

**Stand Level Harvesting in Mountain Pine Beetle
Affected Stands and Impact on Riparian Based
Cultural Resource Management Zones Within
Skeetchestn Traditional Territory
(FSP # M085112)**

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Abstract

British Columbia is currently experiencing an extensive outbreak of mountain pine beetle which has resulted in a large proportion of pine forests being killed – this has also resulted in an accelerated harvest aimed at salvaging these trees while they maintain economic value. This accelerated harvest has impacted many resources including riparian zones – this is of concern as the riparian zone supports high species diversity as compared to upland areas. Although British Columbia currently has legislation which outlines management and reserve zones (typically less than 50-m) related to these riparian zones there is some concern that these zones are inadequate to protect resources associated with these zones.

The Skeetchestn Indian Band has proposed 100-meter Cultural Resource Management Zones may need to be used in order to protect critical resources associated with these riparian zones. A critical resource identified by the Skeetchestn Indian Band are Culturally Important Plants; in particular, *Ledum glandulosum*, *Valeriana sitchensis*, *Rubus pubescens*, *Arnica cordifolia*, *Arnica latifolia*, *Shepherdia canadensis*, and *Lonicera involucrata*.

In response to these concerns and to test the validity of these 100-m CRMZ's, we initiated a study comparing plant communities at increasing distance away from riparian zones within recently clearcut and unharvested plots. The results of this show that clearcut harvesting within these 100-m zones has a negative affect on the frequency of occurrence as well as the percent cover of these important plants as compared to uncut forests. It therefore, becomes prudent to consider applying 50-m reserve zones on riparian zones to ensure the occurrence of these species is maintained.

Acknowledgements

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Introduction

The current outbreak of mountain pine beetle (*Dendroctonus ponderosae*) (MPB) is the largest ever recorded for British Columbia (Martin et al. 2006). This outbreak has been facilitated by high overwinter survival of larvae, multiple flights during the summer (Wood and Unger 1996), and a large number of mature lodgepole pine (*Pinus contorta* var. *latifolia*) (Nelson et al. 2006). This has resulted in 8.5 million ha of forests in British Columbia being effected (Martin et al. 2006). By the time the infestation is projected to end, 80% of all pine trees in British Columbia are expected to be affected (Eng et al. 2004). The enormity of the MPB infestation in British Columbia is resulting in accelerated harvest aimed at salvaging dead trees while they maintain economic value (Bunnell et al. 2004).

This accelerated harvesting has led to a drastic increase in the annual cut of forests within British Columbia. This accelerated harvest has also led to an increased impact on many resources including riparian zones within these harvested forests. Increased harvesting within the riparian zone, the ecotone between terrestrial and aquatic ecosystems where the vegetation complex and microclimate are products of the combined pressure and influence of perennial and/or intermittent water, are of concern as the riparian zone serves many functions including erosion and runoff control, protection of water quality, provision of shade and litter fall for aquatic biota, and habitat for wildlife. The riparian zone has also been identified as supporting high plant species diversity as compared to upland areas (Sarr and Hibbs 2007) and many plant species are associated with these riparian zones.

Forest policy in British Columbia have permitted the application of reserve zones of 5-10 metres on some streams with other streams having no provisions for protection. In response to the potential impacts of harvesting within these riparian zones, the Skeetchestn Indian Band has suggested that a larger buffer or management zone may need to be placed around these riparian zones to protect these values for harvesting that occurs within their traditional territory. The Skeetchestn Indian Band has proposed that current 50-meter reserve and management zones will need to be increased to 100-meter Cultural Resource Management Zones (CRMZ's) in order to fully protect riparian zones values. The intention of the 100-meter CRMZ's is to protect biodiversity values and help maintain culturally important plants (CIP) which are associated with these riparian zones. They are also intended to provide for habitat connectivity and to mitigate negative impacts to hydrological function.

For the Skeetchestn Indian Band, CIP's are very important for traditional medicine, food, ceremonial, technology, spiritual, and cultural heritage. In particular, the Skeetchestn Indian Band has identified seven plant species that are culturally important and are also typically associated with riparian areas (Klinka et al. 1989). These species include *Ledum glandulosum*, *Valeriana sitchensis*, *Rubus pubescens*, *Arnica corifolia*, *Arnica latifolia*, *Shepherdia canadensis*, and *Lonicera involucrata*. As forest harvesting within riparian areas has increased due to the mountain pine beetle outbreak, understanding the potential impact of forest harvesting on both the frequency of occurrence as well as the total cover of these CIP's becomes important.

Here in we examine the influence of distance from the riparian zone as well as forest harvesting on the frequency of occurrence and percent cover of each of these

CIP's. We also examine differences in species richness between harvested and control sites. The intention is to gain an understanding as to the role that 100 meter CRMZ's would play at protecting these CIP's.

Methods

Study Sites

In order to examine the influence of forest harvesting on the occurrence and cover of the CIP's we initially selected appropriate riparian area sites using existing GIS and aerial inventory data maps provided by the Skeetchestn Indian Band, Ministry of Forest, West Fraser Ltd, and Weyerhaeuser Canada. This original list of potential sites was further refined following field truthing of each site in order to select four appropriate study areas. We selected sites from three distinct geographic areas all of which were located within the traditional territory of the Skeetchestn Indian Band. The first study area was located on Greenstone Mountain with two sites located at 14.5 km and at 17.0 km along Greenstone Mountain FSR. The two other study areas, Heller Creek and Road 3300, were both located within the Deadman Creek watershed. All sites occurred within the Montane Spruce (MS) and Interior Douglas Fir (IDF) biogeoclimatic zones (Lloyd et al. 1990 and Meidinger and Pojar 1991). At each of these study areas, we located paired study sites along S5/S6 stream that were within an intact forest (control) and a recently clearcut (3-5 years post-harvest). We also selected one old clearcut (approximately 15 years old) at the Heller Creek site in order to gauge potential recovery of CIP's.

Data Collection

In each paired study site we established 100-m base lines perpendicular to each stream within the clearcut and the intact forest (control) wherever possible. However, on

some sites a 50-meter line was established due to a lack of a uniform area over a 100 meter distance from the stream edge. Five or six sample lines (20 m length) were established perpendicular to the 100 m (50 m) line and were parallel to the stream at 0, 5, 10, 20, 50 and 100 m from the edge of the stream. Along each sample line, ten 1-m² vegetation sample plots were established at 2-m intervals (modified from Hagen et al. 2006, Karakatsoulis et al. 2005, and Daubenmire 1959). All vegetation within each sampling plot was recorded by species and percent cover was estimated visually. Each site contained two base lines within each clearcut and control site. Plant species were identified in accordance with Hitchcock and Croonquist (1973) and Parish et al. (1996). All species were noted but we focussed on *Valeriana sitchensis*, *Rubus pubescens*, *Arnica cordifolia*, *Arnica latifolia*, *Shepherdia canadensis*, and *Lonicera involucrata*.

Data Analysis

A one-way analysis of variance (ANOVA) was used, via function PROC GLM in SAS 9.1 (SAS Institute 2006), to determine if significant differences in species richness and cover occurred between stand types (clearcut and control). Percentage data were arcsine transformed to meet requirements of normality and equal variance (Zar 1999) and all mean data are reported with standard error. For species richness and percent cover data we combined both *Arnica* spp. in to one category, in addition, the occurrence of both *Ledum glandulosum* and *Valeriana sitchensis* was limited to a few sites so they were excluded from the analysis. It is also important to note that the 100-m transects only occurred within a few of the sites due to logistics; as such, data from these lines were not included in the data analyses. Chi-square goodness-of-fit tests (Zar 1999) were used to

compare the frequency of occurrence of each of the identified plants for each distance from the riparian zone.

Results

Species Richness

Species richness varied from 57 species within the Road 3300 site to 69 species within the Heller Creek site. Mean species richness was generally higher at the stream edge and gradually decreased when moving up to 100-m from the riparian edge for all study types (Figure 1). This pattern was a little different in the Old Clearcut sites where mean species richness was highest at 10 and 20 meters from the riparian edge. There were no significant differences in species richness between the clearcut and control sites at any of the distances from the riparian zone (all $F_{s(1,7)} \leq 2.08$; $P_s \geq 0.176$).

