LONG TERM VEGETATION MONITORING PLOTS: REVISIT OF 5 PLOTS ON ELMENDORF AIR FORCE BASE

Prepared for:

Natural and Cultural Resources Office
3 CES/CEANC
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Elmendorf Air Force Base, Alaska
99506-3204

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2008

Copies of this report and access to original data are available from the Elmendorf AFB Wildlife Biologist or Chief of Natural and Cultural Resources:

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EXECUTIVE SUMMARY

The Asset Management Flight of 3rd Civil Engineer Squadron on Elmendorf Air Force Base contracted with the Alaska Natural Heritage Program, Environment and Natural Resources Institute at University Alaska Anchorage to revisit 5 of Elmendorf's 24 long-term vegetation monitoring plots (LTVMP) which were established and initially measured in 1999. The objective was to make comparison of the vegetative community structure between years and identify notable changes in structure and identify any vegetation community health issues. In 2008, five LTVMPs were re-visited and analyzed. The primary observation was old growth forest plots were shrubbier in 2008 than in 1999 and most of the spruce bark beetle-killed trees, prevalent in 1999, were no longer standing. Canopy coverage in the shrub layer increased in the beetle-killed plots, probably as a result of the reduced canopy of white spruce. The black spruce forest plot sampled had a dramatic decrease in dwarf shrubs and the birch forest plot sampled had an increase in confers and decrease in deciduous trees. The plots revisited represented only 3 of 5 dominant vegetation communities on the base. Researchers recommended more samples to include the lesser vegetation communities. Infestations of orange hawkweed were noted north of 46th Street.

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ACKNOWLEDGMENTS

We wish to thank Kellee Hampee for helping with field work and entering data, Jerry Tande for sharing his data and knowledge of the project and Helen Cortés-Burns for writing the proposal. We would also like to thank Herman Griese for his support in requesting this project be funded and for logistical support.

INTRODUCTION

In 1999 The Alaska Natural Heritage Program (AKNHP) set up and characterized the vegetation in 24 Long Term Vegetation Monitoring Plots (LTVMPs) on Elmendorf Air Force Base (Tande et al. 2001). Five LTVM plots were re-visited in 2008 and were described using procedures specified in "Procedures for Establishing Long-term Vegetation Monitoring Plots on Elmendorf Air Force Base, Alaska" (Tande 2000). One purpose for setting up the LTVMPs was to monitor forest changes on Elmendorf Air Force Base (EAFB) and re-visit the plots at regular intervals. The data collected would assist with management of wildlife, forest resources, wetlands, threatened and endangered species, and outdoor recreation resources (Tande et al. 2001). During the 1999 survey most of the mature white spruce were dead or dying as a result of the spruce bark beetle. Returning to those sites would increase knowledge about spruce and birch regeneration in forests impacted by spruce bark beetles. A side-by-side comparison of characteristics of the LTVM plots is discussed in this report. The current vegetation status and any significant changes from 1999-2008 are presented and summarized. Plant species nomenclature follows the Integrated Taxonomic Information System (ITIS 2008). Tree species are referred by common name for ease of reading.

Documentation of the location of invasive plant species was another objective of the 2008 project. Two populations of invasive species were located. *Hieracium aurantiacum* (Orange hawkweed) was documented on the access trail to LTVMPs 11 and 12. Another group of invasive species was documented near the antennae field near the access trail to LTVMP 5. Both locations were documented using hand held GPS units.

Location

Elmendorf Air Force Base is situated north of Anchorage Alaska at the head of Cook Inlet. The Base is approximately 5,445 hectares at 149 degrees, 48 minutes west longitude and 61 degrees, 15 minutes north latitude (Tande et al. 2001). Knik Arm is to the north and West, Fort Richardson Army Base is to the East and the Municipality of Anchorage is to the South. Plots surveyed are noted on the map below.

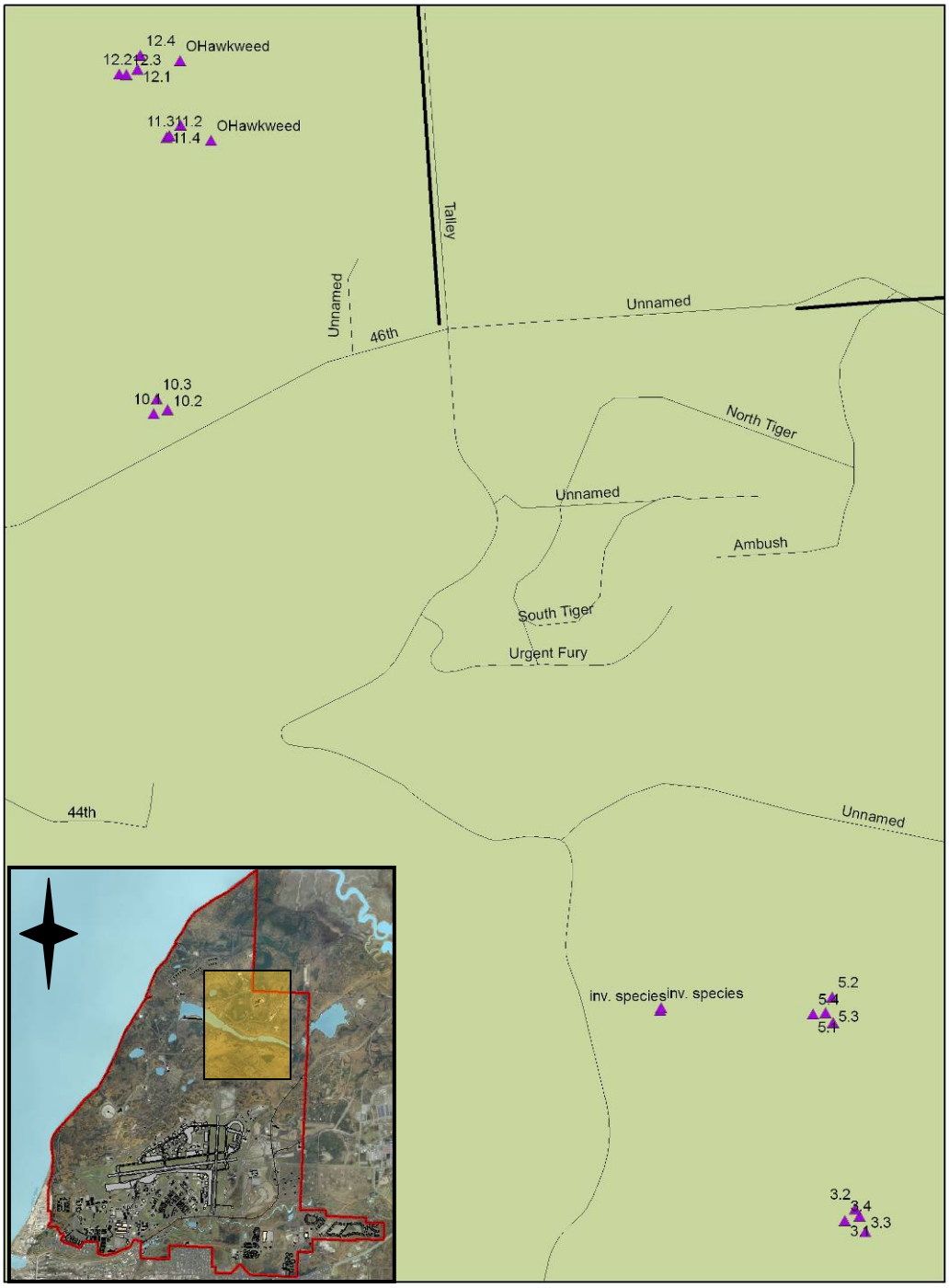

Figure 1. Map of LTVM plots sampled in 2008.

METHODS

Alaska Natural Heritage Program staff installed and measured 24 Long Term Vegetation Monitoring Plots (LTVMP) in 1999 (Tande et al. 2001). In 2008 Alaska Natural Heritage staff re-measured five of the original 24 plots in order to document changes in composition and structure in selected forest types.

From the original sample of 24 LTVM plots measured in 1999, five plots were selected for remeasurement in 2008. Three representative forest types were selected based on the original classification by Tande (1983). A random sample was selected from the pre-determined forest types. Of the five plots selected, three plots were from the Old-Growth Paper Birch-White Spruce Forest type (LTVMPs 5, 11 and 12), one was from the Closed Young Mixed Paper Birch-White Spruce Forest type (LTVMP 3), and one was from the Closed Black Spruce Forest type (LTVMP 10; the black spruce forest was selected randomly from a pool of the remaining vegetation types: black spruce, alder, and bluejoint grass).

Tande et al. (2001) established the original LTVMPs using methods described in Tande (2000). Each plot was a 0.4 ha circle with an initial plot (subplot 1) at plot center and three satellite subplots at 0, 120 and 240 degrees (see Figure 2). The subplots were 36.6 m from the initial plot center and had a radius of 7.32 m.

Each plot established in 1999 was marked with either a rebar or aluminum screw anchor. The screw anchors each had an aluminum tag etched with the plot number, date and project name. Originally, the screw anchors had flagging attached as a way to help in relocation. We found that in many cases the flagging was worn, faded or no longer attached. In one instance the screw anchor had been disturbed and was lying on its side under litter; in another instance the original screw anchor was not recovered, but the center was located by triangulation using witness trees in the plot.

Within each 7.32 m subplot measurements were made on trees ≥ 12.7 cm diameter at breast height (DBH; 1.37 m from top of root collar). Saplings (≥2.54 cm and <12.7 cm DBH) and seedlings (< 2.54 cm DBH) were tallied on a 2.07 m radius nested microplot centered on the 7.32 m subplot. For each tree and sapling the following measurements were made: DBH, height, crown diameter, crown condition, and damage. Understory composition and structure was also measured on the microplot. Sample datasheets are shown in Appendices B through F. In 2008, we re-measured trees from the 1999 sample and noted their present status and added new trees as necessary. Within the 36.6 m radius plot all dead trees were blazed and numbered.

Basal area was calculated on the subplots by tree species and forest type between 1999 and 2000 using the following formulas:
Tree Basal Area: $BA = \pi(DBH/2)^2$
Basal Area per hectare: $BA/ha = \sum$(Tree Basal Area) *Expansion factor for plot area (Husch et al. 2002)
Since each plot totals 1/15 ha (four 1/60 ha subplots), the expansion factor is 15.

Plots were located using directions and GPS coordinates from the original 1999 data sheets now housed at Elmendorf Air Force Base. GPS locations were updated and are included with this report (Appendix A).

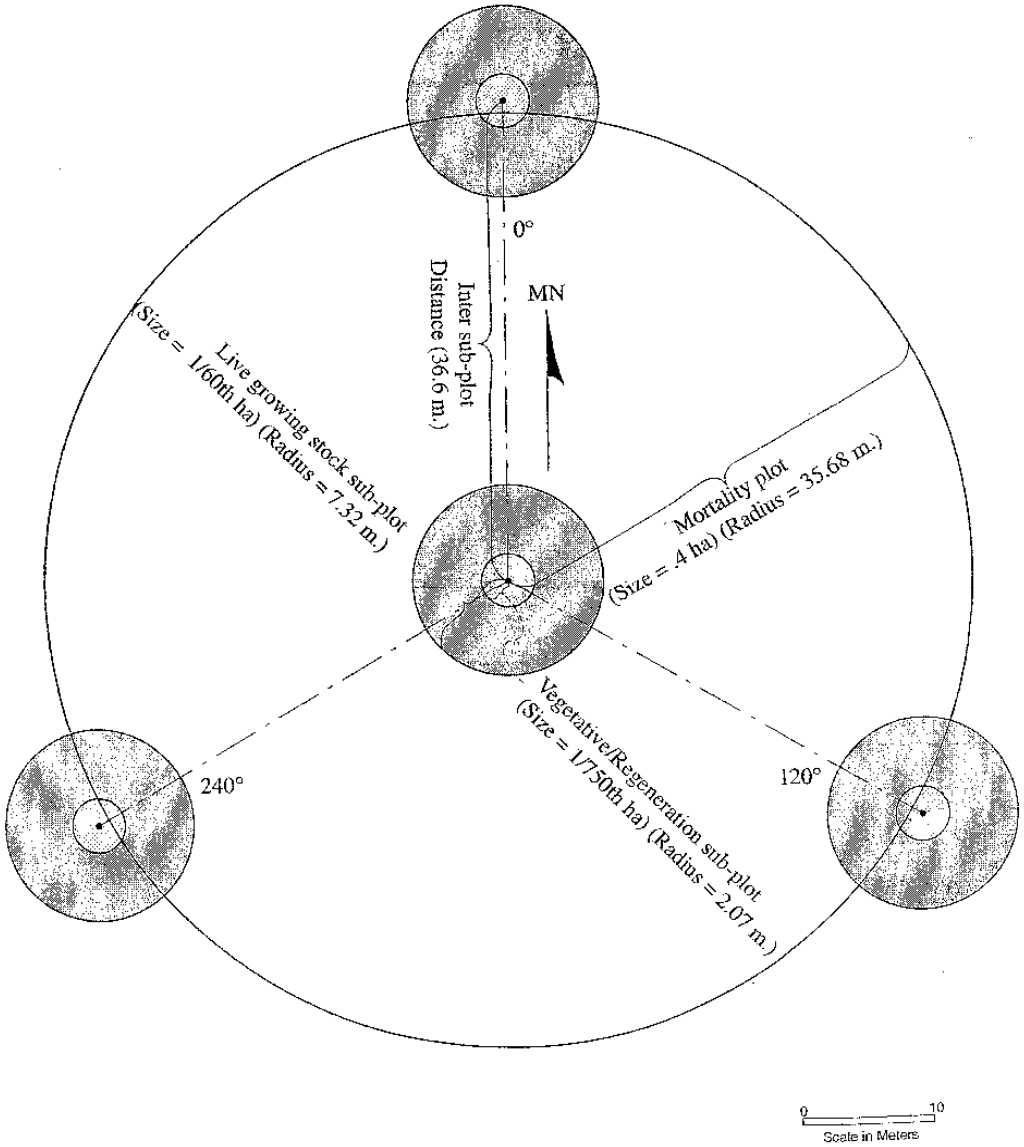

Figure 2. Diagram of each LTVMP showing location of initial plot, subplot azimuth and distance, vegetative/regeneration microplot plot within each subplot and the mortality plot.

