5	2.12
LACL_2007_02_006	Salix pulchra Cham.	4	5	0.71
LACL_2007_02_006	Sanionia uncinata (Hedwig) Loeske	1	1	0.00
LACL_2007_02_006	Sphagnum girgensohnii Russow	2	1	0.71
LACL_2007_02_006	Stereocaulon paschale (L.) Hoffm.	7	6	0.71
LACL_2007_02_006	Thamnia Ach. ex Schaerer	4	5	0.71
LACL_2007_02_006	Tuckermannopsis sepincola (Ehrh.) Hale	11	14	2.12

Plot id	Species	2010	2012	SD
LACL_2007_02_006	Vaccinium uliginosum L.	15	14	0.71
LACL_2007_02_006	Vaccinium vitis-idaea L.	15	15	0.00
LACL_2007_02_006	Vulpicida pinastri (Scop.) J.-E. Mattsson & M. J. Lai	11	12	0.71

Table B3. Within-plot estimates of frequency for vascular and nonvascular species in white spruce woodland plots established in 2012. Number of quadrats (4 m²) in which species were present is shown for each sampling year. Values can be converted to percentages by dividing by 15. Nonvascular species were not recorded in the LACL plots.

Species	LACL 2012 plots		KATM 2012 plots		
	01_162	01_S992	01_S041	01_S190	01_S994
Anastrophyllum minutum (Schreb.) R. M. Schust. var. minutum	0	0	0	0	2
Anthoxanthum monticola (Bigelow) Veldkamp ssp. alpinum (Sw. ex Willd.) Soreng	0	0	1	0	1
Arctostaphylos alpina (L.) Spreng.	0	0	5	3	2
Artemisia arctica Less. subsp. arctica	0	0	1	0	0
Aulacomnium palustre (Hedwig) Schwaegr.	0	0	13	9	2
Aulacomnium turgidum (Wahlenb.) Schwaegr.	0	0	0	3	0
Barbilophozia kunzeana (Huebener) Gams	0	0	1	2	1
Betula × dugleana Lepage	2	2	0	0	0
Betula nana L.	14	9	13	15	13
Bromus pumpellianus ssp. pumpellianus Scribn.	0	4	0	0	0
Calamagrostis canadensis (Michx.) Beauv.	1	0	5	1	0
Calamagrostis lapponica (Wahlenb.) Hartm.	5	0	0	0	0
Campanula lasiocarpa Cham.	0	0	0	0	4
Carex lugens T. Holm	0	0	2	9	0
Cetraria islandica subsp. crispiformis (Räsänen) Kärnefelt	0	0	3	1	2
Cetraria laevigata Rass.	0	0	1	10	6
Chamerion angustifolium (L.) Holub subsp. angustifolium	14	7	6	0	2
Cladonia amaurocraea (Flörke) Schaerer	0	0	0	0	2
Cladonia arbuscula subsp. beringiana Ahti	0	0	4	10	13
Cladonia bellidiflora (Ach.) Schaerer	0	0	0	0	2
Cladonia chlorophaea (Flörke ex Sommerf.) Sprengel	0	0	1	2	2
Cladonia cornuta (L.) Hoffm. subsp. cornuta	0	0	2	2	2
Cladonia crispata (Ach.) Flotow var. crispata	0	0	0	2	7
Cladonia cyanipes (Sommerf.) Nyl.	0	0	3	1	1
Cladonia furcata (Hudson) Schrader	0	0	2	0	1
Cladonia gracilis subsp. vulnerata Ahti	0	0	12	14	13