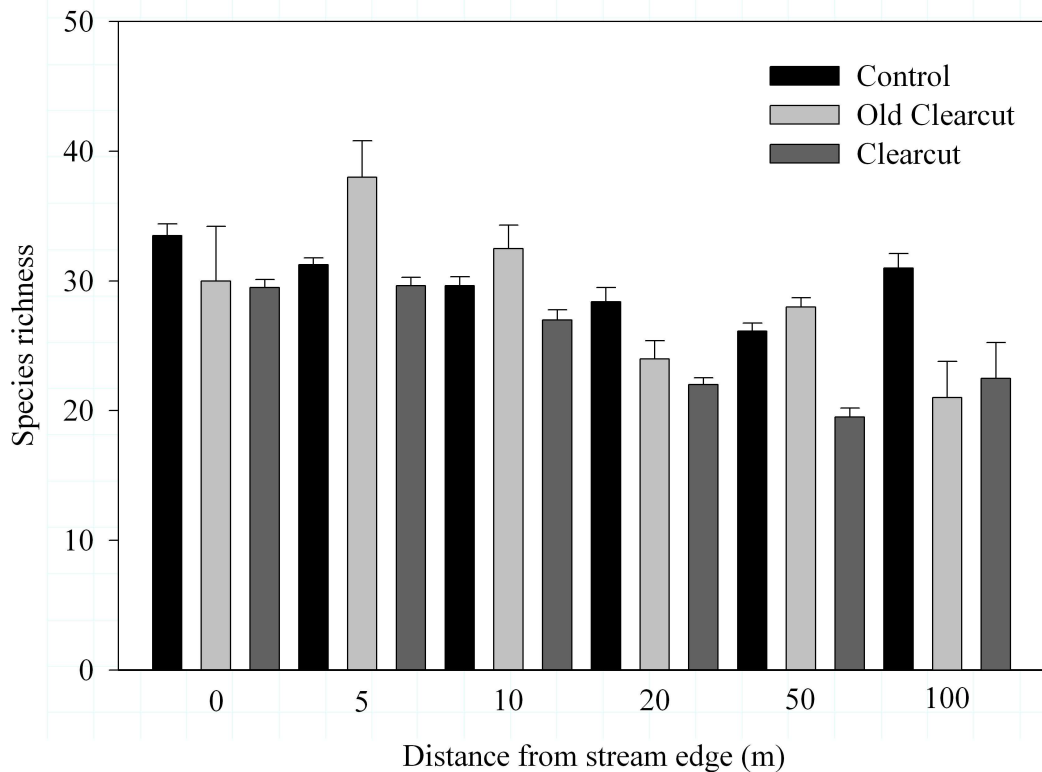


Figure 1. Mean plant species richness within the control, clearcut, and old clearcut.

Percent Cover

As with mean species richness, mean percent cover generally decreased moving away from the riparian zone (Figure 2). In the control sites mean percent cover decreased from 65% to 47% and from 32% to 19% in the clearcut sites. Percent cover was significantly higher in the control sites versus the clearcut sites for all distances (all $F_{s(1,7)} \geq 3.63$; $P_s \leq 0.05$).

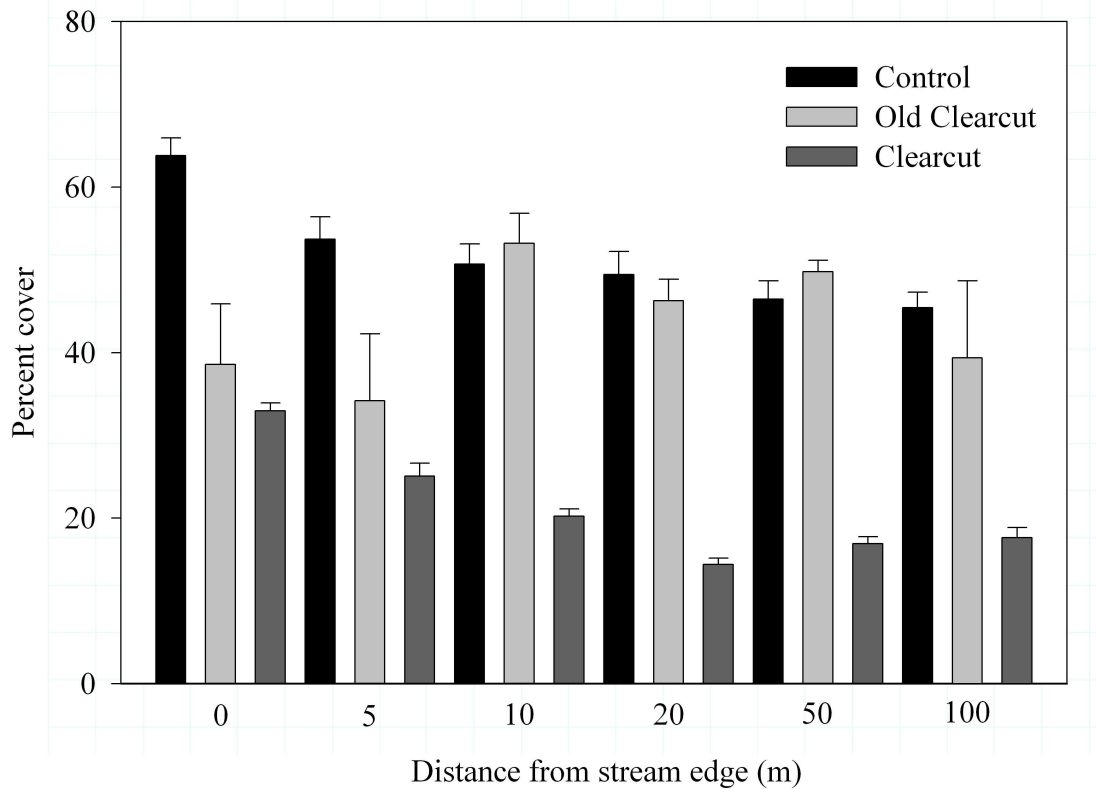


Figure 2. Percent cover of all plant species within the control, old clearcut and recent clearcut along

The percent cover of *V. membranaceum*, *S. canadensis*, *R. pubescens*, *L. involucrata*, and *Arnica* spp. were all higher within the control and clearcut sites. The mean percent cover of *R. pubescens* was the only species which showed a clear pattern of decreasing in cover when moving away from the riparian zone (refer to Figures 3 through 7).

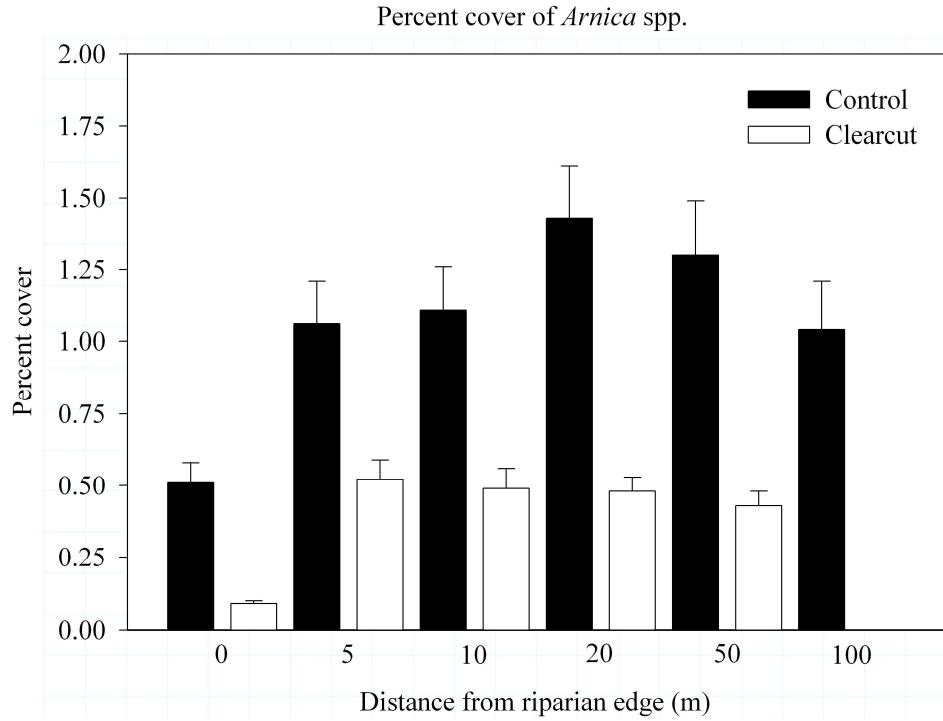


Figure 3. Percent cover of the two *Arnica* spp. within the control and clearcut.

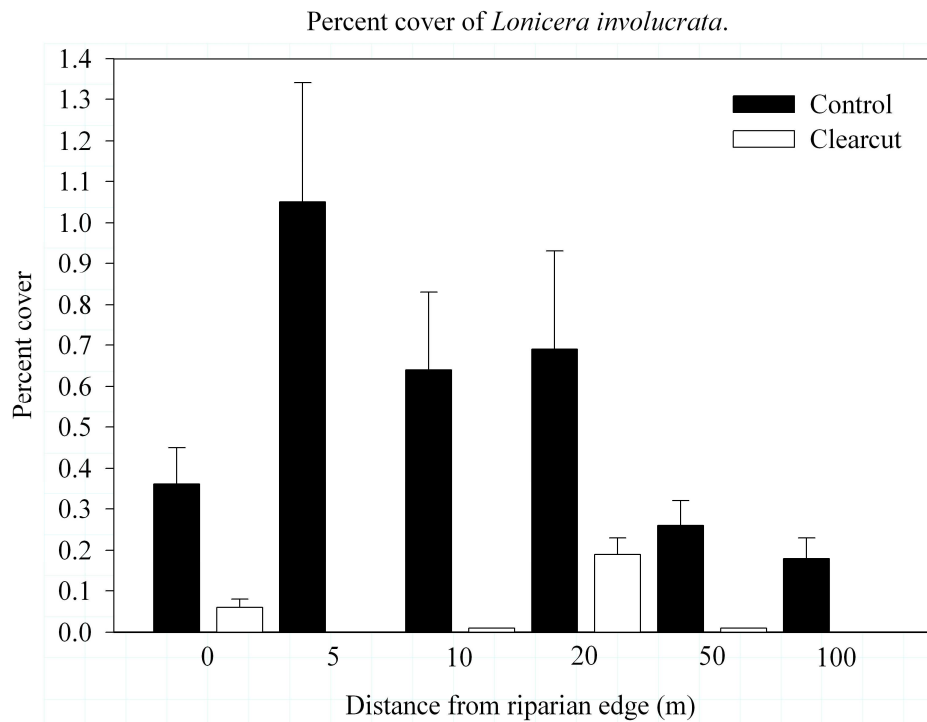


Figure 4. Percent cover of *Lonicera involucrata* within the control and clearcut.