Field work on the five plots was conducted in July 2008. A one-day of field training in plot methods as described in Tande (2000) took place prior to the start of field work, and a safety and regulations orientation took place in May 2008. The following individuals participated in the 2008 field season:

Susan Klein	Co-PI/Plant Ecologist, (participated in 1999 inventory)
Julia Lenz	Data Manager/field assistant (participated in 1999inventory)
Kellee Hampee	Field Technician
Tina Boucher	Plant Ecologist (conducted one-day field training)
Herman Griese	Wildlife Biologist with the 3rd Civil Engineer Squadron/Asset Management Flight at Elmendorf Air Force Base (orientation and plot location)
Ron Gunderson	Elmendorf AFB (plot location)

RESULTS

Detailed descriptions of the selected forest types can be found in Tande (1983), and baseline descriptions of individual plots can be found in Tande et al. (2001). Of the three forest vegetation types sampled (Closed Old-Growth Paper Birch-White Spruce Forest, Closed Young Mixed Paper Birch-White Spruce Forest, and Closed Black Spruce Forest), trends were detected that can be explained by disturbance (spruce bark beetle impact) and forest succession. In summary, in the three Old-Growth Paper Birch-White Spruce Forest plots most of the spruce bark beetle-killed trees that were standing in 1999 were on the ground in 2008, one of three plots showed an increase in shrub covererage, and two showed little change in shrub coverage between 1999 and 2008. The Closed Black Spruce Forest plot had an increase in spruce canopy coverage and a dramatic decrease in dwarf shrubs and herbaceous canopy coverage in the understory. The Closed Young Mixed Paper Birch-White Spruce Forest sampled had an increase in conifers and decrease in deciduous trees. Changes between 1999 and 2008 within each Long Term Vegetation Monitoring Plot are described in the following sections.

Basal area was calculated by forest type for each tree species (≥ 12.7 cm DBH) for each measurement year (Table 1). The largest change between years was detected in standing dead white spruce in the Old Growth Birch spruce forest type, which decreased from 26.11 m^2/ha in 1999 to 0.79 m^2/ha in 2008. In 1999 many of the beetle killed spruce were still standing, whereas in 2008, most of these trees had broken off and were on the ground.. Basal area for live trees showed little change between 1999 and 2008 across all forest types (Table 1).

Table 1.. Comparison of basal area (m^2/ha) in1999 and 2008 by forest type

	Old Growth Birch-Spruce		**Young Mixed Birch-Spruce**		**Black Spruce**	
:	**LTVMP 5, 11, 12**		**LTVMP 3**		**LTVMP 10**	
Tree Species	**1999** BA m^2/ha	**2008** BA m^2/ha	**1999** BA m^2/ha	**2008** BA m^2/ha	**1999** BA m^2/ha	**2008** BA m^2/ha
White Spruce	62.85	58.94	1.26	1.21	1.54	2.31
Dead White Spruce (standing)	26.11	0.79	.45	0.36	0.43	0
Paper Birch	5.17	4.99	17.87	19.90	0	0
Dead Birch (standing)	0	2.33	0	0	0	0
Balsam Poplar	0	0	5.89	6.04	0	0
Black Spruce	0	0	0	0	2.13	2.15
Dead Black Spruce (standing)	0	0	0	0	0.45	0

Closed Old-Growth Paper Birch-White Spruce Forest plots (LTVM plots 5, 11 and 12)

Three plots were measured in the Closed Old Growth Birch White Spruce forest type **(**LTVM plots 5, 11 and 12). This forest type is widespread on EAFB and is characterized by widely spaced paper birch and white spruce. A variety of shrubs dominate the understory; *Oplopanax horridus, Menziesia ferruinea, Sambucus racemosa, Alnus viridis* ssp. *sinuata,* or *Viburnum edule* may be present or locally abundant. The understory is also variable. *Calamagrosits canadensis*, ferns, and feathermosses are common. These mature stands have been impacted by a variety of forest pathogens. Most of the large diameter white spruce have been killed or injured by spruce bark beetles (*Dendroctonus rufipennis*), and most of the mature paper birch show signs of fungal decay.

In 1999, 22 dead spruce trees were recorded for the three old growth forest plots (Table 1). All of these trees died due to the spruce bark beetle. In 2008 none of the beetle-killed spruce were still standing. The single standing dead tree recorded in 2008 was a paper birch (Table 1).

Shrub cover increased in LTVMP 12, but showed little change in LTVMP 5 and 11. Herbaceous species cover declined across all three old growth birch-white spruce forest plots in 2008 compared to 1999.

Table 2. Tree mortality (standing dead) in Closed Old-Growth Paper Birch-White Spruce Forest plots 5, 11 and 12 in 1999 and 2008.

Year	Plot. Subplot	Tree #	Species	DBH (mm)	Height (m)	Comments	Basal Area (m^2/ha)
1999	5.1	1	WS	313	33		1.15
	5.1	2	WS	293	20		1.01
	5.1	3	WS	415	10	Top broken off, only lower trunk	2.03
	5.1	4	WS	255	22		0.77
	5.1	5	WS	276	17		0.90
	5.1	6	WS	459	33		2.48
	5.1	7	WS	390	22	Broken	1.79
	5.1	8	WS	362	18		1.54
	5.1	9	WS	269	17	Broken trunk	0.85
	5.1	10	WS	202	17		0.48
	5.1	11	WS	317	17		1.18
	5.1	12	WS	183	16		0.39
	5.3	1	WS	257	12	**still standing in 2008**	0.78
	5.4	1	WS	318	10		1.19
	11.1	1	WS	217	16		0.55
	11.1	1	WS	306	15		1.10
	11.1	2	WS	351	28	Beetle and Carpenter ants.	1.45
	11.1	3	WS	369	18		1.60
	11.1	4	WS	199	16		0.47
	11.1	5	WS	300	24		1.06
	11.3	1	WS	402	22		1.90
	12.1	1	WS	346	20	Carpenter ants.	1.41
						TOTAL BASAL AREA 1999	**26.08**
2008	5.1	1	PB	445	22.8	Disease or insects (aphids)?	2.33
	11.0					no mortality	
	12.0					no mortality	
						TOTAL BASAL AREA 2008	**2.33**

Many of the live trees recorded for LTVM plots 5, 11 and 12 remain on the plots, but with additional injury. Eight have lost portions of their crowns and others have burls and conks on them. Table 2 compares live tree statistics between 1999 and 2008. Live ratio on many trees is reduced as is crown diameter. Two trees (white spruce in subplot 11.1 and paper birch in subplot 11.3) have died since 1999. Burls and broken top are the most common comments for the remaining live trees in the old growth forest plots sampled. Broken top or dead top was recorded for eight trees in 2008, one of which was missing a top in 1999. In 2008, two additional white spruce trees were recorded in plot 11.1; these trees may have been overlooked in 1999.

Table 3. Comparison of live tree data for Closed Old-Growth Paper Birch-White Spruce Forest plots 5, 11 and 12, 1999-2008.

YEAR	PLOT.SUBPLOT	TREE #	SPECIES	DBH >0127 mm	HEIGHT dm	BEETLE TYPE	COMMENTS
2008	5.1	1	PB	320	167		lots of burls on lower trunk
1999	5.1	1	PB	332	220		burls
2008	5.1	2	WS	424	223	SPBL	
1999	5.1	2	WS	410	260	SPBL	
2008	5.2	1	PB	467	146		crown dead, conks lower trunk
1999	5.2	1	PB	518	160		trees 1 & 2 - Crown dead, conks on lower trunks
2008	5.2	2	PB	447	213		crown dead, conks lower trunk
1999	5.2	2	PB	515	170		trees 1 & 2 - Crown dead, conks on lower trunks
2008	5.2	3	PB	559	223		burls
1999	5.2	3	PB	580	180		burls
2008	5.3	1	WS	153	52		top 1/2 tree dead
1999	5.3	1	WS	141	060		porcupine browsed on trunk
2008	5.3	2	PB	414	177		top gone
1999	5.3	2	PB	391	180		loss of apex
2008	5.4	1	PB	447	153		top gone, burls
1999	5.4	1	PB	445	160		top is dead, burls
2008	5.4	2	PB	394	229		
1999	5.4	2	PB	384	210		
2008	5.4	3	PB	508	229		
1999	5.4	3	PB	504	190		apex lost, branches in two 2/3 of the way up; conk
2008	5.4	4	PB	462	198		fork 6 ft (1.8 m) up on trunk from roots
1999	5.4	4	PB	445	185		top is dead
2008	11.1	1	WS	231	88		some resin on lower trunk
1999	11.1	1	WS	135	065	SPBL	lost top of tree; live part is a sucker branch off the dead.
2008	11.1	2	PB	401	213		top gone - sucker growing at top of tree
1999	11.1	2	PB	395	175		
2008	11.1	3	-	-	-	-	dead and fallen - 3 meter stump
1999	11.1	3	WS	335	210	SPBL	
2008	11.1	4	WS	318	137	SPBL	top gone
1999	11.1	4	WS	315	150	SPBL	top gone
2008	11.1	5	WS	178	79	SPBL	top gone
1999	11.1	5	WS	145	080		
2008	11.1	6	WS	129	73		new tree to subplot
2008	11.1	7	WS	132	67		new tree to subplot
2008	11.2	1	PB	569	228		small conks on trunk
1999	11.2	1	PB	550	220		
2008	11.3	1	PB	495	213		lots of burls - lower trunk
1999	11.3	1	PB	540	220		burl
2008	11.3	2					tree is dead and fallen down, alder has grown into area
1999	11.3	2	PB	335	180		tree is leaning at 60 deg. on another birch.
2008	11.4	1	PB	575	228	-	
1999	11.4	1	PB	520	360		
2008	11.4	2	PB	429	183		burl
1999	11.4	2	PB	400	220		burl
2008	12.1	1	PB	635	174		trunk leans at 45º angle
1999	12.1	1	PB	665	180		
2008	12.2	1	PB	432	183		live tree is about 45' high, about 15' of top dead & apical broken off
1999	12.2	1	PB	445	130		
2008	12.2	2	PB	559	179		burls near bottom
1999	12.2	2	PB	615	125		burls all over.
2008	12.2	3	PB	391	189		split at bottom of trunk
1999	12.2	3	PB	480	120		
2008	12.2	4	PB	483	189		top broken off, burls on lower trunk
1999	12.2	4	PB	490	130		1. Main trunk broken off; 2. Burls.
2008	12.3	1	PB	577	167		upper half of trunk gone
1999	12.3	1	PB	580	180		broken trunk
2008	12.4	1	PB	554	177		conks, burls, leaves withering. Tree is dying
1999	12.4	1	PB	535	180		burls

Basal area for live trees was similar since many of the live trees recorded in 1999 were still standing in 2008. Basal area for spruce was 62.85 m^2/ha and 58.94 m^2/ha in 1999 and 2008, and basal area for paper birch was 5.17 m^2/ha and 4.99 m^2/ha in 1999 and 2008 (Table 1).

Shrubs and ferns both increased in the old growth plots, but herbaceous species decreased over 50% as seen in Figure 3 below. The overall decline in herbaceous species may be due to the increase in shrub cover.

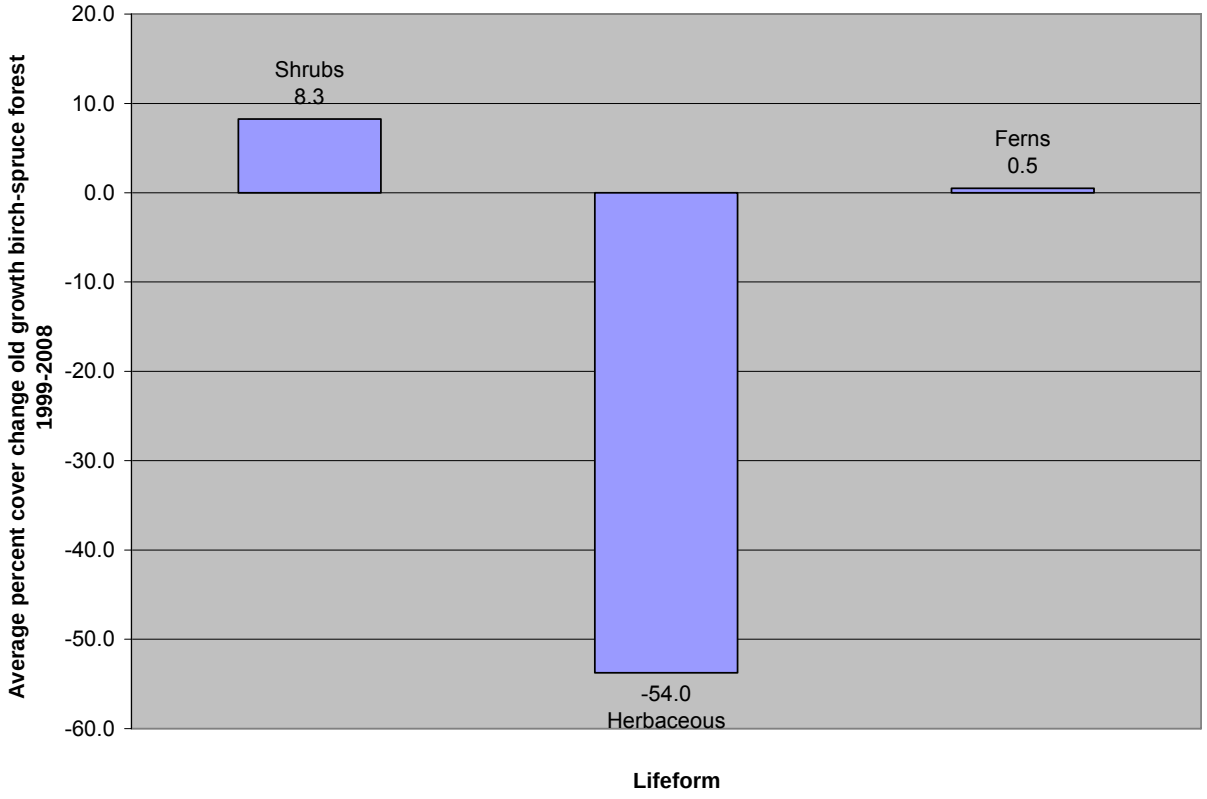

Figure 3. Comparison of vegetation percent cover in old growth birch-spruce forest plots, 1999-2008.