Species	LACL 2012 plots		KATM 2012 plots		
	01_162	01_S992	01_S041	01_S190	01_S994
<i>Cladonia nipponica</i> Asahina	0	0	0	0	1
<i>Cladonia rangiferina</i> (L.) F. H. Wigg.	0	0	4	0	0
<i>Cladonia scabriuscula</i> (Delise) Nyl.	0	0	0	1	0
<i>Cladonia squamosa</i> Hoffm.	0	0	0	0	4
<i>Cladonia stellaris</i> (Opiz) Pouzar & Vězda	0	0	0	1	9
<i>Cladonia stygia</i> (Fr.) Ruoss	0	0	11	10	13
<i>Cladonia uncialis</i> (L.) F. H. Wigg.	0	0	0	1	8
<i>Dicranum scoparium</i> Hedwig	0	0	11	14	11
<i>Dicranum undulatum</i> Bridel	0	0	0	1	3
<i>Empetrum nigrum</i> L.	1	1	15	15	15
<i>Festuca altaica</i> Trin.	11	0	0	0	1
<i>Flavocetraria cucullata</i> (Bellardi) Kärnefelt & Thell	0	0	0	2	8
<i>Geocaulon lividum</i> (Richardson) Fernald	0	6	0	0	0
<i>Hylocomium splendens</i> (Hedwig) Schimper in B.S.G.	0	0	11	0	2
<i>Hypnum plicatum</i> (Lindberg) Jaeg.	0	0	0	0	1
<i>Ledum palustre</i> subsp. <i>decumbens</i> (Ait.) Hultén	3	12	11	15	15
<i>Loiseleuria procumbens</i> (L.) Desv.	0	0	0	0	4
<i>Lophozia ventricosa</i> (Dicks.) Dumort.	0	0	2	2	0
<i>Lycopodium alpinum</i> L.	0	1	0	0	0
<i>Lycopodium lagopus</i> (Laestadius ex C. Hartman) Zinserl. ex Kuzen	0	2	0	0	0
<i>Nephroma arcticum</i> (L.) Torss.	0	0	1	1	0
<i>Parmelia sulcata</i> Taylor	0	0	0	1	0
<i>Parmeliopsis ambigua</i> (Wulfen) Nyl.	0	0	0	1	0
<i>Pedicularis labradorica</i> Wirsing	0	0	0	0	8
<i>Peltigera aphthosa</i> (L.) Willd.	0	0	8	0	0
<i>Peltigera britannica</i> (Gyelnik) Holt.-Hartw. & Tønsberg	0	0	1	5	11
<i>Peltigera leucophlebia</i> (Nyl.) Gyelnik	0	0	1	5	0
<i>Peltigera malacea</i> (Ach.) Funck	0	0	3	8	8
<i>Peltigera membranacea</i> (Ach.) Nyl.	0	0	0	0	1

Species	LACL 2012 plots		KATM 2012 plots		
	01_162	01_S992	01_S041	01_S190	01_S994
<i>Peltigera neopolydactyla</i> (Gyelnik) Gyelnik	0	0	0	3	0
<i>Peltigera polydactyla</i> (Necker) Hoffm.	0	0	12	3	0
<i>Peltigera scabrosa</i> Th. Fr.	0	0	9	12	3
<i>Picea glauca</i> (Moench) Voss	12	3	11	10	9
<i>Picea mariana</i> (Mill.) Britton, Sterns & Poggenb.	1	2	0	0	0
<i>Pleurozium schreberi</i> (Bridel) Mitten	0	0	15	15	11
<i>Poa alpina</i> Linnaeus	0	0	1	0	0
<i>Pohlia nutans</i> (Hedwig) Lindberg	0	0	1	2	0
<i>Polytrichum commune</i> Hedwig var. <i>commune</i>	0	0	15	14	7
<i>Polytrichum strictum</i> Bridel	0	0	11	5	0
<i>Populus balsamifera</i> L.	0	1	0	0	0
<i>Populus tremuloides</i> Michx.	0	3	0	0	0
<i>Psoroma hypnorum</i> (Vahl) Gray	0	0	0	0	3
<i>Ptilidium ciliare</i> (L.) Hampe	0	0	2	6	11
<i>Ptilium crista-castrensis</i> (Hedwig) De Not.	0	0	11	4	10
<i>Racomitrium lanuginosum</i> (Hedwig) Bridel	0	0	0	0	8
<i>Rhytidiadelphus triquetrus</i> (Hedwig) Warnstorf	0	0	0	0	1
<i>Rosa acicularis</i> Lindl.	0	1	0	0	0
<i>Rubus chamaemorus</i> L.	0	0	0	3	0
<i>Salix arctica</i> Pall.	0	0	0	0	9
<i>Salix glauca</i> L.	0	4	6	2	3
<i>Salix pulchra</i> Cham.	0	1	8	8	0
<i>Salix reticulata</i> L.	0	0	0	0	1
<i>Sanionia uncinata</i> (Hedwig) Loeske	0	0	0	3	1
<i>Sciuro-hypnum reflexum</i> (Starke) Ignatov & Huttunen	0	0	0	0	2
<i>Sphagnum girgensohnii</i> Russow	0	0	7	12	0
<i>Spiraea stevenii</i> (C.K. Schneid.) Rydb.	0	0	4	5	0
<i>Stereocaulon paschale</i> (L.) Hoffm.	0	0	0	1	9
<i>Trientalis europaea</i> L. subsp. <i>arctica</i> (Fisch. ex Hook.) Hultén	4	0	0	0	0