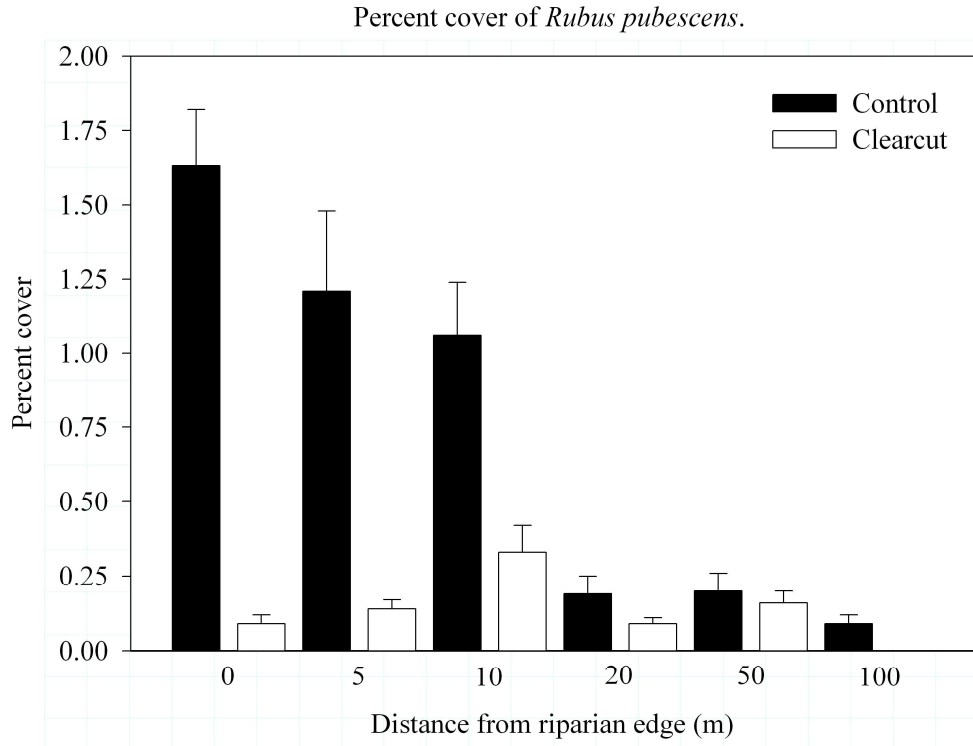


Figure 5. Percent cover of *Rubus pubescens* within the control and clearcut.

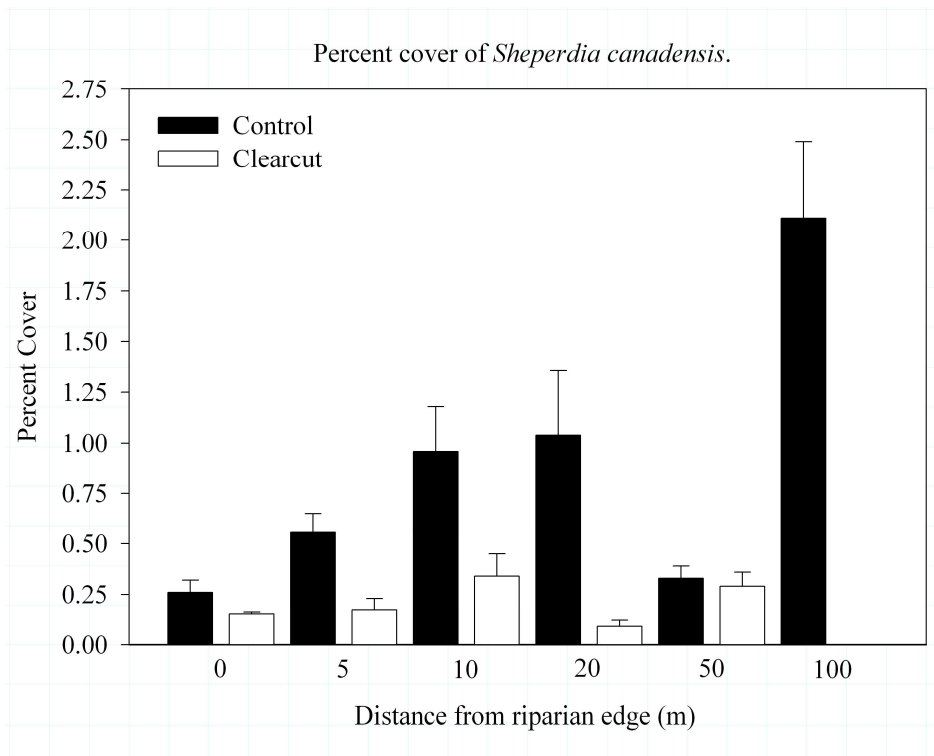


Figure 6. Percent cover of *Sheperdia canadensis* within the control and clearcut.

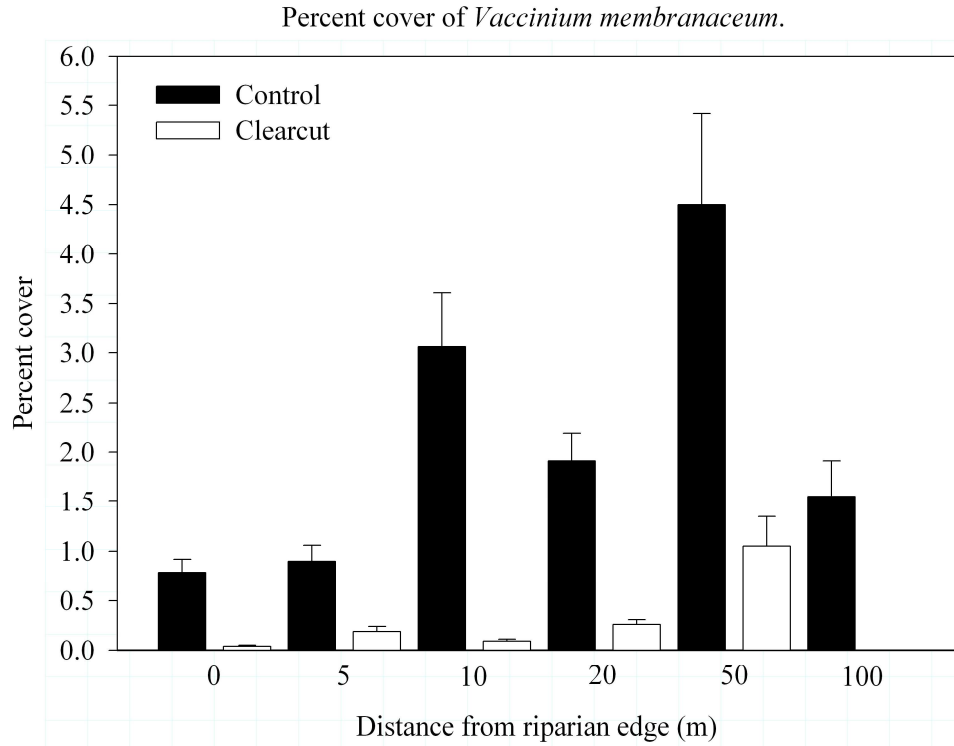


Figure 7. Percent cover of *Vaccinium membranaceum* within the control and clearcut.

The percent cover of *Arnica* spp, *L. involucrata*, and *V. membranaceum* were all significantly higher within the control sites versus the clearcut sites for all distances away from the riparian zone (all $F_{s(1,7)} \geq 3.73$; $P_s \leq 0.045$). The percent cover of *R. pubescens* was significantly higher at 0, 5, and 10 meters and the percent cover of *S. canadensis* was higher at 0, 5, 10, and 20 meters (all $F_{s(1,7)} \geq 3.45$; $P_s \leq 0.05$).

Percent Frequency

The frequency of occurrence of *Arnica* spp. and *L. involucrata*, *R. pubescens*, and *V. membranaceum* (Figures 8-11) was higher in the control sites versus the clearcut sites at all distances ($X^2 \geq 7.80$, $df=2$, $P \leq 0.049$) – with the exception of *Arnica* spp. at 5-meters. This pattern was not evident for *S. canadensis*, here the frequency of occurrence was higher in the clearcut sites at zero and ten metres (Figure 12).