LTVMP 5

Subplot 5.4. 2008 on left, 1999 on right

Subplot comparison of Live Trees 1999-2008

The live trees recorded in 1999 were still standing in 2008. All but two of the paper birch had damage recorded for them. The damage included burls, conks, dead portions of the crown and broken tops (Table 2).

Subplot 1: Two trees were recorded in 1999 both of which are still standing in 2008. One tree has many burls on the lower trunk.

Subplot 2: Three trees were recorded in 1999 and the same three trees were re-recorded in 2008. Little change was recorded in 2008; two trees had dead crowns and conks, and one tree had burls. All remain the same.

Subplot 3. Two trees were recorded in 1999 one with apical loss and one with porcupine browse. The porcupine-browsed tree was recorded with the top half dead; the other tree lost the top.

Subplot 4. Four trees were recorded in 1999 and remain in the same condition in 2008.

Subplot comparison of Dead Trees 1999-2008

Fourteen (14) dead trees were recorded for LTVMP 5 in 1999 (12 in 5.1, and one each in 5.3 and 5.4). Of these only one remained standing in 2008 and one new dead tree was recorded in subplot 5.1 No new dead trees were recorded in the other subplots.

Microplot vegetation

Average percent cover of vegetation for this plot decreased in all life forms within the microplots (Figure 4), but individual species cover shows a different picture (Table 4).

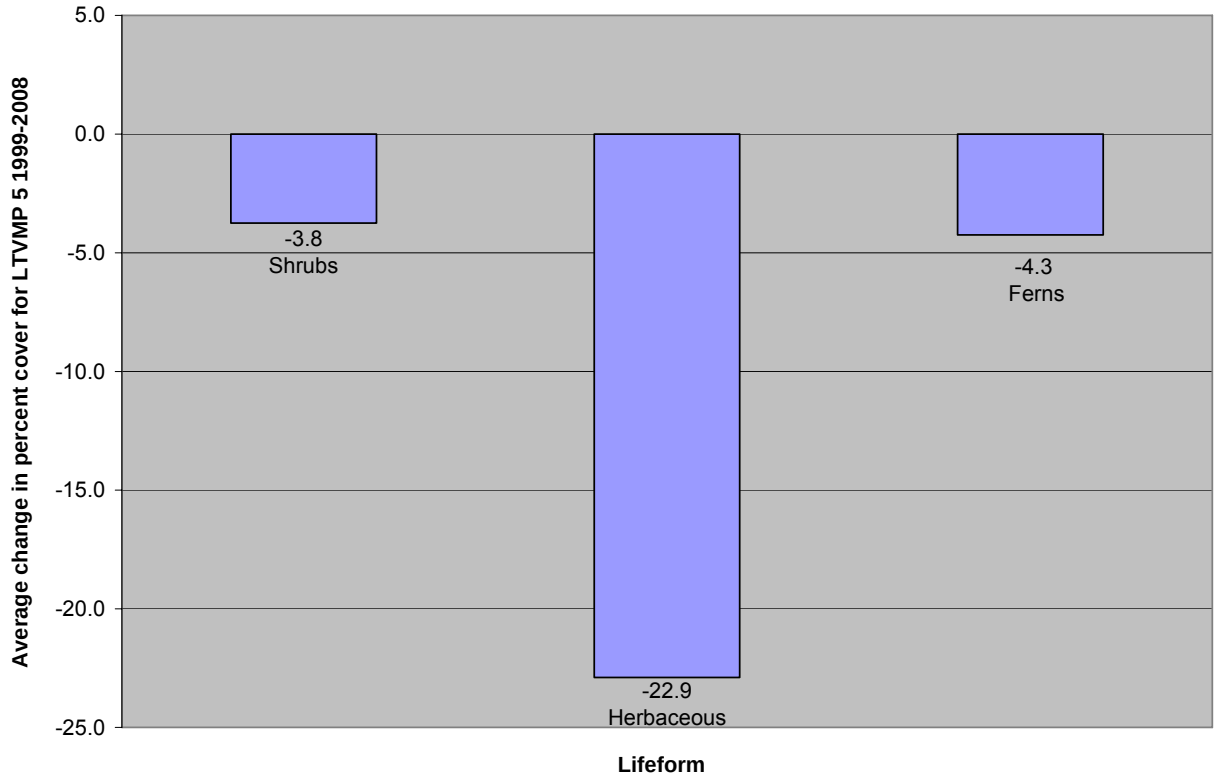

Figure 4. Lifeform percent cover change for LTVMP 5, 1999 to 2008. Note the decrease in cover for all life forms, especially herbaceous species, from 1999 to 2008.

Shrubs: Table 4 describes the change in shrub species composition in LTVMP 5 between 1999 and 2008. *Rosa acicularis* (prickly rose) decreased in all microplots except 5.2 where it increased two-fold. The decrease in the other three microplots was dramatic (20-30% to 2-5%). Overall change for *R. acicularis* cover was -12.5%. *Oplopanax horridus* (devil's club) cover changes were mixed across the microplots. *O. horridus* cover declined from 30 to 0% in microplot 5.2, but increased in microplots 5.1 and 5.3. The overall net change for *Oplopanax horridus* was +1.2%. When *R. acicularis* decreased, *Oplopanax horridus* increased, and visa versa. Tree mortality data changed between 1999 and 2008 with 14 trees dead in 1999 and one dead in 2008. In addition, only one of the dead trees recorded 1999 was still standing. Live data collected in 2008 does not indicate a great change in the stand.

Rubus idaeus (American red raspberry) was not recorded in LTVMP 5 in 1999, but was recorded with low cover in 2008 for an overall increase of 3.3%. In addition, *Viburnum edule* (high bush cranberry) increased 5.8% between 1999 and 2008. Overall shrub cover decreased mostly due to changes in *Rosa acicularis*.

Table 4 . Comparison of shrub species percent cover for LTVMP 5, 1999 to 2008.

		Subplots							
Year	Species	5.1	5.2	5.3	5.4	Total	Average	Change since 1999	Average change since 1999
2008	*Menziesia ferrungea*	80	0	0	0	80	20.0	+	0.0
1999	*Menziesia ferrungea*	80	0	0	0	80	20.0		
2008	*Oplopanax horridus*	30	0	60	0	90	22.5	-	1.3
1999	*Oplopanax horridus*	10	30	45	0	85	21.3		
2008	*Ribes triste*	0	1	0	0	1	0.3	-	0.3
1999	*Ribes triste*	0	0	0	0	0	0.0		
2008	*Rosa acicularis*	3	30	2	5	40	10.0		-12.5
1999	*Rosa acicularis*	30	15	25	20	90	22.5	+	
2008	*Rubus idaeus*	10	0	2	1	13	3.3		3.3
1999	*Rubus idaeus*	0	0	0	0	0	0.0		
2008	*Vaccinium vitis-idaea*	0	0	0	3	3	0.8	-	-1.8
1999	*Vaccinium vitis-idaea*	0	0	0	10	10	2.5		
2008	*Viburnum edule*	10	30	8	80	128	32.0	+	5.8
1999	*Viburnum edule*	30	25	20	30	105	26.3		
				Total change 1999 to 2008				**-**	**-3.8**

Herbaceous species: *Calamagrostis canadensis* (bluejoint grass) and *Cornus canadensis* (bunchberry or dwarf dogwood) increased in two microplots and decreased in two between 1999 and 2008 (Table 5). When one increased, so did the other. In microplots 5.2 and 5.4, bluejoint increased from 10 to 25 % and from 30 to 45%, and bunchberry increased 60 to 80% and 55 to 60%. In microplots 5.1 and 5.3, bluejoint decreased 10 to 5% and 40 to 25%, and bunchberry decreased 70 to 55% and 60 to 25%. In addition, *Equisetum sylvaticum* decreased dramatically in microplots 5.3 and 5.4 from 20 to 0% and 53 to 5% respectively, for an overall decrease of 12%. Total change in herbaceous species for LTVMP 5 between 1999 and 2008 was -22.9%.

Table 5. Comparison of herbaceous species percent cover for LTVMP 5, 1999 to 2008.

Year	Species	5.1	5.2	5.3	5.4	Total	Average	Change since 1999	Average change since 1999
2008	*Calamagrostis canadensis*	5	25	20	45	95	23.8	+	1.3
1999	*Calamagrostis canadensis*	10	10	40	30	90	22.5		
2008	*Chamerion angustifolium*	t	0	t	1	1	0.3	-	-0.5
1999	*Chamerion angustifolium*	0	0	3	0	3	0.8		
2008	*Cornus canadensis*	55	80	25	60	220	55.0	-	-6.3
1999	*Cornus canadensis*	70	60	60	55	245	61.3		
2008	*Equisetum arvense*	t	0	30	1	31	7.8	+	6.5
1999	*Equisetum arvense*	5	0	0	0	5	1.3		
2008	*Equisetum sylvaticum*	0	5	0	0	5	1.3	-	-12.0
1999	*Equisetum sylvaticum*	0	3	30	20	53	13.3		
2008	*Galium triflorum*	0	0	5	0	5	1.3	+	0.8
1999	*Galium triflorum*	0	0	2	0	2	0.5		
2008	*Gymnocarpum dryopteris*	20	0	10	55	85	21.3	+	2.5
1999	*Gymnocarpum dryopteris*	25	0	15	35	75	18.8		
2008	*Linnea borealis*	0	0	0	0	0	0.0	-	-2.5
1999	*Linnea borealis*	0	0	0	10	10	2.5		
2008	*Lycopodium annotinum*	6	0	0	0	6	1.5	-	-6.0
1999	*Lycopodium annotinum*	20	10	0	0	30	7.5		
2008	*Osmorhiza depauperata*	0	0	5	0	5	1.3	+	1.3
1999	*Osmorhiza depauperata*	0	0	0	0	0	0.0		
2008	*Trientalis europea*	t	3	0	0	3	0.8	-	-8.0
1999	*Trientalis europea*	0	5	20	10	35	8.8		
				Total change 1999 to 2008				**-**	**-22.9**

Ferns: Fern species composition remained relatively stable between 1999 and 2008 (Table 7). In 1999, *Dryopteris expansa* was recorded in one plot. This was true in 2008, but with a decrease in percent cover from 35% to 8% for an overall decrease of 6.8%. *Gymnocarpium dryopteris* was recorded in three of the four microplots in both years. *G. dryopteris* cover decreased in two microplots, but increased in one for an overall increase of 2.5%. Overall fern cover change was -4.3%.

Table 7. Comparison of fern species percent cover for LTVMP 5, 1999 to 2008.

		Subplots							
Year	**Species**	**5.1**	**5.2**	**5.3**	**5.4**	**Total**	**Average**	**Change since 1999**	**Average change since 1999**
2008	*Dryopteris expansa*	8	0	0	0	8.0	2.0	+	-6.8
1999	*Dryopteris expansa*	35	0	0	0	35.0	8.8		
2008	*Gymnocarpium dryopteris*	20	0	10	55	85.0	21.3	-	2.5
1999	*Gymnocarpium dryopteris*	25	0	15	35	75.0	18.8		
				Total change 1999 to 2008				**-**	**-4.3**

LTVMP 11

Subplot 11.1. 2008 on left, 1999 on right.

Subplot comparison of Live Trees 1999-2008

Subplot 1: Five trees were recorded in 11.1 in 1999 and six trees were recorded in 2008 (Table 8). One tree from 1999 was recorded as dead and two additional trees were recorded (trees 6 and 7 in 11.1). Both new trees were white spruce and each had a live ratio of 90, DBH of 129 mm and 132 mm and heights of 7.3 and 6.7 m respectively. Since no saplings were recorded in the subplot in 1999 it is possible they were missed in the 1999 survey. Of the remaining four trees from 1999 two have lost their tops since 1999. The other two trees from 1999 were recorded as having lost tops in 1999.

Subplot 2: One paper birch was recorded in subplot 11.2 in 1999. The same tree remains standing in 2008.

Subplot 3. Two paper birch trees were recorded in subplot 11.3 in 1999. In 2008 only one of those trees remains. The remaining tree damage severity increased from 1 in 1999 to 10 2008.

Subplot 4. Two paper birch trees were recorded in subplot 11.4 in 1999 and both trees remain in 2008 with little change since 1999.

Table 8. Comparison of live tree data for LTVMP 11 1999-2008.

YEAR	PLOT.SUBPLOT	TREE #	SPECIES	DBH >0127 mm	DOMINANCE	HEIGHT (m)	LIVE RATIO	CROWN DIAM	CROWN FORM	DENSITY	DAMAGE	SEVERITY	BEETLE TYPE	COMMENTS
2008	11.1	1	WS	231	3	9	90	12	1	50				some resin on lower trunk
1999	11.1	1	WS	135	4	7	95	20	1	55	22	10	SPBL	lost top of tree; live part is a sucker branch off the dead.
2008	11.1	2	PB	401	1	21	50	17	6	55	21	1		top gone - sucker growing at top of tree
1999	11.1	2	PB	395	2	18	55	30	4	55				
2008	11.1	3	-	-	-	-	-	-	-	-	-	-	-	dead and fallen - 3 meter stump
1999	11.1	3	WS	335	1	21	70	20	1	65	4	15	SPBL	
2008	11.1	4	WS	318	2	14	60	8	1	45	21	1	SPBL	top gone
1999	11.1	4	WS	315	2	15	65	50	4	65	21	1	SPBL	top gone
2008	11.1	5	WS	178	4	8	75			45	21	1	SPBL	top gone
1999	11.1	5	WS	145	4	8	70	30	1	25	22	2		
2008	11.1	6	WS	129	3	7	90	12	1	50				new tree to subplot
2008	11.1	7	WS	132	3	7	90	10	1	45				new tree to subplot
2008	11.2	1	PB	569	2	23	80	18	6	60	2	0		small conks on trunk
1999	11.2	1	PB	550	2	22	80	100	4	35	22	1		
2008	11.3	1	PB	495	1	21	75	17	6	70	1	20		lots of burls - lower trunk
1999	11.3	1	PB	540	2	22	75	40	4	55	21	1		burl
2008	11.3	2												tree is dead and fallen down, alder has grown into area
1999	11.3	2	PB	335	2	18	30	25	4	45	21	1		tree is leaning at 60 deg. on another birch.
2008	11.4	1	PB	575	1	23	183	27	6	50	22	5	-	
1999	11.4	1	PB	520	1	36	75	60	4	45	22	5		
2008	11.4	2	PB	429	2	18	80	16	5	40	21	1		burl
1999	11.4	2	PB	400	2	22	80	50	4	35	21	1		burl

Microplot vegetation

There was a decrease in percent cover for shrub and herbaceous species and a slight increase in fern species cover between 1999 and 2008 in LTVMP 11 (Figure 5).