Species	LACL 2012 plots		KATM 2012 plots		
	01_162	01_S992	01_S041	01_S190	01_S994
Tuckermannopsis sepincola (Ehrh.) Hale	0	0	6	10	4
Vaccinium oxycoccos L.	0	0	1	0	0
Vaccinium uliginosum L.	0	13	15	14	10
Vaccinium vitis-idaea L.	15	15	15	15	15

Appendix C

Table C1. Comparison of mean species cover from ocular estimates in beetle-kill and spruce woodland plots collected at two sampling dates (2009-2012). Cover estimates are recorded in 4 m² quadrats and averaged across the 30 m transects (n=3).

cover type	Mature closed spruce/beetle-kill spruce								White spruce woodland					
	KATM-2009-01-S995		KATM-2009-01-S996		LACL-2010-01-S998		LACL-2010-01-S999		LACL-2008-02-014		LACL-2010-01-024		LACL-2011-01-033	
	2009	2012	2009	2012	2010	2012	2010	2012	2010	2012	2010	2012	2011	2012
Bare ground	0.0	0.2	0.0	0.0	2.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bedrock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cryptogamic crust	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Downed wood	5.6	3.8	0.5	1.0	4.8	3.2	4.8	2.9	0.0	0.0	0.7	0.5	0.0	0.0
Dwarf shrub	4.8	4.0	20.3	23.5	17.3	13.8	23.0	18.1	26.3	29.0	13.5	15.1	11.3	11.1
Forb	5.1	6.3	0.0	0.0	23.0	14.4	16.9	15.5	0.0	0.0	0.2	0.2	0.2	0.0
Graminoid	2.0	6.0	0.0	0.1	1.8	0.3	0.3	0.2	0.1	0.0	0.1	0.1	0.1	0.1
Gravel	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lichen	1.6	1.7	1.4	0.7	3.9	4.3	0.4	0.6	12.1	16.3	9.5	11.9	55.7	68.3
Litter	17.3	11.1	8.6	5.3	7.1	3.9	7.7	4.9	5.3	0.7	4.5	0.3	9.5	1.2
Moss	83.7	89.3	95.7	94.3	83.0	82.9	87.0	83.3	54.3	72.0	72.3	58.2	3.1	2.5
Rock/cobble	0.0	0.0	0.1	0.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Shrub	13.9	30.1	0.8	3.8	4.3	1.7	16.0	10.5	23.5	34.0	59.3	35.7	37.3	33.7
Standing dead	2.4	1.4	14.5	32.2	0.1	0.0	0.5	1.5	2.4	0.7	1.2	0.5	0.4	0.1
Tree	13.4	19.5	26.7	18.3	24.0	17.5	34.7	32.2	0.9	3.4	3.1	2.9	1.5	3.7