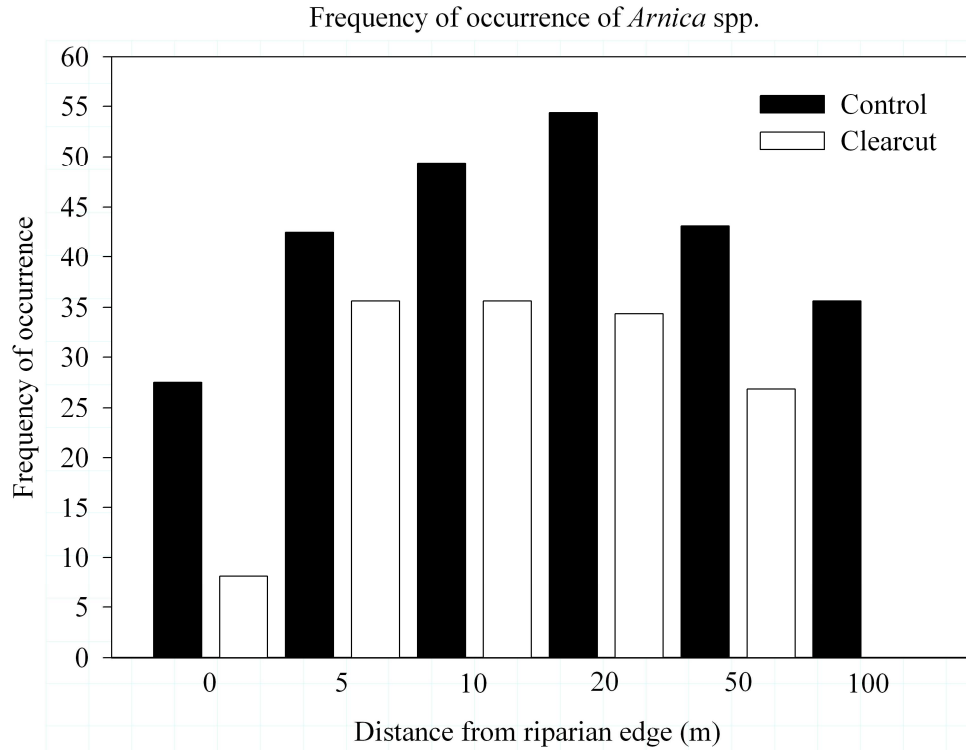


Figure 8. Changes in % frequency of *Arnica* spp. along a 100 m transect perpendicular to the stream within a control and adjacent clearcut.

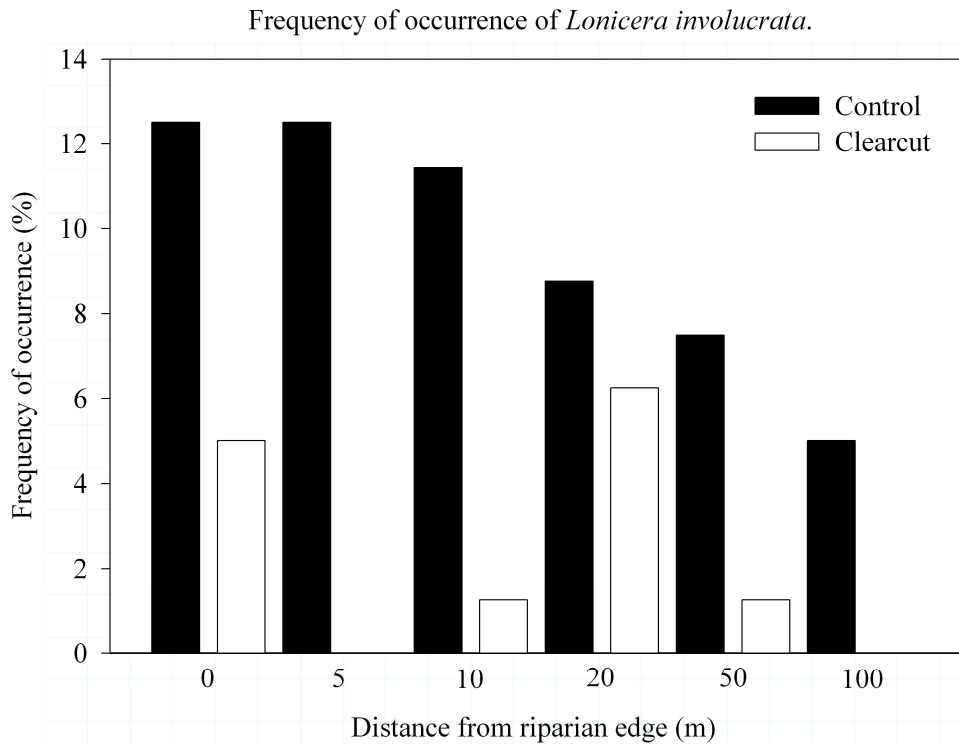


Figure 9. Changes in percent frequency of *Lonicera involucrata* along a 100 m transect perpendicular to the riparian zone within a control and adjacent clearcut.

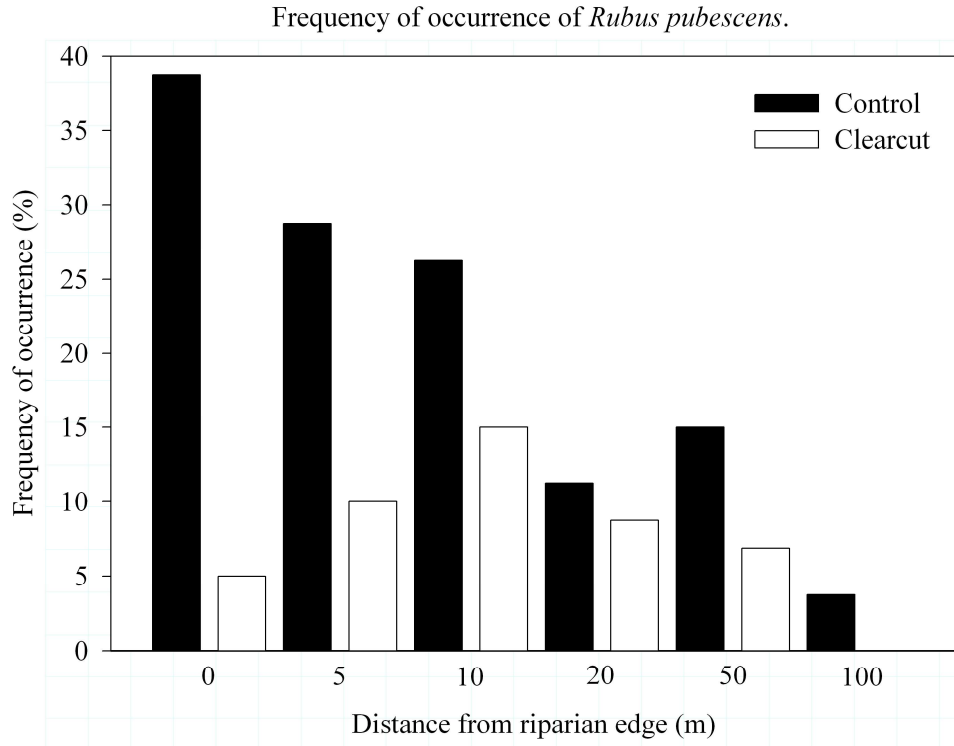


Figure 10. Changes in % frequency of *Rubus pubescens* along a 100 m transect perpendicular to the stream within a control and adjacent clearcut.

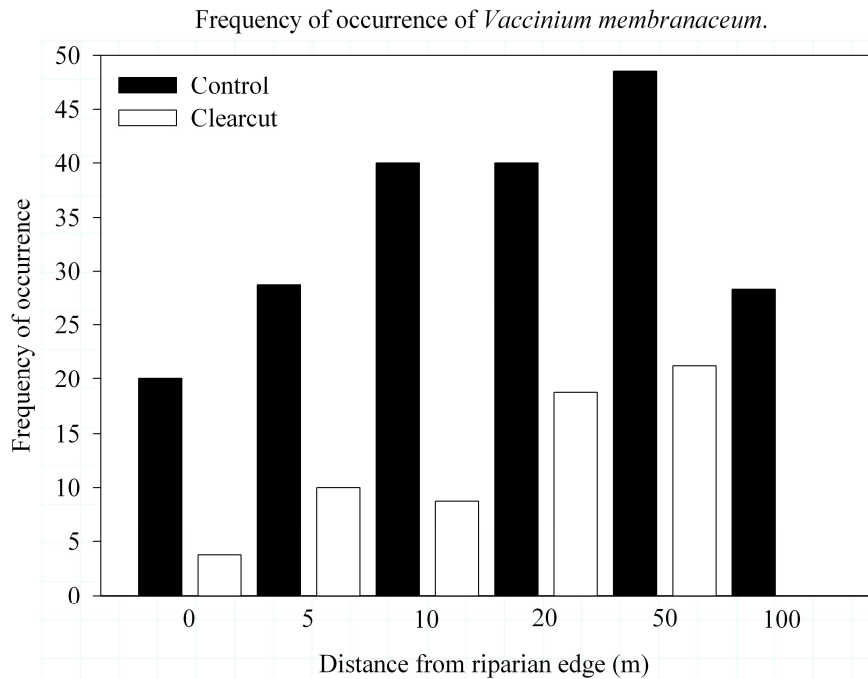


Figure 11. Changes in mean percent frequency of *Vaccinium membranaceum* along a 100 m transect perpendicular to the riparian zone within a control and adjacent clearcut.