Shrubs: Two subspecies of *Alnus viridis* were recorded in LTVMP 11 in 1999 (*Alnus viridis* spp. *crispa* and *A. viridis* spp. *sinuata*). In 2008 both were recorded as the same species, and for this summary the two have been combined in *A. viridis* spp. *crispa*. The percent cover of *A. viridis* spp. *crispa* increased from 0 to 55% in microplot 11.1, but decreased from 25 to 0% in microplot 11.3 and from 10 to 0% in microplot 4, for an overall average change of 5.0% (Table 9).

Ribes triste had the greatest increase in cover of all shrub species increasing an average of 12.3%. All microplots saw an increase. Other shrubs with an increase in average cover were *Oplopanax horridus* with 7.5% increase and *Viburnum edule* with a 7.0 % increase.

Rubus idaeus and *Rosa acicularis* both decreased in cover between 1999 and 2008. *R. acicularis* remained the same in one microplot and decreased in the other three for an overall decrease of 8.5%. *R. idaeus* had the greatest decrease of all shrubs in LTVMP 11. Cover of *R. idaeus* decreased in all microplots for a total average decrease of 17.5 %. Other shrubs with a decrease in average cover between 1999 and 2008 were *Ledum decumbens* recorded in microplot 11.1 in 1999, but not present in any microplots in 2008 and Sorbus scopulina present in one plot both years, but declining in cover from 10 to 1%, for an average change of -2.3%.

Overall shrub change was not great (-0.75%), but the species composition within the shrub layer changed from low shrubs such as *R. acicularis* and *Rubus idaeus* to tall shrubs such as *Oplopanax horridus* between 1999 and 2008.

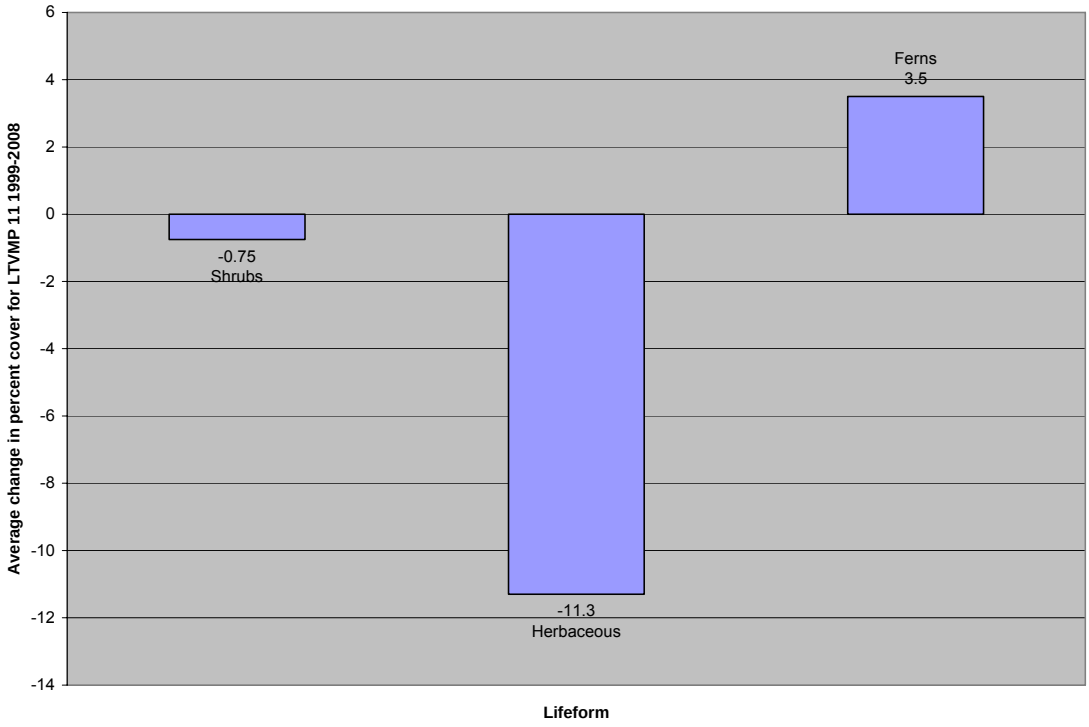

Figure 5. Lifeform percent cover change for LTVMP 11, 1999-2008.

Table 9. Comparison of shrub species percent cover for, LTVMP 11, 1999 to 2008.

		Subplot							
Year	Species	11.1	11.2	11.3	11.4	Total	Average	Change since 1999	Average change since 1999
2008	*Alnus viridis* ssp. *crispa*	55	0	0	0	55	13.8	+	5.0
1999	*Alnus viridis* ssp. *crispa*	0	0	25	10	35	8.8		
2008	*Ledum decumbens*	0	0	0	0	0	0.0	-	-3.8
1999	*Ledum decumbens*	15	0	0	0	15	3.8		
2008	*Oplopanax horridus*	35	0	0	10	45	11.3	+	7.5
1999	*Oplopanax horridus*	0	15	0	0	15	3.8		
2008	*Ribes triste*	8	20	6	30	64	16.0	+	12.3
1999	*Ribes triste*	5	0	5	5	15	3.8		
2008	*Rosa acicularis*	10	6	20	15	51	12.8	-	-8.5
1999	*Rosa acicularis*	25	20	25	15	85	21.3		
2008	*Rubus idaeus*	10	0	5	0	15	3.8	-	-17.5
1999	*Rubus idaeus*	15	30	20	20	85	21.3		
2008	*Sambucus racemosa*	0	0	0	0	0	0.0	-	-0.5
1999	*Sambucus racemosa*	0	0	2	0	2	0.5		
2008	*Sorbus scopulina*	0	0	1	0	1	0.3	-	-2.3
1999	*Sorbus scopulina*	0	0	10	0	10	2.5		
2008	*Viburnum edule*	20	30	8	20	78	19.5	+	7.0
1999	*Viburnum edule*	15	15	10	10	50	12.5		
				Total change 1999 to 2008				-	**-0.8**

Herbaceous species: *Cornus canadensis* and *Equisetum arvense* increased in LTVMP 11 between 1999 and 2008. *C. canadensis* increased in two of the four microplots as seen in Table 10 below, for an overall increase of 2.5% between 1999 and 2008. *E. arvense* increased in all but microplot 11.2 for an average increase of 15.0% over the nine-year time period. All other herbaceous species decreased between 1999 and 2008 for an average decrease for herbaceous species of -11.3% (Table 10).

Table 10. Comparison of herbaceous species percent cover for LTVMP 11, 1999 to 2008.

		Subplot							
Year	Species	11.1	11.2	11.3	11.4	Total	Average	Change since 1999	Average change since 1999
2008	*Calamagrostis canadensis*	30	65	30	40	165	41.3	-	-10.0
1999	*Calamagrostis canadensis*	30	60	80	35	205	51.3		
2008	*Chamerion angustifolium*	0	0	0	0	0	0.0	-	-2.0
1999	*Chamerion angustifolium*	3	5	0	0	8	2.0		
2008	*Cornus canadensis*	0	50	15	20	85	21.3	+	2.5
1999	*Cornus canadensis*	15	10	10	40	75	18.8		
2008	*Equisetum arvense*	30	20	45	15	110	27.5	+	15.0
1999	*Equisetum arvense*	5	25	20	0	50	12.5		
2008	*Equisetum silvaticum*	0	0	0	0	0	0.0	-	-6.3
1999	*Equisetum silvaticum*	0	0	0	25	25	6.3		
2008	*Galium triflorum*	0	5	0	t	5	1.3	-	-0.8
1999	*Galium triflorum*	5	3	0	0	8	2.0		
2008	*Linnea borealis*	0	0	0	0	0	0.0	-	-3.3
1999	*Linnea borealis*	10	0	3	0	13	3.3		
2008	*Trientalis europaea*	0	0	0	0	0	0.0	-	-1.3
1999	*Trientalis europaea*	0	1	1	3	5	1.3		
2008	*Lycopodium annotinum*	0	0	0	0	0	0.0	-	-3.8
1999	*Lycopodium annotinum*	15	0	0	0	15	3.8		
2008	*Moehringia lateriflora*	0	0	0	0	0	0.0	-	-1.3
1999	*Moehringia lateriflora*	0	0	0	5	5	1.3		
				Total change 1999 to 2008				**-**	**-11.3**

Ferns: As seen in Table 11, fern species composition changed between 1999 and 2008. *Dryopteris expansa* was present in two microplots in 1999 and in none in 2008 for an overall decrease of -4.0%. *Gymnocarpium dryopteris* was present in two microplots in 1999 and in three in 2008, for an overall increase of 7.5%.

Table 11. Comparison of fern species percent cover for LTVMP 11, 1999 to 2008.

		Subplot							
Year	Species	11.1	11.2	11.3	11.4	Total	Average	Change since 1999	Average change since 1999
2008	*Dryopeteris expansa*	0	0	0	0	0	0.0	+	-4.0
1999	*Dryopeteris expansa*	0	15	1	0	16	4.0		
2008	*Gymnocarpium dryopteris*	30	15	0	15	60	15.0	-	7.5
1999	*Gymnocarpium dryopteris*	0	15	0	15	30	7.5		
				Total change 1999 to 2008				**-**	**3.5**

LTVMP 12

Subplot 12.1. 2008 on left, 1999 on right – but may not be same location

Subplot comparison of Live Trees 1999-2008
Subplot 1: One tree was recorded in 1999 and this tree is still standing in 2008 (Table 12). The difference in tree height (17.4 m in 2008 and 18.0 m in 1999) can be attributed to measurement error. Crown diameter and crown density are both reduced in 2008 from 1999. In addition the tree is now at a 45° angle and this was not noted in 1999 which may contribute to the change in height.

Subplot 2: Four trees were recorded in 1999 and the same four trees were re-recorded in 2008. All four have additional or similar injuries since 1999 and crown diameter is reduced.

Subplot 3. One tree was recorded in 1999 with a broken trunk. The same tree was recorded in 2008 with the upper half of the trunk gone.

Subplot 4. One tree was recorded in 1999 with burls. In 2008 conks were recorded as well as burls and leaves withering. Additional comments note the tree is dying.

Table 12. Comparison of live tree data for LTVMP 12, 1999-2008.

YEAR	PLOT.SUBPLOT	TREE #	SPECIES	DBH >0127mm	DOMINANCE	HEIGHT (dm)	LIVE RATIO	DEAD RATIO	CROWN DIAM	CROWN FORM	DENSITY	BEETLE TYPE	COMMENTS
2008	12.1	1	PB	635	2	174	85		30	6	85		trunk leans at 45º angle
1999	12.1	1	PB	665	2	180	85		35	4	55		
2008	12.2	1	PB	432	2	183	25		18	5	50		live tree is about 45' high, about 15' of top dead & apical broken off
1999	12.2	1	PB	445	2	130	40	10	25	4	45		
2008	12.2	2	PB	559	2	179	80		36	6	70		burls near bottom
1999	12.2	2	PB	615	2	125	80		45	4	55		burls all over.
2008	12.2	3	PB	391	2	189	60		15	5	80		split at bottom of trunk
1999	12.2	3	PB	480	2	120	75		20	4	45		
2008	12.2	4	PB	483	2	189	65		22	5	80		top broken off, burls on lower trunk
1999	12.2	4	PB	490	2	130	50	35	35	4	45		1. Main trunk broken off; 2. Burls.
2008	12.3	1	PB	577	3	167	30		34	5	45		upper half of trunk gone
1999	12.3	1	PB	580	2	180	40	5	25	3	45		broken trunk
2008	12.4	1	PB	554	1	177	75		17	5	50		conks, burls, leaves withering. Tree is dying
1999	12.4	1	PB	535	2	180	80	10	50	5	55		burls

Microplot vegetation

Data for the four microplots shows an increase in shrub cover of 12.8% and a slight increase in fern cover. Herbaceous species decreased 19.8% between 1999 and 2008 (Figure 6).