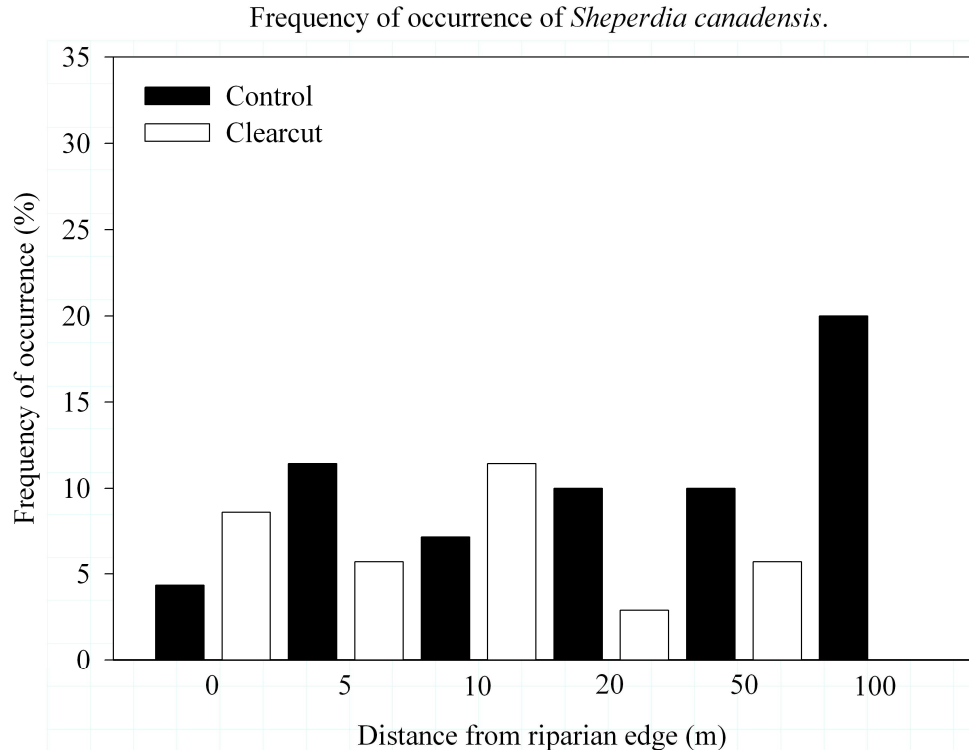


Figure 12. Changes in percent frequency of *Sheperdia canadensis* along a 100 m transect perpendicular to the riparian zone within a control and adjacent clearcut.

versus the control. The mean occurrence of *Arnica* spp. was 42.0% in control sites versus 27.6% in clearcut sites, for *L. involucrata* it was 9.7% and 2.7%, for *R. pubescens* it was 20.8% and 8.8%, for *V. membranaceum* it was 33.7% and 11.8%, and for *S. canadensis* it was 10.2% and 6.8% respectively.

Discussion

The current outbreak of mountain pine beetle within British Columbia has resulted in an unprecedented rate of harvest within these forests. This increase in harvesting is expected to influence many species and ecosystems; in particular, riparian ecosystems. The Skeetchestn Indian Band recognizes that this harvesting may impact upon plants that are culturally important to them. The results of this work support this

notion as the frequency of occurrence and cover of these species were all reduced in the clearcut sites as compared to control sites – with the exception of *S. canadensis*.

The only plant in which a clear pattern of reduced frequency and cover was not evident was for *S. canadensis*. The occurrence of *S. canadensis* is associated with dry to moist open forest, openings and clearings (Parish et al. 1996). As such, the relative increase in cover and occurrence seen within the clearcut sites is likely a factor of the ecology of the species instead of a positive response to clearcut harvesting. It is also important to note that the results of this work are based on data collected from four sites, it would be prudent to increase the sample size of this work in the future to ensure a full suite of ecological site conditions are considered. It would also be beneficial to consider the clumping nature of some of the identified species and incorporate this in to future sampling plans.

The results of this study show that 50-m reserve zones along riparian zones would be needed to adequately protect the identified CIP's. Moving away from this 50-m zone, the occurrence and cover of these plants generally decreased. As such, 50-m reserve zones would likely be sufficient as compared to 100-m reserve zones – though it is recognized that data is lacking. British Columbia currently has legislation which outlines management and reserve zones (typically less than 50-m) related to riparian zones – this work suggests that these may be inadequate to fully protect the CIP's identified in this study.

There is some evidence that the identified plants may begin to recover within 15-years following harvesting as exhibited by the data collected within the old clearcut sites. However, these results need to be considered in light of the limited data which was

collected due to a variety of constraints. The available evidence does allude to this potential though; as such, it would be of value to collect more data to identify how long it takes for plants to recover to their pre-disturbance occurrence and cover. These data would help managers develop long-term harvesting plans which could account for the recovery of CIP's.

Conclusion

Culturally Important Plants are essential elements of traditional medicine, food, ceremony and cultural heritage for members of the Skeetchestn Indian Band. By ensuring that sensitive and important riparian areas are reserved (with a minimum of 50-m reserve zones) the occurrence of these important plants will be maintained. Forest harvesting impacts a host of plant species but these impacts could be partially mitigated through the implementation of 50-m reserve zones on riparian zones.

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Appendix A – Frequency and Cover Tables

Table 1. Mean percent cover of recorded plant species within the control and clearcut areas adjacent (0 – 100 m) to an S6 stream. Note: A 50m distance from the stream was used in the clearcut area due to size of the clearcut.

Plant Species	Greenstone Mtn. (km 14.5)						Greenstone Mtn. (km 14.5)					
	Mean % Cover (N = 20)						Mean % Cover (N = 20)					
	Control						Clearcut					
	0m	5m	10m	20m	50m	100m	0m	5m	10m	20m	50m	100m
<i>Abies lasiocarpa</i>	0.2	1.0	0.1				0.5					
<i>Actaea rubra</i>	1.9	1.5	5.5	0.3	0.1		6.5	4.9	1.0			
<i>Alnus sp.</i>	0.1	1.8					0.3	2.8				
<i>Arnica cordifolia</i>	0.2		0.6	1.2	2.2	1.6	0.1	1.2	1.9	0.7	1.2	
<i>Aster conspicuus</i>	2.1	1.4	1.1	0.3	0.6	0.2	0.9	0.6	0.4	0.5	0.2	
<i>Calamagrostis rubescens</i>	0.6	0.5	0.2	0.2	4.0	5.2	0.8	0.5	1.4	3.9	1.9	
<i>Chimaphila umbuletta</i>								0.2	0.1			
<i>Clematis occidentalis</i>								0.2	0.5			
<i>Cornus canadensis</i>				0.9	1.4			0.3	0.8	0.6		
<i>Epilobium angustifolium</i>		0.1		0.1	0.1	0.1		0.3	0.1	0.1	0.1	
<i>Equisetum arvense</i>	0.5	0.5	0.1				1.5	0.2	0.1			
<i>Equisetum scirpoides</i>	12.0	3.4	7.0	0.1			1.2	0.4				
<i>Equisetum sp.</i>							0.2	0.2				
<i>Erigeron speciosus</i>							1.5	0.8	0.7	0.2	0.3	
<i>Festuca sp.</i>						0.1			0.1			
<i>Fragaria virginiana</i>	0.3	0.4	0.2	0.5	1.0	0.9	1.2	1.2	1.2	0.8	1.7	
<i>Galium boreale</i>	0.6		0.3				0.2	0.1	0.2			
<i>Galium triflorum</i>	0.8	1.1	0.7	0.2		0.1	0.7	0.9	0.6	1.4		
<i>Geranium sp.</i>	0.2	0.4					0.7	0.3				
<i>Geum macrophyllum</i>										0.1		
<i>Geum triflorum</i>							0.6	0.1			0.1	
<i>Goodyera oblongifolia</i>	0.1			0.1	0.2	0.1						
Gramineae family	0.4	0.6	0.5	0.4			0.1					
<i>Heracleum lanaton</i>	0.2	0.4	0.1					0.1	0.1		0.1	
<i>Hylocomium splendens</i>					0.1							
<i>Lillium columbianum</i>					0.1			0.2	0.2		0.2	
<i>Linnaea borealis</i>	0.4	0.9	0.4	0.9	3.1	1.3	1.3	3.5	1.6	0.8	0.9	
<i>listera sp.</i>		0.1	0.1									
<i>Lonicera involucrata</i>	0.1		0.1	0.1	0.2							
<i>Lupinus articus</i>				0.1		0.9						
<i>Lupinus sericeus</i>				0.2	1.4			0.1	1.0			
<i>Mitella sp.</i>	1.2	0.9	0.5	0.3	0.4		0.7	0.4	0.2			
<i>Orthilia secunda</i>	0.5	0.6	0.5	0.8	0.8	0.4	0.6	0.9	0.1	0.2	0.1	
<i>Osmorhiza chilensis</i>	1.0	1.3	0.6	0.4	0.4	0.5	0.3	0.6	0.1	0.3	0.2	
<i>Paxistima myrsinites</i>											0.1	
<i>Pedasites palmatus</i>	1.3	1.3	0.9				0.3					
<i>Pedasites sagittatus</i>	0.1							0.3				

<i>Peltigeria sp.</i>	0.1	0.1		2.6	0.2	0.1						
<i>Picea engelmannii</i>	0.2		2.1	0.2	1.4	1.5		1.4	0.6			
<i>Platanthera unalachensis</i>		0.2										
<i>Pleurozium schreberia</i>	1.0	12.4	3.5	2.8	16.0	2.4	0.9	0.2	1.2			0.3
<i>Populus tremuloides</i>	0.6	0.9	0.5				0.3	0.3	1.4	1.2		5.7
<i>Populus trichocarpa</i>	0.9	1.0	0.5				0.8		0.2			0.1
<i>Ptilium crista-castrensis</i>		0.1		0.1	0.1	1.5						
<i>Ranaunculus spp.</i>	0.2	0.8	0.2	0.2			0.3	0.1	0.2			
<i>Ribes idaeus</i>							0.1	1.3	0.4	0.4		
<i>Ribes lacustre</i>	7.3	6.4	5.2	2.9	0.2		6.0	6.4	0.8	1.4		0.4
<i>Rosa spp.</i>	1.1	0.7	0.7	0.2	0.7	0.4	1.1	1.2	1.4	1.4		1.4
<i>Salix spp.</i>	0.4							0.2	1.0			0.1
<i>Senecio pseudoaureus</i>	0.6	1.1	0.7	0.2			0.8	0.5	0.4			
<i>Sheperdia canadensis</i>		0.4			0.9	3.1			1.0	0.3		0.4
<i>Smilacina stellata</i>	0.5	0.3	0.3	0.1	0.5		0.4	0.1	0.2	0.2		0.1
<i>Spirea betufoia</i>						2.2			0.1			
<i>Streptopus sp.</i>	0.4	0.4	0.3						0.1			
<i>Symphoricarpus albus</i>	8.0	1.9	0.1						0.7			
<i>Thalictrum occidentale</i>	0.5	0.3	0.6	0.6	0.5		0.3	1.7	1.1	0.7		0.3
<i>Urtica dioica</i>							0.1					
<i>Vaccinium membranaceum</i>					6.9	2.1						0.3
<i>Vaccinium scoparium</i>					0.3	0.2						0.3
<i>Veronica americana</i>		0.1					0.2	0.2	0.1	0.2		
<i>Viola sp.</i>	0.4	0.6	0.7	0.2	0.2		0.5	0.3	0.1	0.1		

Table 2. Mean percent Frequency of recorded plant species within the control and clearcut areas adjacent (0 – 100 m) to an S6 stream. Note: A 50m distance from the stream was used in the clearcut area due to size of the clearcut.

Greenstone Mtn. (km 14.5)													
Plant Species	Mean % Frequency (N = 20)						Mean % Frequency (N = 20)						
	Control						Clearcut						
	0m	5m	10m	20m	50m	100m	0m	5m	10m	20m	50m	100m	
<i>Abies lasiocarpa</i>	5	5	5				5						
<i>Achillea millefolium</i>													
<u><i>Actaea rubra</i></u>	50	50	70	15	5		35	35	30				
<i>Alnus sp.</i>	5	25					20	15					
<i>Arnica cordifolia</i>	15		25	65	35	45	5	60	95	30	65		
<i>Arnica fulgens</i>									70	55	20		
<u><i>Aster conspicuus</i></u>	85	80	60	30	45	15	55	30	30	30	15		
<i>Calamagrostis rubescens</i>	55	50	15	15	85	50	45	45	80	80	95		
<i>Chimaphila umbuletta</i>								10	5				
<i>Clematis occidentalis</i>								5	20				
<i>Cornus canadensis</i>				30	45			20	50	40			
<i>Epilobium angustifolium</i>		5		5	10	5		10	10	5	10		
<u><i>Equisetum arvense</i></u>	35	45	10				50	20	5				
<i>Equisetum scirpoides</i>	90	85	85	5			35	15					
<i>Equisetum sp.</i>							5	15					
<u><i>Erigeron speciosus</i></u>							25	25	35	15	10		
<i>Festuca sp.</i>						10			5				
<i>Fragaria virginiana</i>	30	40	20	50	80	50	40	70	85	35	80		
<i>Galium boreale</i>	35		25				10	5	15				
<u><i>Galium triflorum</i></u>	55	85	55	20		5	40	70	45	30			
<i>Geranium sp.</i>	15	25					35	25					
<i>Geum macrophyllum</i>										5			
<i>Geum triflorum</i>							45	5			5		
<i>Goodyera oblongifolia</i>	5			5	15	5							
Gramineae family	35	60	35	30			5						
<i>Heracleum lanaton</i>	5	15	10					5	5		5		
<i>Hylocomium splendens</i>					5								
<i>Juniperus communis</i>		5											
<i>Lillium columbianum</i>					5			15	15		15		
<i>Linnaea borealis</i>	15	35	20	40	95	30	5	45	65	30	60		
<i>listera sp.</i>		5	10										
<i>Lonicera involucrata</i>	5		5	5	5								
<i>Lupinus articus</i>				5		45							
<i>Lupinus sericeus</i>				15	45			5	30				
<i>Lycopodium sp.</i>													
<i>Mitella sp.</i>	50	45	45	25	30		45	40	15				
<i>Moneses uniflora</i>													
<u><i>Orthilia secunda</i></u>	35	40	40	75	65	35	40	55	10	15	10		
<u><i>Osmorhiza chilensis</i></u>	60	70	60	35	40	30	25	50	10	20	20		

<i>Paxistima myrsinites</i>											5
<i>Pedasites palmatus</i>	70	70	75				20				
<i>Pedasites sagittatus</i>	5							10			
<i>Peltigeria sp.</i>	5	10		45	20	10					
<i>Picea engelmannii</i>	5		20	10	15	5		20	10		
<i>Platanthera unalaschensis</i>		15									
<i>Pleurozium schreberia</i>	20	55	25	25	85	35	40	10	30		15
<i>Poa pratensis</i>											
<i>Populus tremuloides</i>	25	40	20				10	10	15	20	25
<i>Populus trichocarpa</i>	15	30	25				35		20		5
<i>Ptilium crista-castrensis</i>		5		5	10	25					
<i>Ranaunculus spp.</i>	15	60	20	20			25	10	15		
<i>Ribes idaeus</i>							5	45	10	20	
<u>Ribes lacustre</u>	70	45	50	45	10		70	60	25	20	15
<i>Rosa sp.</i>	30	30	40	15	50	15	35	45	40	35	60
<i>Salix sp.</i>	15							10	10		5
<u>Senecio pseudoaureus</u>	50	70	50	15			55	45	20		
<i>Sheperdia canadensis</i>		15			25	15			20	5	10
<i>Smilacina stellata</i>	35	20	15	5	30		35	10	20	15	5
<i>Spiraea betuifolia</i>						50			5		
<i>Streptopus sp.</i>	20	40	20						5		
<i>Symphoricarpus albus</i>	10	25	5						20		
<i>Thalictrum occidentale</i>	35	25	45	30	25		25	60	55	30	25
<i>Urtica dioica</i>							5				
<i>Vaccinium membranaceum</i>					35	45					20
<i>Vaccinium scoparium</i>					20	10					25
<i>Veronica americana</i>		10					15	20	10	15	
<i>Viola sp.</i>	20	45	55	20	20		35	25	10	10	

Table 3. Mean percent cover of recorded plant species within the control and clearcut areas adjacent (0 – 100 m) to stream. Note: A 50m distance from the stream was used in the clearcut area due to size of the clearcut.

Plant Species	Greenstone Mtn. (km 17)											
	Mean % Cover (N = 20)						Mean % Cover (N = 20)					
	Control						Clearcut					
	0m	5m	10m	20m	50m	100m	0m	5m	10m	20m	50m	100m
<i>Achillea millefolium</i>						0.1					0.1	
<i>Actaea rubra</i>	0.4											
<i>Alnus sp.</i>	10.8	0.4	1.8				5.0	5.8	0.1			
<i>Aquilegia formaosa</i>												0.1
<i>Arctostaphylos uva-ursi</i>												0.2
<i>Arnica cordifolia</i>	0.3	0.6		0.4	1.2	1.2			0.1			
<i>Arnica fulgens</i>		0.1	0.7	0.6	0.4	0.7			0.1	1.3	0.1	
<i>Aster conspicuus</i>	1.1	0.7	0.8	0.8	0.6	0.8	0.4	0.7	0.7	0.5	1.4	
<i>Betula papyrifera</i>							0.1					
Bryophyte	1.6	5.3	16.3	1.3	0.2	2.5	5.5	4.0		0.2		
<i>Calamagrostis rubescens</i>			0.3	0.8	0.7	3.1						
<i>Carex sp.</i>	0.6	2.0			0.2			17.5	2.4			
<i>Chimaphila umbuletta</i>			0.1	0.1		0.4						
<i>Clintonia uniflora</i>						0.1		0.1				
<i>Cornus canadensis</i>		0.1	0.4	0.5	0.8		2.2	0.6	1.2	0.9	0.8	
<i>Epilobium angustifolium</i>				0.1				0.1	0.1	0.4	0.8	
<i>Equisetum arvense</i>	0.1	0.1					5.6					
<i>Equisetum scirpoides</i>		0.4		0.6				3.5	1.1			
<i>Equisetum sp.</i>	12.9	1.1	2.8	0.5			6.1	1.6	1.0	0.2		
<i>Erigeron speciosus</i>	0.1									0.1	0.1	
<i>Festuca sp.</i>	0.3		0.1	0.2	0.1	0.3			0.2		0.2	
<i>Fragaria virginiana</i>	0.1	0.3	0.4	1.1	0.4	1.7	0.3	0.6	0.8	0.9	3.1	
<i>Galium boreale</i>		0.2	0.1		0.3	0.3		0.1	0.1	0.5	0.7	
<i>Galium triflorum</i>	0.2	0.1		0.1	0.1	0.1		0.2	0.1		0.1	
<i>Geranium sp.</i>												
<i>Geum macrophyllum</i>	0.1	0.1					0.2	0.1				
<i>Geum triflorum</i>								0.1				
<i>Goodyera oblongifolia</i>			0.1	0.1	0.4	0.6						
Gramineae family	1.0	0.4	2.3	0.2		0.1	11.4	0.1		1.7	2.6	
<i>Heracleum lanaton</i>								0.1				
<i>Lathyrus sp.</i>						0.1						
<i>Ledum glandulosum</i>												
<i>Lillium columbianum</i>			0.1		0.2	0.3						
<i>Linnaea borealis</i>	0.6	0.4	0.5	2.1	1.9	2.9	0.2	0.7	3.3	0.2	0.8	
<i>Listera sp.</i>		0.1		0.1								
<i>Lonicera involucrata</i>			0.1						0.1			
<i>Lupinus articus</i>										0.3	0.3	
<i>Lupinus sericeus</i>				0.1		0.8			0.1		0.5	
<i>Lycopodium sp.</i>												