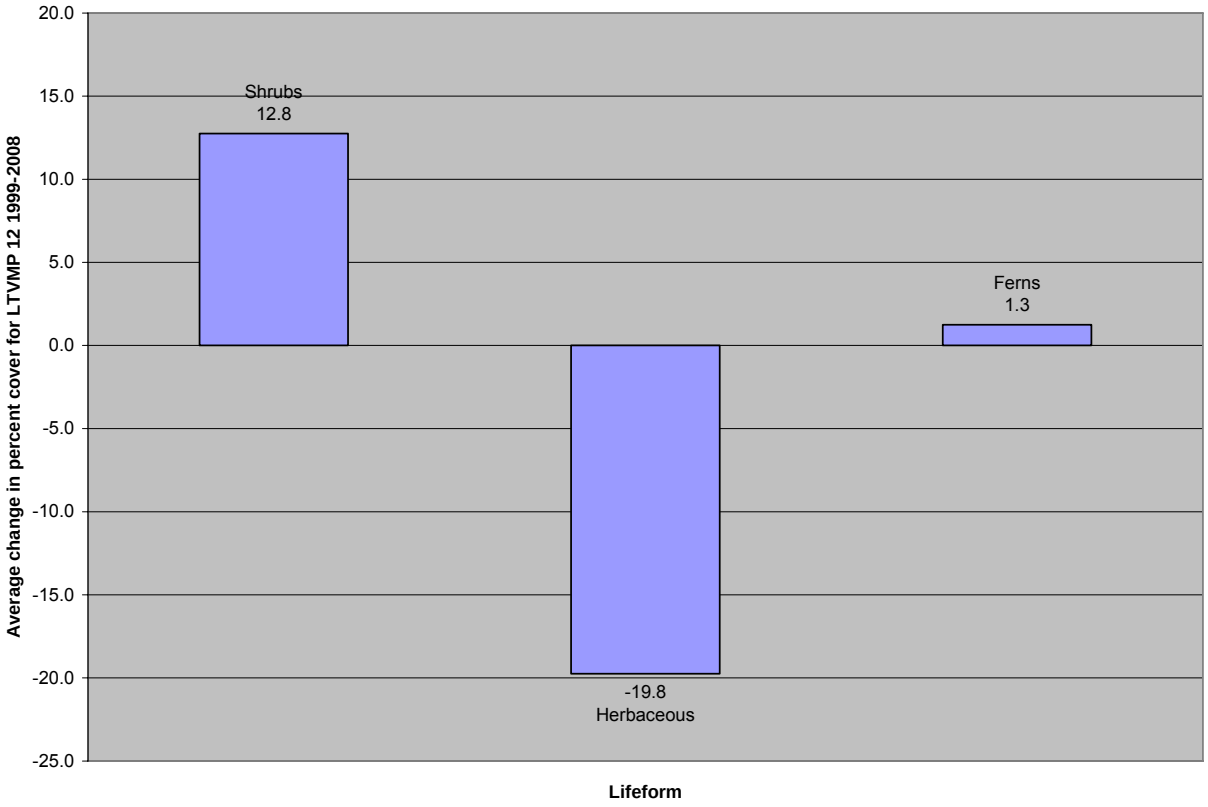

Figure 6. Lifeform percent cover change for LTVMP 12, 1999 to 2008. Note the decrease in herbaceous cover and increase in shrub cover from 1999 to 2008.

Shrubs: Shrub species composition changed across most microplots in LTVMP 12 (Table 13). The increase in *Oplopanax horridus* across all microplots was responsible for most of the change from an herbaceous to a shrubbier plot. Where *Oplopanax horridus* average cover increased 25.8%, *Ribes triste*, *Rubus idaeus* and *Viburnum edule* all decreased. The change from low to tall shrub from herbaceous is evident across all the old growth forest plots re-sampled in 2008.

Table 13. Comparison of shrub species percent cover for LTVMP 12, 1999 to 2008.

		Subplot							
Year	Species	12.1	12.2	12.3	12.4	Total	Average	Change since 1999	Average change since 1999
2008	*Alnus viridis* ssp. *crispa*	0	0	0	100	100	25.0	+	1.8
1999	*Alnus viridis* ssp. *crispa*	0	0	3	90	93	23.3		
2008	*Alnus viridis* ssp.*sinuata*	0	0	0	0	0	0.0	-	-0.8
1999	*Alnus viridis* ssp.*sinuata*	3	0	0	0	3	0.8		
2008	*Oplopanax horridus*	60	45	80	25	210	52.5	+	25.8
1999	*Oplopanax horridus*	30	30	45	2	107	26.8		
2008	*Ribes triste*	0	0	15	0	15	3.8	-	-6.3
1999	*Ribes triste*	5	10	15	10	40	10.0		
2008	*Rosa acicularis*	5	6	0	0	11	2.8	-	-8.5
1999	*Rosa acicularis*	30	15	0	0	45	11.3		
2008	*Rubus idaeus*	0	8	10	0	18	4.5	+	0.3
1999	*Rubus idaeus*	0	2	15	0	17	4.3		
2008	*Sambucus racemosa*	0	0	20	30	50	12.5	-	3.5
1999	*Sambucus racemosa*	0	1	20	15	36	9.0		
2008	*Viburnum edule*	20	8	0	0	28	7.0	-	-3.0
1999	*Viburnum edule*	15	25	0	0	40	10.0		
				Total change 1999 to 2008				**+**	**12.8**

Herbaceous species: *Cornus canadensis* and *Equisetum sylvaticum* both decreased in LTVMP 12 as seen in Table 14 below for a total decrease of 25.1% for the two species. *Equisetum arvense* increased an average of 7.0%. The overall change in herbaceous species was a negative 19.8% cover.

Table 14. Comparison of herbaceous species percent cover for LTVMP 12, 1999 to 2008.

		Subplot							
Year	Species	12.1	12.2	12.3	12.4	Total	Average	Change since 1999	Average change since 1999
2008	*Calamagrostis canadensis*	40	40	55	0	135	33.8	+	1.3
1999	*Calamagrostis canadensis*	30	55	45	0	130	32.5		
2008	*Chamerion angustifolium*	5	0	2	0	7	1.8	+	0.5
1999	*Chamerion angustifolium*	5	0	0	0	5	1.3		
2008	*Cornus canadensis*	20	1	0	0	21	5.3	-	-12.3
1999	*Cornus canadensis*	70	0	0	0	70	17.5		
2008	*Equisetum arvense*	2	25	20	1	48	12.0	+	7.0
1999	*Equisetum arvense*	20	0	0	0	20	5.0		
2008	*Equisetum silvaticum*	0	0	0	0	0	0.0	-	-12.8
1999	*Equisetum silvaticum*	1	20	25	5	51	12.8		
2008	*Galium triflorum*	0	0	0	0	0	0.0	-	-0.8
1999	*Galium triflorum*	3	0	0	0	3	0.8		
2008	*Lycopodium annotinum*	0	0	0	0	0	0.0	-	-1.3
1999	*Lycopodium annotinum*	0	5	0	0	5	1.3		
2008	*Trientalis europaea*	t	t	0	25	25	6.3	-	-1.5
1999	*Trientalis europaea*	25	3	0	3	31	7.8		
				Total change 1999 to 2008				**-**	**-19.8**

Ferns: Fern cover composition changed from *Dryopteris expansa* to *Gymnocarpium dryopteris* between 1999 and 2008, although not in all microplots. See Table 15 below.

Table 15. Comparison of fern species cover for LTVMP 12, 1999 to 2008.

		Subplot							
Year	**Species**	**12.1**	**12.2**	**12.3**	**12.4**	**Total**	**Average**	**Change since 1999**	**Average change since 1999**
2008	*Dryopeteris expansa*	0	15	1	15	31	7.8	-	-0.3
1999	*Dryopeteris expansa*	2	10	10	10	32	8.0		
2008	*Gymnocarpium dryopteris*	40	10	1	10	61	15.3	-	1.5
1999	*Gymnocarpium dryopteris*	20	15	15	5	55	13.8		
				Total change 1999 to 2008				-	**1.3**

Closed Black Spruce Forest

The black spruce forest type is characterized as being moist to wet with a groundcover of mosses, especially *Sphagnum* species and feathermosses such as *Hylocomium splendens*. Dwarf shrubs are common in the understory. Herbaceous species are usually sparse, but in some instances *Equisetum sylvaticum* may be the dominant understory vegetation, but most herbaceous species are not dominant (Tande et al. 2001).

LTVMP 10

One plot (LTVMP 10) was sampled in the Closed Black Spruce Forest Type. This plot is described as having an open black spruce overstory with a black spruce sapling layer below the main canopy, possibly due to layering. The dwarf and low shrub layer is dominated by *Ledum decumbens*, *Rosa acicularis*, *Spiraea stevenii*, and *Empetrum nigrum*. Common species in the herbaceous layer include *Equisetum sylvaticum*, *Cornus canadensis*, and *Calamagrostis canadensis*. The moss layer is abundant and the dominant species are *Sphagnum* spp. and feather mosses.

Subplot 10.4. Not paired. Left is 2008, right is 1999

Subplot comparison of Live Trees 1999-2008

Little has changed in the density of trees in the black spruce forest, although one additional white spruce was recorded in one subplot (Table 16). No dead trees were located on any subplot. However, in the microplots, canopy cover of black spruce saplings increased by 19.5%.

Subplot 1: Four trees were recorded in both 1999 and 2008. In 2008 one tree was recorded as leaning at a 45° angle with the top growing into neighboring trees.

Subplot 2: Nine trees were recorded in 1999 and one new tree not present in 1999 was recorded in 2008 for a total of ten trees. The new tree does not seem to be the sapling recorded in 1999 since azimuth is different. It is possible the tree was overlooked in 1999.

Subplot 3. One tree was recorded in 1999 and was recorded as resinous in 2008.

Subplot 4. Four trees were recorded in 1999 and remain in the same condition in 2008.

Table 16. Comparison of live tree data for LTVMP 10, 1999-2008.

Year	plot.subplot	TREE #	SPECIES	DBH >0127mm	DOMINANCE	HEIGHT (dm)	LIVE RATIO	DEAD RATIO	CROWN DIAM	DENSITY	BEETLE TYPE	COMMENTS
2008	10.1	1	BS	145	2	107	75		3.5	85		SEE NOTES FROM LAST SURVEY 1999
1999	10.1	1	BS	133	1	120	60	30	30	85	SPBL	2. Catface - possible fire scar.
2008	10.1	2	BS	132	2	91	60		1.5	85		
1999	10.1	2	BS	139	1	120	60	30	10	85	SPBL	Burl formation lower trunk.
2008	10.1	3	BS	157	2	91	55		4	85		
1999	10.1	3	BS	138	2	115	80	20	20	85	SPBL	Crooked base.
2008	10.1	4	BS	125	2	73	50		2.5	90		Trunk at 25 deg. angle lean - top growing into neighbor trees
1999	10.1	4	BS	128	2	85	50	40	20	75		Small burl formation.
2008	10.2	1	WS	152		107	60	10	4.5	60		
1999	10.2	1	WS	143	2	80	70	10	15	65		Trunk splits 2/3 way up.
2008	10.2	2	WS	135		35	60	10	4.5	85		
1999	10.2	2	WS	128	2	70	60	10	15	85		Mistletoe broom 2/3 way up -dead branches
2008	10.2	3	BS	145		91	40	30	3.5	90		
1999	10.2	3	BS	131	2	75	40	30	10	85		
2008	10.2	4	WS	163		91	60	15	5.5	85		
1999	10.2	4	WS	152	2	90	65	10	20	75		
2008	10.2	5	WS	152		107	90		4	90		
1999	10.2	5	WS	139	2	95	95	-	25	95		
2008	10.2	6	BS	157	1	137	50	50	2	90		
1999	10.2	6	BS	147	1	105	40	55	20	95		
2008	10.2	7	WS	183		101	80	15	4.5	85		
1999	10.2	7	WS	142	2	80	80	20	20	65		
2008	10.2	8	WS	224	1	152	70	25	4	70		
1999	10.2	8	WS	177	1	105	60	20	15	65		
2008	10.2	9	BS	178		98	80	20	5	80		
1999	10.2	9	BS	141	2	85	95	05	15	95		Unknown if beetle.
2008	10.2	10	WS	145		85	70	20	4	70		Tree added this survey; not in 1999 survey
2008	10.3	1	BS	142	1	107	80	20	3	90		Resinous, see 1999 notes
1999	10.3	1	BS	131	2	95	80	20	15	85	SPBL	
2008	10.4	1	BS	80	1	35	80	20	3	90		
1999	10.4	1	BS	180	1	100	95	05	15	85		Mistletoe & burl

Microplot vegetation

Tree cover for all microplots increased an average of 25.3% between 1999 and 2008. All other life forms decreased in cover, in particular dwarf shrubs (-42.3%) and herbaceous species (-35.8%) (Figure 7). Sampling was conducted the same week in July in 1999 and 2008, thus the change in understory composition is unlikely attributable to changes in phenology.

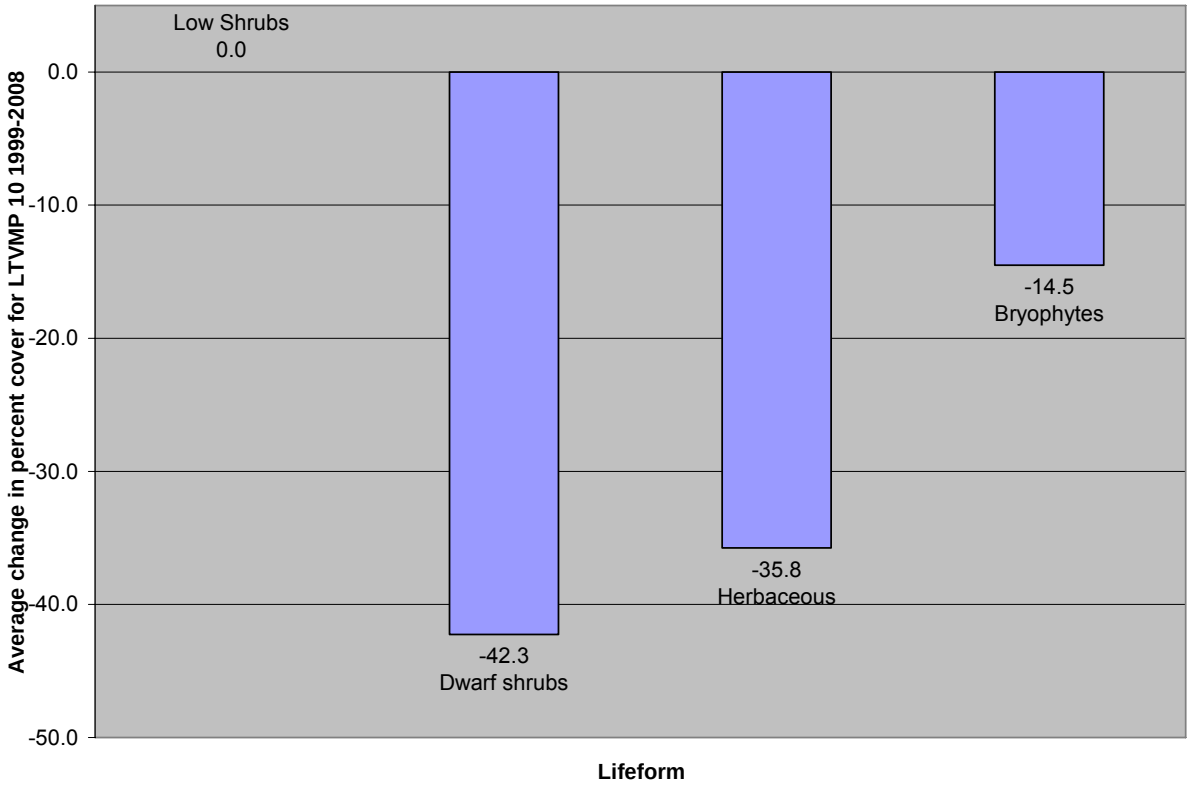

Figure 7. Lifeform percent cover change for LTVMP 10 between 1999 and 2008. Note the decrease in dwarf shrub, herbaceous and bryophyte cover from 1999 to 2008.