<i>Mitella sp.</i>	0.5	0.7	0.7	0.5	0.1		0.6	1.8	0.8	0.1	0.1
<i>Orthilia secunda</i>	0.1	0.2	0.5	0.4	0.7	2.0	0.1	0.8	0.8		
<i>Osmorhiza chilensis</i>	0.2	0.1	0.4	0.7	0.2	0.1	0.1	0.2	0.7	0.1	0.3
<i>Pedasites palmatus</i>	1.0	0.2	0.7	0.9			0.2	0.3	1.2	0.4	
<i>Pedasites palmatus var</i>		0.2					1.0	3.9	1.0		
<i>Pedasites sagittatus</i>	1.1						2.2	0.2			
<i>Peltigeria sp.</i>	0.1	0.1	0.1	0.8	0.1	0.5	0.1	0.3	0.2		
<i>Picea engelmannii</i>		0.1				0.5	1.8	0.1	0.1		0.1
<i>Pinus contorta</i>										0.1	0.1
<i>Platanthera unalaschensis</i>	0.2				0.1						
<i>Pleurozium schreberia</i>	0.1	0.6			25.4	0.4		0.6			
<i>Populus tremuloides</i>	0.9	1.1	0.1	0.2	0.1	0.3	0.2	1.4	0.4		0.4
<i>Populus trichocarpa</i>		0.1							0.1		
<i>Ranaunculus sp.</i>	0.3	0.2		0.1		0.1		0.2	0.2		
<i>Ribes hudsonianum</i>	0.1	0.1					1.7	0.5			
<i>Rubus idaeus</i>	0.9	0.2							0.2		0.3
<i>Ribes lacustre</i>	2.7	0.7	2.4	3.3	0.1	0.1	1.4	3.7	3.1	0.6	0.1
<i>Rosa sp.</i>		0.2	0.5	2.8	1.2	1.0	0.2	0.7	0.4	4.2	1.3
<i>Rubus parviflorus</i>	0.1	0.2	0.3								
<i>Rubus pubescens</i>	0.5						0.1	0.6	0.2	0.3	
<i>Salix sp.</i>								0.3			
<i>Senecio pseudoaureus</i>	1.2	0.3	0.3	0.3	0.1	0.4	0.4	0.6	0.6		0.2
<i>Senecio triangularis</i>	0.3										
<i>Sheperdia canadensis</i>			0.1	3.5		3.4			0.1		
<i>Smilacina stellata</i>	0.2	0.1				0.1	0.1				
<i>Spiranthes romanzoffiana</i>								0.1			
<i>Streptopus sp.</i>	0.4	0.1	0.1				1.2	2.1	0.3		
<i>Thalictrum occidentale</i>		0.6	0.1	0.3	0.1	0.2			0.1		0.2
<i>Vaccinium caespitosum</i>											0.1
<i>Vaccinium membranaceum</i>			0.1								1.2
<i>Vaccinium scoparium</i>	0.4		0.1							0.1	
<i>Valeriana sitchensis</i>											
<i>Veronica amricana</i>	0.3	0.8	0.2	0.1			0.3	0.1	0.1	0.3	1.2
<i>Viola sp.</i>	0.3	0.3	0.1				0.2	0.1	0.1		

Table 4. Mean percent Frequency of recorded plant species within the control and clearcut areas adjacent (0 – 100 m) to an S6 stream. Note: A 50m distance from the stream was used in the clearcut area due to size of the clearcut.

Plant Species	Greenstone Mtn. (km 17.0)											
	Mean % Frequency (N = 10)						Mean % Frequency (N = 20)					
	Control						Clearcut					
	0m	5m	10m	20m	50m	100m	0m	5m	10m	20m	50m	100m
<i>Achillea millefolium</i>						5					5	
<i>Actaea rubra</i>	15											
<i>Alnus sp.</i>	40	15	5				10	40	5			
<i>Aquilegia formaosa</i>											5	
<i>Arctostaphylos uva-ursi</i>											15	
<i>Arnica cordifolia</i>	15	35		20	50	40			5			
<i>Arnica fulgens</i>		5	35	15	15	45			10	85	10	
<i>Aster conspicuus</i>	50	70	70	60	40	55	40	55	60	40	45	
<i>Betula papyrifera</i>							5					
Bryophyte	35	55	50	40	30	65	40	10		10		
<i>Calamagrostis rubescens</i>			35	20	45	75						
<i>Carex sp.</i>	20	45			20			95	40			
<i>Chimaphila umbuletta</i>			5	5		25						
<i>Clintonia uniflora</i>						10		5				
<i>Cornus canadensis</i>		5	35	25	30		65	40	45	70	50	
<i>Epilobium angustifolium</i>				10				5	5	35	40	
<i>Equisetum arvense</i>	5	5					50					
<i>Equisetum scirpoides</i>		30		35				90	75			
<i>Equisetum sp.</i>	90	95	50	40			80	95	90	15		
<i>Erigeron speciosus</i>	5									10	5	
<i>Festuca sp.</i>	10		10	10	5	25			15		15	
<i>Fragaria virginiana</i>	5	25	40	50	35	80	20	45	70	55	95	
<i>Galium boreale</i>		15	5		10	25		10	5	35	45	
<i>Galium triflorum</i>	20	10		10	5	5		15	10		10	
<i>Geum macrophyllum</i>	10	5					20	5				
<i>Geum triflorum</i>								5				
<i>Goodyera oblongifolia</i>			5	5	20	40						
Gramineae family	50	75	10	15		5	50	5		40	95	
<i>Heracleum lanaton</i>								5				
<i>Lathyrus sp.</i>						5						
<i>Lillium columbianum</i>			5		10	30						
<i>Linnaea borealis</i>	15	20	35	45	65	85	10	45	45	15	45	
<i>Listera sp.</i>		5		5								
<i>Lonicera involucrata</i>			5						5			
<i>Lupinus articus</i>										10	10	
<i>Lupinus sericeus</i>				5		20			5		20	
<i>Mitella sp.</i>	40	40	45	20	10		50	95	65	5	10	
<i>Orthilia secunda</i>	10	15	40	40	50	65	5	30	45			
<i>Osmorhiza chilensis</i>	15	10	30	45	15	10	5	15	60	10	25	
<i>Pedasites palmatus</i>	60	10	50	35			5	20	45	30		
<i>Pedasites palmatus var</i>		20					45	85	70			
<i>Pedasites sagittatus</i>	50						30	10				

<i>Peltigeria sp.</i>	10	5	5	25	10	25	5	30	5		
<i>Picea engelmannii</i>		5				5	10	5	5		5
<i>Pinus contorta</i>										10	5
<i>Platanthera</i>											
<i>unalachensis</i>	15				5						
<i>Pleurozium schreberia</i>	10	20			80	25		10			
<i>Populus tremuloides</i>	30	30	5	10	10	20	10	30	20		25
<i>Populus trichocarpa</i>		5							10		
<i>Ptilium crista-castrensis</i>					15						
<i>Ranaunculus sp.</i>	30	20		5		5		15	15		
<i>Ribes hudsonianum</i>	5	5					30	15			
<i>Ribes lacustre</i>	40	25	40	50	5	5	50	85	45	25	10
<i>Rosa sp.</i>		15	20	60	35	45	10	25	15	55	45
<i>Rubus idaeus</i>	10	5							15		15
<i>Rubus parviflorus</i>	5	5	10								
<i>Rubus pubescens</i>	15						10	50	30	20	
<i>Salix sp.</i>								10			
<i>Senecio pseudoaureus</i>	35	25	25	10	10	20	15	50	40		10
<i>Senecio triangularis</i>	20										
<i>Sheperdia canadensis</i>			10	30		40			5		
<i>Smilacina stellata</i>	10	10				5	10				
<i>Spiranthesromanzoffiana</i>								10			
<i>Streptopus sp.</i>	20	10	5				70	65	25		
<i>Thalictrum occidentale</i>		45	10	25	5	10			5		20
<i>Vaccinium caespitosum</i>											5
<i>Vaccinium</i>											
<i>membranaceum</i>			10								30
<i>Vaccinium scoparium</i>	10		5							5	
<i>Veronica amricana</i>	25	35	20	5			20	5	10	20	65
<i>Viola sp.</i>	25	25	10				15	10	5		

Table 5. Mean percent cover of recorded plant species within the control and clearcut areas adjacent (0 – 100 m) to stream. Note: A 50m distance from the stream was used in the clearcut area due to size of the clearcut.