Shrubs: Dwarf and low shrubs were examined separately since dwarf shrubs are integral to the black spruce forest.

Dwarf shrub cover decreased dramatically for an overall loss of 42.3% between 1999 and 2008 Table 17). All species recorded in 1999 showed a decrease over the nine years. The decrease in dwarf shrubs may be a result of increased shading from the tree canopy, however it is unclear what may have lead to the increase in overstory coverage. Tande et al. (2001) reported an understory tree layer in the 1999 measurement, and late summer ice lenses were reported in the soil description from 1999. An increase in soil temperature could explain the changes documented in 2008, particularly an increase in tree canopy coverage, however, since we did not monitor soil temperature, we do not have information to support this speculation.

Table 17. Comparison of dwarf shrub species percent cover for LTVMP 10, 1999 to 2008.

		Subplot							
Year	Species	10.1	10.2	10.3	10.4	Total	Average	Change since 1999	Average change since 1999
2008	*Empetrum nigrum*	10	7	5	5	27	6.8	-	-9.5
1999	*Empetrum nigrum*	10	15	25	15	65	16.3		
2008	*Ledum decumbens*	5	5	3	10	23	5.8	-	-12.8
1999	*Ledum decumbens*	15	9	30	20	74	18.5		
2008	*Vaccinium vitis-idaea*	0	0	0	0	0	0.0	-	-20.0
1999	*Vaccinium vitis-idaea*	15	10	30	25	80	20.0		
				Total change 1999 to 2008				**-**	**-42.3**

Low shrub cover remained the same, although species composition changed from *Spiraea stevenii* and *Rosa acicularis* to *Viburnum edule*. The net change for low shrubs was 0% (Table 18).

Table 18. Comparison of low shrub species cover for LTVMP 10, 1999 to 2008.

		Subplot							
Year	Species	10.1	10.2	10.3	10.4	Total	Average	Change since 1999	Average change since 1999
2008	*Rosa acicularis*	0	5	0	0	5	1.3	-	-1.5
1999	*Rosa acicularis*	0	10	0	1	11	2.8		
2008	*Salix bebbiana*	0	0	0	0	0	0.0	-	-0.5
1999	*Salix bebbiana*	0	1	1	0	2	0.5		
2008	*Salix* species	5	0	0	0	5	1.3	+	0.8
1999	*Salix* species	2	0	0	0	2	0.5		
2008	*Spiraea stevenii*	1	5	5	10	21	5.3	-	-3.5
1999	*Spiraea stevenii*	0	15	10	10	35	8.8		
2008	*Vaccinium uliginosum*	0	0	0	0	0	0.0	-	-2.3
1999	*Vaccinium uliginosum*	5	1	3	0	9	2.3		
2008	*Viburnum edule*	10	0	10	8	28	7.0	+	7.0
1999	*Viburnum edule*	0	0	0	0	0	0.0		
				Total change 1999 to 2008					**0.0**

Herbaceous species: Table 19 documents a decrease in forb and graminoid cover of -35.8% between 1999 and 2008 with most of the decrease due to a decrease in *Equisetum sylvaticum* (20% negative change). Other species that declined were *Calamagrostis canadensis* and *Rubus chamaemorus*. Slight increases were recorded for low-growing herbaceous species such as *Geocaulon lividum*, *Lycopodium annotinum* and *Linnaea borealis* with little net effect on overall herbaceous cover. These changes may be a related to the increase in tree canopy coverage.

Table 19. Comparison of herbaceous species cover for LTVMP 10, 1999 to 2008.

		Subplots							
Year	Species	10.1	10.2	10.3	10.4	Total	Average	Change since 1999	Average change since 1999
2008	*Calamagrostis canadensis*	2	5	5	0	12	3.0	-	-5.8
1999	*Calamagrostis canadensis*	5	20	5	5	35	8.8		
2008	*Chamerion angustifolium*	0	2	0	0	2	0.5	-	-1.0
1999	*Chamerion angustifolium*	1	5	0	0	6	1.5		
2008	*Cornus canadensis*	20	70	5	15	110	27.5	-	-2.5
1999	*Cornus canadensis*	30	75	0	15	120	30.0		
2008	*Equisetum silvaticum*	40	3	10	12	65	16.3	-	-20.0
1999	*Equisetum silvaticum*	40	40	30	35	145	36.3		
2008	*Geocaulon lividum*	0	1	15	10	26	6.5	+	1.5
1999	*Geocaulon lividum*	2	3	10	5	20	5.0		
2008	*Linnaea borealis*	0	2	0	0	2	0.5	+	0.5
1999	*Linnaea borealis*	0	0	0	0	0	0.0		
2008	*Lycopodium annotinum*	0	1	0	0	1	0.3	+	0.3
1999	*Lycopodium annotinum*	0	0	0	0	0	0.0		
2008	*Rubus chamaemorus*	1	0	0	1	2	0.5	-	-8.8
1999	*Rubus chamaemorus*	15	2	10	10	37	9.3		
				Total change 1999 to 2008				**-**	**-35.8**

Ferns: No ferns were recorded in LTVMP 10.

Bryophytes: Mosses and lichens are an integral part of the black spruce forest. Changes were recorded for all species most of which decreased between 1999 and 2008 (Table 20). *Hylocomium splendens* is the only species that increased over this time period. Overall average cover for bryophytes decreased -14.7.

Table 20. Comparison of bryophytes cover for LTVMP 10, 1999 to 2008.

		Subplot							
Year	Species	10.1	10.2	10.3	10.4	Total	Average	Change since 1999	Average change since 1999
2008	*Dicranum* species	0	0	0	0	0	0.0	-	-1.3
2008	*Dicranum* species	0	0	0	5	5	1.3		
2008	*Hylocomium splendens*	0	0	30	0	30	7.5	-	2.5
1999	*Hylocomium splendens*	0	0	15	5	20	5.0		
2008	*Lobaria linita*	0	0	0	0	0	0.0	-	-2.5
1999	*Lobaria linita*	0	0	10	0	10	2.5		
2008	*Nephroma articum*	0	0	0	0	0	0.0	-	-0.3
1999	*Nephroma articum*	0	0	1	0	1	0.3		
2008	*Peltigera aphthosa*	10	0	10	5	25	6.3	+	0.8
1999	*Peltigera aphthosa*	10	2	0	10	22	5.5		
2008	*Peltigera membranacea*	0	0	0	0	0	0.0	-	-1.3
1999	*Peltigera membranacea*	0	0	0	5	5	1.3		
2008	*Pleurozium schreberi*	30	30	10	0	70	17.5	-	-6.3
1999	*Pleurozium schreberi*	15	30	20	30	95	23.8		
2008	*Polytrichum juniperinum*	0	0	0	0	0	0.0	-	-1.3
1999	*Polytrichum juniperinum*	0	0	5	0	5	1.3		
2008	*Sphagnum girgensohnii*	40	40	30	50	160	40.0	-	-2.5
1999	*Sphagnum girgensohnii*	75	40	25	30	170	42.5		
2008	*Tomentypnum nitens*	10	5	0	0	15	3.8	-	-2.5
1999	*Tomentypnum nitens*	10	10	5	0	25	6.3		
				Total change 1999 to 2008				**-**	**-14.7**

Closed Mixed Paper Birch - White Spruce Forest

The closed mixed paper birch-white spruce forest is characterized by closed paper birch stands with young white spruce growing in a canopy layer under the birch. Balsam poplar may also be present. The understory is open and consists of low shrubs such as *Rosa acicularis*, *Rubus idaeus* and *Viburnum edule*. *Cornus canadensis* is the dominant understory species although *Calamagrostis canadensis* may also dominate or co-dominate. Other herbaceous species are present but with low percent cover (Tande et al. 2001).

LTVMP 3
One plot was re-sampled in the Closed Young Birch-White Spruce forest type. The plot was LTVMP 3. This plot is typical for the forest type with a young, closed-canopied overstory of paper birch with a young white spruce canopy layer below the birch. The shrub layer is dominated by *Viburnum edule* with occasional *Rosa acicularis*. The herbaceous layer is well-developed and dominated by *Gymnocarpium dryopteris*, *Cornus canadensis*, and *Pyrola asarifolia* (Tande et al. 2001).

Subplot 3.4. 2008 on left, 1999 on right – slightly different angle.

Subplot comparison of Live Trees 1999-2008
There was little overall change in tree and sapling density between 1999 and 2008, though an increase in white spruce canopy cover was detected in the microplots.

Subplot 1 (Initial plot): All trees in the subplot were paper birch and all were co-dominant with heights ranging from 13.4 m to 19.8 m. Two additional paper birch trees were recorded since the 1999 inventory; these trees may have been overlooked in 1999 (Table 21).

Subplot 2: Two paper birch trees recorded in 1999 were dead in 2008. No new trees were recorded in this subplot. Damage recorded for trees in 1999 remained the same in 2008 (Table 21).

Table 21. Comparison of live tree data LTVMP 3 subplots 1 and 2, 1999-2008

YEAR OF SURVEY	Plot.subplot	TREE #	DIST. TO TREE (m)	AZIM TO TREE	SPECIES	DBH >0127 mm	DOMINANCE	HEIGHT (dm)	LIVE RATIO	DEAD RATIO	CROWN DIAM	CROWN FORM	DENSITY	COMMENTS
2008	3.1	1	53	42	PB	166	2	168	25		28	5	40	
1999	3.1	1	52	42	PB	162	2	164	30		40	5	55	
2008	3.1	2	55	42	PB	147	2	168	25		26	5	50	
1999	3.1	2	55	42	PB	147	2	160	30		20	5	45	
2008	3.1	3	71	103	PB	137	2	162	30		18	5	50	
1999	3.1	3	66	103	PB	165	2	170	45		20	4	55	
2008	3.1	4	69	103	PB	160	2	183	45		24	5	75	
1999	3.1	4	71	95	PB	135	2	150	35		25	4	45	
2008	3.1	5	61	150	PB	152	2	158	30		24	5	80	
1999	3.1	5	61	150	PB	148	2	140	35		20	5	35	
2008	3.1	6	55	157	PB	211	2	183	35		24	5	60	
1999	3.1	6	55	157	PB	201	2	155	35		40	4	75	
2008	3.1	7	22	173	PB	195	2	198	50		24	4	90	
1999	3.1	7	22	171	PB	189	1	180	45		30	4	65	
2008	3.1	8	19	174	PB	224	2	183	40		28	5	75	
1999	3.1	8	21	183	PB	198	1	170	45		50	4	75	
2008	3.1	9	50	174	PB	191	2	195	30		16	5	60	
1999	3.1	9	50	180	PB	180	2	160	25		40	6	55	
2008	3.1	10	58	180	PB	147	2	159	40		22	4	45	
1999	3.1	10	58	190	PB	144	2	140	55		60	6	45	
2008	3.1	11	43	295	PB	135	2	134	25		20	5	85	
1999	3.1	11	43	295	PB	138	2	168	35		25	5	45	
2008	3.1	12	52	301	PB	157	2	189	25		14	6	90	
1999	3.1	12	52	301	PB	146	1	173	30		25	6	55	
2008	3.1	13	29	311	PB	175	2	183	35		28	4	65	
1999	3.1	13	30	311	PB	169	2	163	45		50	4	45	
2008	3.1	14	55	342	PB	206	2	183	30		18	5	65	
1999	3.1	14	55	342	PB	190	1	178	35		30	5	65	
2008	3.1	15	65	310	PB	175	2	198	25		30	5	45	new in 2008
2008	3.1	16	62	311	PB	185	2	198	25		30	5	50	new in 2008
2008	3.2	1	38	12	PB	142		152	30		14	5	75	
1999	3.2	1	38	12	PB	135	2	150	30		30	5	45	
2008	3.2	2	58	40	PB	155		167	30		12	5	50	
1999	3.2	2	58	43	PB	146	2	175	35		40	5	45	
2008	3.2	3	28	65	PB	152		183	25		10	6	65	
1999	3.2	3	28	65	PB	148	1	195	30		30	5	55	
2008	3.2	4	20	79	WS	142		79	60		10	1	50	
1999	3.2	4	20	79	WS	140	4	100	75	25	25	1	75	
2008	3.2	5	53	81	PB	236		183	40		18	5	75	
1999	3.2	5	54	81	PB	230	2	160	45		50	6	75	
2008	3.2	6												dead on ground
1999	3.2	6	38	94	PB	152	3	135	10	50	10	1	05	Loss of apex.
2008	3.2	7	64	118	PB	202		174	30		14	5	55	
1999	3.2	7	61	118	PB	197	2	160	40		50	5	55	Broken branches.
2008	3.2	8	49	133	PB	155		212	45		12	5	35	
1999	3.2	8	49	133	PB	144	1	190	10		25	5	55	
2008	3.2	9	50	133	PB	135		191	30		20	6	50	Apical split 7m from top
1999	3.2	9	59	133	PB	130	1	185	30		20	5	45	Apical split 7 meters from top.
2008	3.2	10	70	133	PB	178		198	30		16	6	70	Apical split 9m from top
1999	3.2	10	70	133	PB	173	1	200	40		50	6	85	Apical split 9 meters from top.
2008	3.2	11				201								
2008	3.2	12	67	203	PB	201		168	35		24	5	55	
1999	3.2	12	67	203	PB	189	1	190	40		60	6	45	
2008	3.2	13	64	210	PB	135		171	25		24	5	50	Split trunk-dbh meas. above split
1999	3.2	13	35	210	PB	147	2	170	25	05	25	5	55	Split trunk.
2008	3.2	14	62	233	PB	149		183	25		14	5	75	
1999	3.2	14	62	233	PB	150	2	180	30		30	5	75	
2008	3.2	15	32	247	PB	157		168	35		12	6	85	
1999	3.2	15	33	247	PB	149	2	150	50		40	4	85	
2008	3.2	16						177						out of plot
2008	3.2	17												out of plot
2008	3.2	18	53	280	PB	170		177	25		10	5	70	
1999	3.2	18	53	273	PB	156	2	150	35		30	5	35	
2008	3.2	19				212		191						out of plot
1999	3.2	19												
2008	3.2	20	34	305	PB	178		191	35		16	5	60	
1999	3.2	20	33	305	PB	202	1	185	40		60	5	55	
2008	3.2	21	63	332	PB	249		198	30		16	5	75	
1999	3.2	21	63	332	PB	160	1	155	40		50	5	65	
2008	3.2	22	63	340	PB	249		198	25		20	6	85	Apical split 1/2 way up tree
1999	3.2	22	563	340	PB	229	1	160	30		60	6	45	Apical split half way up tree.

Table 22. Comparison of live tree data LTVMP 3 subplots 3 and 4, 1999-2008

YEAR OF SURVEY	Plot.subplot	TREE #	DIST. TO TREE (m)	AZIM TO TREE	SPECIES	DBH >0127 mm	DOMINANCE	HEIGHT (dm)	LIVE RATIO	DEAD RATIO	CROWN DIAM	CROWN FORM	DENSITY	COMMENTS
2008	3.3	1												out of plot
2008	3.3	2	70	55	BP	287		198	30		8	5	80	
1999	3.3	2	70	55	BP	263	2	185	30		60	4	85	
2008	3.3	3	39	88	PB	149		158	30		8	5	80	
1999	3.3	3	39	88	PB	152	2	150	35		25	4	55	
2008	3.3	4	100	93	PB	216		158	30		16	5	80	
1999	3.3	4	40	93	PB	207	2	155	45		20	4	55	
2008	3.3	5	48	128	BP	173		229	30		12	6	85	
1999	3.3	5	48	128	BP	163	2	145	45		30	4	35	Open wound on trunk.
2008	3.3	6	37	128	BP	216		229	25		12	6	85	
1999	3.3	6	37	128	BP	208	2	165	45		30	4	75	
2008	3.3	7	29	131	BP	203		189	30		14	5	80	
1999	3.3	7	36	131	BP	163	2	155	45		20	4	45	
2008	3.3	8	30	150	BP	226		189	30		18	5	80	
1999	3.3	8	29	150	BP	197	2	165	40		20	4	55	
2008	3.3	9												dead fall
1999	3.3	9	31	155	BP	201	2	165	40		25	4	55	
2008	3.3	10	66	163	BP	191		186	25		12	5	85	
1999	3.3	10	66	163	BP	177	2	150	45		20	4	45	
2008	3.3	11	68	163	BP	145		167	30		16	5	80	
1999	3.3	11	68	163	BP	143	2	150	45		15	6	25	
2008	3.3	12	10	245	BP	291		219	35		16	5	85	
1999	3.3	12	10	245	BP	268	2	185	45		50	6	75	
2008	3.3	13				157								dead
1999	3.3	13	15	245	BP	164	2	150	35		20	5	55	
2008	3.3	14	50	255	PB	157		167	30		14	6	70	
1999	3.3	14	50	255	PB	155	2	150	30		30	4	25	
2008	3.3	15	49	255	PB	178		182	25		30	6	80	
1999	3.3	15	49	255	PB	177	2	150	30		25	4	25	
2008	3.3	16	17	259	BP	231		198	25		16	5	85	Bark damaged and peeling 7 ft from bottom
1999	3.3	16	46	259	BP	236	2	185	40		25	4	85	
2008	3.3	17	57	269	PB	203		228	45		14	5	85	
1999	3.3	17	57	269	PB	198	2	155	65		35	4	65	
2008	3.3	18	32	338	PB	180		198	30		16	5	70	
1999	3.3	18	61	338	PB	178	2	160	45		40	4	45	
2008	3.3	19	56	55	BP	257		198	30		14	5		
1999	3.3	19	55	339	BP	222	2	190	50		30	4	65	
2008	3.3	20												dead fall, log rotting
1999	3.3	20	18	5	ALD	130	4	100	20	70	5	3	-	Lower half alive, top dead
2008	3.3	21	70	5	PB	145		167	30		10	5	75	
1999	3.3	21	70	5	PB	143	2	150	45		40	5	55	
2008	3.4	1	68	20	PB	198		174	50		18	6	65	
1999	3.4	1	68	20	PB	176	2	163	55		80	3	65	
2008	3.4	2	31	117	WS	180		113	65		12	1	50	
1999	3.4	2	31	117	WS	185	2	120	75		60	1	75	
2008	3.4	3	50	123	PB	142		232	30		28	4	60	
1999	3.4	3	50	123	PB	133	2	200	35	25	40	4	55	
2008	3.4	4	50	125	PB	183		142	30		16	4	60	
1999	3.4	4	50	125	PB	171	3	220	30		40	5	75	
2008	3.4	5	50	129	WS	168		183	25		18	1	50	
1999	3.4	5	50	129	WS	165	2	160	30	70	30	1	45	
2008	3.4	6	66	125	WS	147		137	50		12	1	70	
1999	3.4	6	66	135	WS	161	2	160	70	30	80	1	75	
2008	3.4	7	43	242	PB	299		232	50		28	6	65	
1999	3.4	7	42	242	PB	291	2	200	70		50	4	75	
2008	3.4	8	71	245	PB	226		232	50		26	6	60	
1999	3.4	8	71	245	PB	230	2	190	45	05	40	3	45	
2008	3.4	9	33	264	PB	216		174	50		20	5	65	
1999	3.4	9	33	264	PB	215	2	180	55		50	3	75	
2008	3.4	10	63	285	PB	234		183	30		20	6	60	
1999	3.4	10	63	285	PB	221	2	175	40		60	6	55	
2008	3.4	11	66	285	PB	165		183	30		18	5	60	
1999	3.4	11	66	285	PB	161	2	180	30		50	3	55	
2008	3.4	12	70	297	PB	201		168	50		18	5	70	
1999	3.4	12	70	297	PB	218	2	180	55		50	4	55	
2008	3.4	13	47	343	PB	226		198	35		20	5	55	
1999	3.4	13	47	343	PB	208	2	200	45		50	4	55	

Subplot 3: Two cottonwood trees and one alder recorded in 1999 were recorded as dead in 2008. One tree still standing has bark damage and peeling. No new trees were recorded in 2008 (Table 22).

Subplot 4. No changes were recorded between 1999 and 2008 (Table 22).

Microplot vegetation

Canopy cover of white spruce trees and saplings in the microplots increased 20% and 13.5% respectively between 1999 and 2008, while canopy cover for birch trees decreased 5%. The overall increase in tree and sapling cover was 26.5%. Total cover for shrubs, herbs, and ferns decreased across all microplots. Herbaceous species cover decreased -21.8%, while shrub and fern cover decreased -7.0 % and -5.0%, respectively (Figure 8).

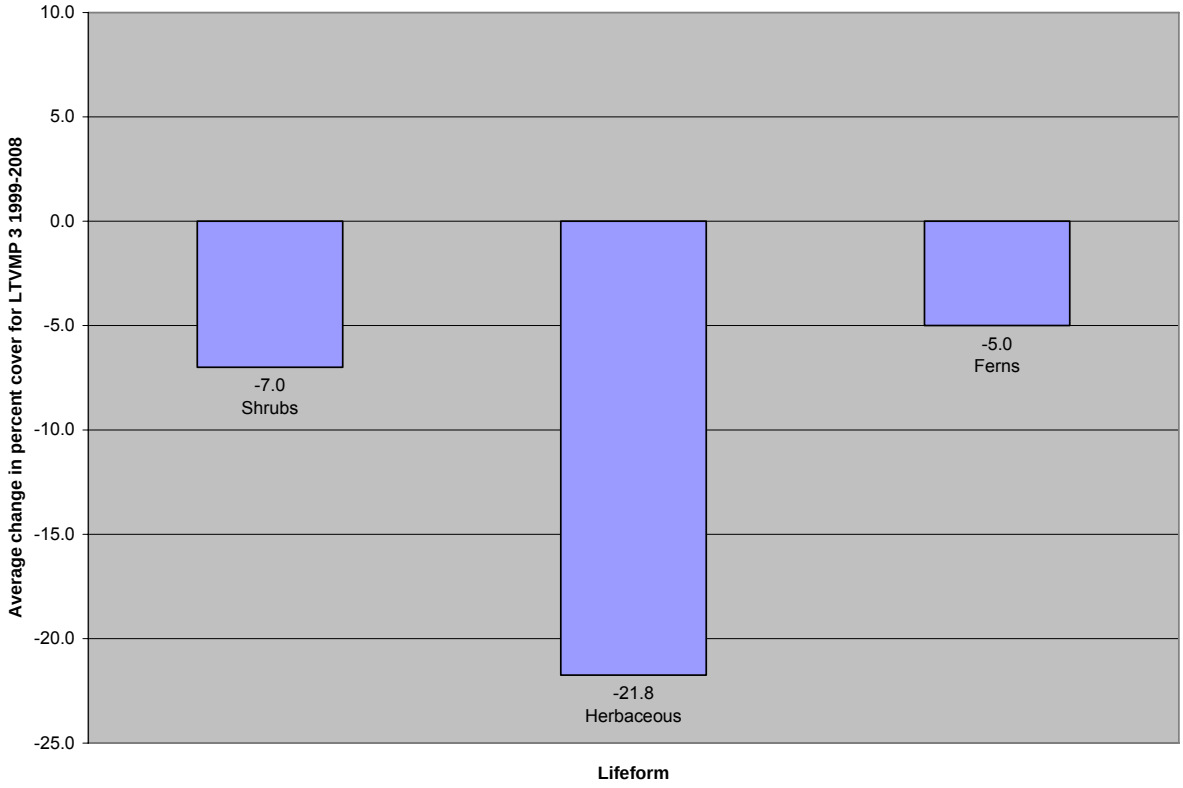

Figure 8. Lifeform percent cover change for LTVMP 3 between 1999 and 2008.

Shrubs: There was slight change in species composition in the shrub layer between 1999 and 2008 (Table 23). *Vaccinium vitis-idaea*, *Rosa acicularis* and *Sorbus scopulina* all saw a decrease in average cover between 1999 and 2008 in LTVMP 3. Most of the change was in microplot 3.4 for *R. acicularis* and *S. scopulina.* Cover for *Viburnum edule* increased slightly in three of the four microplots for an overall change from 20% to 25%. Overall cover change for shrubs was -7.0% between 1999 and 2008.

Table 23. Comparison of shrub species percent cover LTVMP 3, 1999 to 2008.

		Subplots							
Year	Species	3.1	3.2	3.3	3.4	Total	Average	Change since 1999	Average change since 1999
2008	*Rosa acicularis*	20	3	2	2	27	6.8	-	-3.8
1999	*Rosa acicularis*	10	2	10	20	42	10.5		
2008	*Rubus pedatus*	0	10	0	0	10	2.5	+	1.3
1999	*Rubus pedatus*	0	5	0	0	5	1.3		
2008	*Salix bebbiana*	0	0	1	0	1	0.3	-	-1.0
1999	*Salix bebbiana*	0	0	5	0	5	1.3		
2008	*Sorbus scopulina*	1	0	0	0	1	0.3	-	-3.5
1999	*Sorbus scopulina*	5	0	0	10	15	3.8		
2008	*Vaccinium vitis-idaea*	3	0	0	t	3	0.8	-	-5.0
1999	*Vaccinium vitis-idaea*	10	5	5	3	23	5.8		
2008	*Viburnum edule*	35	20	20	25	100	25.0	+	5.0
1999	*Viburnum edule*	30	15	20	15	80	20.0		
					Total change 1999 to 2008			**-**	**-7.0**

Herbaceous species: Herbaceous species in this birch forest consisted of mainly low growing forbs, most of which decreased between 1999 and 2008 (Table 24). Percent cover of *Trientalis europaea* decreased slightly or stayed the same; *Pyrola asarifolia* also decreased in two plots (10 to 3% and 15 to 3%) which resulted in an overall average change of -5.0%. *Linnaea borealis* was also recorded with a decrease in overall cover from 5.8 to 1.0 % across all four microplots for an average change of -4.8%. *Cornus canadensis* also decreased in two of the microplots, but was prevalent in and remained the same in the other two microplots. Although, bunchberry decreased overall, it was still the most prevalent herbaceous species in both 1999 and 2008. Only *Calamagrostis canadensis* increased in this layer, but with a less than 1% average change over the four microplots.

Table 24. Comparison of herbaceous species percent cover LTVMP 3, 1999 to 2008.

		Subplots							
Year	Species	3.1	3.2	3.3	3.4	Total	Average	Change since 1999	Average change since 1999
2008	*Calamagrostis canadensis*	1	3	15	7	26	6.5	+	0.8
1999	*Calamagrostis canadensis*	3	5	10	5	23	5.8		
2008	*Chamerion angustifolium*	1	0	0	0	1	0.3	-	-0.5
1999	*Chamerion angustifolium*	0	0	0	3	3	0.8		
2008	*Cornus canadensis*	55	10	5	20	90	22.5	-	-3.8
1999	*Cornus canadensis*	55	20	10	20	105	26.3		
2008	*Equisetum arvense*	t	2	t	t	2	0.5	-	-1.5
1999	*Equisetum arvense*	3	0	3	2	8	2.0		
2008	*Equisetum pratense*	0	1	0	0	1	0.3	-	-0.3
1999	*Equisetum silvaticum*	0	2	0	0	2	0.5		
2008	*Galium triflorum*	0	0	0	0	0	0.0	-	-2.5
1999	*Galium triflorum*	5	5	0	0	10	2.5		
2008	*Geocaulon lividum*	0	0	0	0	0	0.0	-	-1.3
1999	*Geocaulon lividum*	5	0	0	0	5	1.3		
2008	*Linnaea borealis*	1	1	0	2	4	1.0	-	-4.8
1999	*Linnaea borealis*	10	3	5	5	23	5.8		
2008	*Moehringia lateriflora*	2	3	0	0	5	1.3	-	0.5
1999	*Moehringia lateriflora*	3	0	0	0	3	0.8		
2008	*Orthilia secunda*	0	0	0	0	0	0.0	-	-0.8
1999	*Orthilia secunda*	0	0	3	0	3	0.8		
2008	*Pyrola asarifolia*	t	3	2	5	10	2.5	-	-5.0
1999	*Pyrola asarifolia*	0	10	15	5	30	7.5		
2008	*Streptopus amplexifolius*	1	1	0	5	7	1.8	-	-1.0
1999	*Streptopus amplexifolius*	3	3	0	5	11	2.8		
2008	*Trientalis europaea*	5	3	5	5	18	4.5	-	-1.8
1999	*Trientalis europaea*	10	5	5	5	25	6.3		
					Total change 1999 to 2008			**-**	**-21.8**

Ferns: *Gymnocarpium dryopteris* (oak fern) was the only fern recorded in LTVMP 3 (Table 25). Although cover increased slightly in two microplots, the decrease in the other two plots made for an overall decrease in oak fern of -5.0%.

Table 25. Comparison of fern species percent cover LTVMP 3, 1999 to 2008.

		Subplots							
Year	Species	3.1	3.2	3.3	3.4	Total	Average	Change since 1999	Average change since 1999
2008	*Gymnocarpium dryopteris*	80	85	40	70	275	68.8	-	-5.0
1999	*Gymnocarpium dryopteris*	70	80	60	85	295	73.8		
					Total change 1999 to 2008			**+**	**-5.0**

KEY RESEARCH ACCOMPLISHMENTS

- Updated GPS coordinates for all subplot centers for 5 LTVMPs
- Relocated 19 of 20 subplot screw-anchor markers
- Triangulated to subplot center to re-create subplot center on one plot without a screw-anchor
- Documented increase in shrubs and decrease in herbaceous species in old growth paper birch-white spruce forest sites.
- Documented increase in tree cover and decrease in dwarf shrubs in black spruce forest site.
- Documented increase in white spruce cover in closed young mixed paper birch-white spruce forest site.
- Recommend more samples to expand sample size and include minor vegetation communities

CONCLUSION

Closed Old-Growth Paper Birch-White Spruce Forest

Live tree composition did not change markedly between 1999 and 2008. Most of the standing dead white spruce sampled in 1999 had fallen by 2008. Many of the remaining live trees had signs of damage or decay. The most noticeable change in the old growth forest plots was the decrease in herbaceous species in all three plots sampled and an increase of low and tall shrubs in one of the plots. In addition, *Rosa acicularis* cover decreased across all closed old-growth paper birch-white spruce forest plots, while other taller shrub species such as *Oplopanax horridus* increased.

A slight increase in tree cover in the microplots was also recorded. There seems to be a slight increase in white spruce trees and saplings that may indicate recruitment of white spruce. Paper birch seedlings decreased and saplings remained about the same. Thus paper birch recruitment does not seem to be occurring in these plots.

Black spruce forest

One black spruce forest plot was surveyed. Fewer shrubs, especially dwarf shrubs, were present in 2008 than 1999. Tree and sapling density was similar in the subplots, however black spruce sapling canopy cover increased from 18% to 37.5% between 1999 and 2008. The increase in black spruce may explain of the decrease in dwarf shrub and herbaceous species over the nine years. Paper birch cover increased slightly in one microplot, but seedling and sapling cover decreased for paper birch overall. The marked decrease in dwarf shrubs and slight decrease in mosses and lichens may indicate that the site is warmer and dryer than in 1999. However it is not clear if this is a localized event or a result of climate warming. Soil samples or soil temperature monitoring may help clarify trends in soil thermal regime.

Closed Young Mixed Paper Birch-White Spruce Forest

One birch forest plot was sampled, thus conclusions are hard to quantify. There was an increase in white spruce cover in the microplots as well as a slight increase in paper birch. Low-growing herbaceous species decreased in all microplots while there was a slight increase in bluejoint grass.

In 2008, five LTVMPs were re-visited and analyzed. Although changes are documented in this report, it is recommended that this project be expanded to look at changes in these and other forest types not covered in this report by re-measuring additional LTVMPs from the 2001 report. Evaluation of black spruce and birch forest types were based on one plot each. In addition, alder and bluejoint plots were

not included in any evaluation. More data is needed for adequate assessment of the forest types on Elmendorf Air Force Base.

Non-native invasive plant species

Orange hawkweed was located on the access trail to LTVMPs 11 and 12. This was reported to Herman Griese in July 2008. In addition, the antenna field near the access trail to LTVMP 5 was covered with a number of non-native invasive species. The location was documented with GPS, but plant names were not noted.

Research recommendations

We recommend expanding the number of remeasurement plots and combining these with 2008 data for a broader analysis. A larger sample will help determine if changes observed in forest types with only one plot constitute a trend, and will also help clarify the trend in the Old Growth forest type where the trend was not consistent across the three plots. Soil temperature monitoring would be an informative addition to the monitoring effort, especially in black spruce plots(HOBO® makes a suitable monitoring device). This would help answer questions about changes that may be related to site warming, however, the monitoring probes would need to be read annually.

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APPENDICES

Appendix A. 2008 GPS locations (NAD 83) for LTVMPs 3, 5, 10, 11, 12 and invasive species locations. Note no GPS location for LTVMP 10.4.

ADDRESS (LTVMP)	WAYPOINT	LAT	LONG	Y_PROJ	X_PROJ	COMMENT	ALTITUDE
3.1	001	61.27615216	-149.76185306	6796676.83076362	351953.49870029	21-JUL-08 10:57	82.00
3.2	002	61.27632466	-149.76204207	6796696.46182999	351944.18355491	21-JUL-08 15:26	69.00
3.3	003	61.27580574	-149.76163555	6796637.77443952	351963.52207920	22-JUL-08 11:27	62.00
3.4	004	61.27607647	-149.76254264	6796669.96831018	351916.19299352	22-JUL-08 12:38	72.00
5.1	023	61.28069356	-149.76282184	6797184.57335717	351922.98431387	29-JUL-08 10:24	63.00
5.2	024	61.28102565	-149.76246888	6797220.74122525	351943.45826690	29-JUL-08 11:01	75.00
5.3	025	61.28046666	-149.76250869	6797158.60498490	351938.69228449	29-JUL-08 12:31	112.00
5.4	026	61.28067571	-149.76341092	6797183.92209041	351891.34061323	29-JUL-08 12:43	78.00
10.1	005	61.29486116	-149.79211542	6798828.45422336	350421.06830520	23-JUL-08 10:17	67.00
10.2	006	61.29492452	-149.79146901	6798834.02681049	350455.98487465	23-JUL-08 12:19	68.00
10.3	007	61.29517984	-149.79193253	6798863.51018006	350432.37936709	23-JUL-08 13:46	65.00
11.1	019	61.30118790	-149.79001584	6799527.92873508	350563.60476524	28-JUL-08 11:38	70.00
11.2	022	61.30096410	-149.79058371	6799504.31545910	350532.13654879	28-JUL-08 14:35	73.00
11.3	021	61.30096410	-149.79058371	6799504.31545910	350532.13654879	28-JUL-08 13:58	65.00
11.4	020	61.30094156	-149.79070147	6799502.07591316	350525.72449957	28-JUL-08 13:06	78.00
12.1	012	61.30248383	-149.79185843	6799676.40781154	350471.12565946	25-JUL-08 10:21	64.00
12.2	014	61.30239573	-149.79270626	6799668.54255133	350425.31618948	25-JUL-08 13:06	53.00
12.3	015	61.30238417	-149.79238205	6799666.51306759	350442.61824314	25-JUL-08 13:57	61.00
12.4	013	61.30278239	-149.79167780	6799709.22936377	350482.21752512	25-JUL-08 11:32	59.00
inv. species	027	61.28097033	-149.77045432	6797232.71246549	351515.38720414	29-JUL-08 13:37	82.00
inv. species	028	61.28103420	-149.77041383	6797239.73036016	351517.85813541	29-JUL-08 13:37	83.00
OHawkweed	010	61.30080954	-149.78865101	6799482.68748443	350634.87653065	25-JUL-08 09:39	58.00
OHawkweed	011	61.30260863	-149.78986563	6799685.73834256	350578.40706839	25-JUL-08 09:48	65.00

Appendix B. Datasheet 8: Tree Mortality Record

LTVM Plot No.:_____ DATE: _____

Observer: _____

← Specifics →								Crowns			Death				
SUBPLOT #	TREE #	DIST. TO TREE	AZIM TO TREE	SPECIES	DBH	DOMINANCE	HEIGHT	DEAD RATIO	CROWN DIAM	CROWN FORM	YEAR	CAUSE	OFF ACRE ?	BEETLE TYPE	COMMENTS
x	xx	xx.x	xxx	xxx	xx.x	x	xxx	xx	xx	x	xx	xxx	x	xxxx	
TALLY ON SUBPLOTS (All trees saplings & larger)															
								-	-	-					
								-	-	-					
								-	-	-					
								-	-	-					
								-	-	-					
								-	-	-					
								-	-	-					
								-	-	-					
								-	-	-					
								-	-	-					
TALLY ON FULL-ACRE ONLY (Dead Trees > 127mm & larger)															
1	1							-	-	-			N		
1	2							-	-	-			N		
1	3							-	-	-			N		
1	4							-	-	-			N		
1	5							-	-	-			N		
1	6							-	-	-			N		
1	7							-	-	-			N		
1	8							-	-	-			N		
1	9							-	-	-			N		
1	10							-	-	-			N		
1	11							-	-	-			N		
1	12							-	-	-			N		
1	13							-	-	-			N		
1	14							-	-	-			N		
1	15							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		
1	16							-	-	-			N		

Appendix C. Datasheet 7: Live tree record

LTVM Plot No.:_______________ SubPlot No.__________________

Observer: ____________________ Date: ________________________

← Specifics →							← Crowns →							← Damage →							
TREE #	DIST. TO TREE	AZIM TO TREE	SPECIES	DBH >0127mm	DOMINANCE	HEIGHT	LIVE RATIO	DEAD RATIO	CROWN DIAM	CROWN FORM	DENSITY	DIEBACK	TRANSP	LOCATION	DAMAGE	SEVERITY	LOCATION	DAMAGE	SEVERITY	BEETLE TYPE	COMMENTS
xx	xxx	xxx	xxx	xxx	x	xxx	xx	xx	xx	x	xx	xx	xx	x	xx	xx	x	xx	xx	xxxx	

Appendix D. Datasheet 5: Seedling Record

LTVM PLOT NO: _____ OBSERVER: _____

DATE: _____

SMALL SEEDLING TALLY

Seedlings UNDER 30 cm tall

SUBPLOT NO.	% SEEDLING	SPECIES 1	COUNT	SPECIES 2	COUNT	SPECIES 3	COUNT
	xx %	xxxx	xx	xxxx	xx	xxxx	xx
1							
2							
3							
4							

COMMENTS:

LARGE SEEDLING TALLY

Seedlings OVER 30 cm tall and <2.54 cm diameter Heights (in dm) and Ages

SUBPLOT NO.	% SEEDLING	SPECIES 1	COUNT	SPECIES 2	COUNT	SPECIES 3	COUNT	HEIGHT	AGE	HEIGHT	AGE	HEIGHT	AGE
	xx %	xxxx	xx	xxxx	xx	xxxx	xx	xxx (dm)	xxx (yrs)	xxx (dm)	xxx (yrs)	xxx (dm)	xxx (yrs)
1													
2													
3													
4													

REGENERATION REMARKS:

Appendix E. Datasheet 6: Sapling record

LTVM Plot No.:_______________ Date: ________________________

Observer: ____________________

Specifics								Crowns							Damage							
SUBPLOT #	TREE #	DIST. TO TREE	AZIM TO TREE	SPECIES	DBH (025-126 mm)	DOMINANCE	HEIGHT	LIVE RATIO	DEAD RATIO	CROWN DIAM	CROWN FORM	DENSITY	DIEBACK	TRANSP	LOCATION	DAMAGE	SEVERITY	LOCATION	DAMAGE	SEVERITY	BEETLE TYPE	COMMENTS
x	xx	xxx	xxx	xxx	xxx	x	xxx	xx	xx	xx	x	xx	xx	xx	x	xx	xx	x	xx	xx	xxxx	
1																						
1																						
1																						
1																						
2																						
2																						
2																						
2																						
3																						
3																						
3																						
3																						
4																						
4																						
4																						
4																						

Appendix F. Datasheet 4: Understory vegetation profile record

LTVM PLOT: SUBPLOT: VEGETATION TYPE: OBSERVER:

DATE:

PHYSIOGNOMY	% COVER
Tree (>8m)	
Tall Shrub/dwarf tree (1.5 - < 3m)	
Low Shrub (0.5 - <1.5m)	
Dwarf Shrub (<0.2m)	
Graminoids	
Forb	
Ferns/Fern Allies	
Moss	
Lichen	

PHOTO RECORD:

INIT.	ROLL	FRAME	FRAME	FRAME

Field Notes:

		LAYERS							
		L1 Ground	L2	L3	L4	L5	L6	L7	COMP COVER
	Top of layer (000 dm)								
	%cover of layer								
Notes	Species	%Composition by species within layer							
	Water-standing								
	Water-flowing								
	Ground (soil)								
	Rock (solid)								
	Rock (broken)								
	Residue (liiter)								
	Downwood								
	Basal Vegetation								
	Stumps (<1.37m)								
	Snags								
	Layer totals (100%)								