Plant Species	Road 3300									
	Mean % Cover (n = 20)									
	Control					Clearcut				
	0m	5m	10m	20m	50m	0m	5m	10m	20m	50m
<i>Abies lasiocarpa</i>			0.1							
<i>Achillea millefolium</i>	0.1	0.1	0.1	0.5	0.5	0.5	0.2	0.1	0.9	0.2
<i>Actaea rubra</i>				0.1						
<i>Aquilegia formaosa</i>	0.5			0.5		0.1	0.6			
<i>Arctostaphylos uva-ursi</i>			0.9	1.0			0.1		0.1	1.4
<i>Arnica cordifolia</i>	0.5	1.9	2.3	3.5	1.0	0.2	0.3	0.3	0.5	0.4
<i>Aster conspicuus</i>	0.5	0.4	0.2	0.9	1.4	2.6	0.4	0.1	0.7	0.3
<i>Aster sp.</i>	1.2			0.2						
<i>Calamagrostis rubescens</i>	0.7	3.5	6.1	6.7	1.4	0.2	0.9	1.3	1.3	1.6
<i>Carex sp.</i>						0.8		0.1		0.2
<i>Chimaphila umbuletta</i>			0.1		0.4					0.1
<i>Cornus canadensis</i>	7.2	21.4	14.3	7.3	4.4	0.7	0.9	1.8	1.1	0.4
<i>Epilobium angustifolium</i>		0.3	0.6	1.0	0.2	0.1	0.2	0.4	0.5	0.5
<i>Equisetum scirpoides</i>	2.1	1.0	0.1	0.1		0.4	0.3			
<i>Equisetum spp.</i>	1.1	0.6	0.3			0.3	0.7			
<i>Festuca sp.</i>	0.1			1.1	0.2	0.5			0.1	
<i>Fragaria virginiana</i>	1.9	0.8	0.6	3.1	1.6	1.6	1.3	1.7	1.2	0.2
<i>Galium boreale</i>	0.5	0.1			0.6	0.9	0.5	0.1	0.9	0.1
<i>Galium triflorum</i>		0.1								
<i>Geranium sp.</i>	0.1				0.5					
<i>Goodyera oblongifolia</i>	0.2	0.2	0.3	0.4	0.1					
Gramineae family						0.7	0.1	0.4		0.3
<i>Gymnocarpium dryopteris</i>	0.1									
<i>Heracleum lanaton</i>	0.1									
<i>Lathyrus sp.</i>	1.7	3.2	1.7	1.5	1.1	0.4	1.8	1.7	1.7	0.3
<i>Lillium columbianum</i>	0.1	0.3	0.4	0.1	0.5		0.1	0.2		0.2
<i>Linnaea borealis</i>	1.6	6.3	3.8	4.8	2.5	0.2	0.1	0.1	0.1	1.0
<i>Lonicera involucrata</i>	0.5		0.2		0.2	0.1				
<i>Lupinus articus</i>	0.7				0.9				1.6	
<i>Lupinus sericeus</i>		2.9	3.4	3.3	0.5	0.1	0.5	1.4	0.7	4.2
<i>Mitella spp.</i>	1.8	0.8			0.3	0.3	0.1			
Moss.sp.	18.0	1.8	0.8	1.4	3.8	12.6				
<i>Orthilia secunda</i>	0.5	0.6	0.5	1.0	0.7	0.1				
<i>Osmorhiza chilensis</i>	0.3		0.1	0.1	0.6	0.1	0.2		0.1	
<i>Pedasites palmatus</i>	1.5	2.3	0.3		0.2	0.7	0.9	0.6		
<i>Peltigeria sp.</i>	1.6	0.5			0.1					
<i>Picea engelmannii</i>	8.7	10.0	9.5	2.6	3.3		0.1	3.5		
<i>Pinus contorta</i>			0.5							
<i>Platanthera dilatata</i>			0.2							
<i>Platanthera unalachensis</i>		0.1	0.1							
<i>Pleurozium schreberia</i>	3.9	11.3	13.1	17.1	27.2				1.3	0.3
<i>Populus tremuloides</i>	0.1	0.3	0.2	0.6	0.1	0.2		0.1	0.1	
<i>Ptilium crista-castrensis</i>			0.2	0.2	2.1					
<i>Ranaunculus spp.</i>	0.5					0.6	0.1	0.1	0.1	
<i>Ribes lacustre</i>				2.0		1.8				
<i>Rosa sp.</i>	3.5	2.2	2.2	2.6	1.3	1.5	2.0	1.4	1.1	1.2
<i>Rubus pubescens</i>	2.9	0.5			0.1	0.3	0.2	0.2	0.2	
<i>Salix sp.</i>	0.1	0.3	0.1	0.2						
<i>Senecio pseudoaureus</i>	0.3				0.8	1.0	0.4	0.1	0.2	
<i>Sheperdia canadensis</i>	0.4	0.9	2.3	0.2	0.3	1.6	0.6	0.2	0.1	0.7
<i>Smilacina stellata</i>	0.1					0.1				
<i>Spirea betulifolia</i>	0.3	0.9	1.8	1.7	0.6	0.1	0.1	0.5	0.9	0.4

<i>Streptopus sp.</i>		0.1								
<i>Symphoricarpus albus</i>	0.1				1.6			0.3	0.8	
<i>Thalictrum occidentale</i>	0.2	0.1			1.4	0.3	0.1		0.1	
<i>Vaccinium</i>										
<i>membranaceum</i>	1.7	2.7	9.4	5.0	10.5	0.2	0.7	0.4	0.9	0.5
<i>Vaccinium scoparium</i>		0.1		0.1	0.1	0.1				
<i>Veronica americana</i>	0.1		0.1		0.2	0.3	0.2			
<i>Vicia americana</i>		0.2	0.1	0.3		0.6	0.2		0.1	
<i>Viola sp.</i>	0.7	0.1			0.9	0.1			0.1	

Table 6. Mean percent frequency of recorded plant species within the control and clearcut areas adjacent (0 – 100 m) to an S6 stream. Note: A 50m distance from the stream was used in the clearcut area due to size of the clearcut.

Plant Species	Road 3300					Mean % Frequency (N = 20)				
	Mean % Frequency (N = 20)					Mean % Frequency (N = 20)				
	Control					Clearcut				
	0m	5m	10m	20m	50m	0m	5m	10m	20m	50m
<i>Abies lasiocarpa</i>			5							
<i>Achillea millefolium</i>	10	10	10	25	45	35	15	10	50	20
<i>Aquilegia formaosa</i>	30			5		5	15			
<i>Arctostaphylos uva-ursi</i>			10	10			5		10	30
<i>Arnica cordifolia</i>	65	70	80	85	45	10	30	30	50	35
<i>Aster conspicuus</i>	45	20	5	15	55	95	25	10	30	30
<i>Aster sp.</i>	70			20						
<i>Calamagrostis rubescens</i>	7	100	100	100	95	15	90	100	100	100
<i>Carex sp.</i>						50		5		15
<i>Chimaphila umbuletta</i>			5		20					10
<i>Cornus canadensis</i>	95	75	95	95	60	40	60	60	80	30
<i>Epilobium angustifolium</i>		25	50	55	15	10	20	35	40	35
<i>Equisetum scirpoides</i>	85	20	10	5		25	20			
<i>Equisetum sp.</i>	95	50	30			25	45			
<i>Festuca sp.</i>	10			15	10	25			10	
<i>Fragaria virginiana</i>	85	50	50	65	70	80	80	45	75	15
<i>Galium boreale</i>	45	10			35	70	40	5	35	5
<i>Galium triflorum</i>		10								
<i>Geranium sp.</i>	5				25					
<i>Goodyera oblongifolia</i>	20	15	30	30	10					
Gramineae family						60	5	40		30
<i>Gymnocarpium dryopteris</i>	5									
<i>Heracleum lanaton</i>	5									
<i>Lathyrus sp.</i>	75	90	70	50	70	30	80	55	95	5
<i>Lillium columbianum</i>	10	25	35	10	45		5	15		15
<i>Linnaea borealis</i>	60	75	75	60	60	10	10	10	5	45
<i>Lonicera involucrata</i>	25		10		15	5				
<i>Lupinus articus</i>	35				40				40	
<i>Lupinus sericeus</i>		80	85	95	75	5	40	75	40	90
<i>Mitella sp.</i>	70	20			10	20	10			
Moss.sp.	75	45	30	30	55	60				
<i>Orthilia secunda</i>	50	40	40	30	35	5				
<i>Osmorhiza chilensis</i>	25		5	13	40	10	20		5	
<i>Pedasites palmatus</i>	95	50	15		10	40	40	10		
<i>Peltigeria sp.</i>	35	20			5					
<i>Picea engelmannii</i>	25	50	55	20	10		5	5		
<i>Pinus contorta</i>			5							
<i>Platanthera dilatata</i>			20							
<i>Platanthera unalaschensis</i>		10	10							
<i>Pleurozium schreberia</i>	45	55	95	70	65				5	20
<i>Populus tremuloides</i>	5	20	5	10	5	15		10	5	
<i>Ptilium crista-castrensis</i>			15	5	20					

<i>Ranaunculus sp.</i>	40					35	5	5	5	
<i>Ribes lacustre</i>				5		40				
<i>Rosa sp.</i>	95	95	90	75	80	70	90	65	80	80
<i>Rubus pubescens</i>	65	20			10	15	10	15	15	
<i>Salix sp.</i>	5	15	5	10						
<i>Senecio pseudoaureus</i>	30				40	60	20	5	15	
<i>Sheperdia canadensis</i>	5	10	5	5	10	25	20	15	5	10
<i>Smilacina stellata</i>	5					10				
<i>Spirea betufoia</i>	25	30	45	55	35	5	10	35	60	20
<i>Streptopus sp.</i>		5								
<i>Symphoricarpus albus</i>	5				15			25	30	
<i>Thalictrum occidentale</i>	10	5			40	25	5		5	
<i>Vaccinium membranaceum</i>	55	75	90	95	80	15	35	35	60	45
<i>Vaccinium scoparium</i>		5		5	10	5				
<i>Veronica americana</i>	5		5		20	25	20			
<i>Vicia americana</i>		20	5	15		45	20		10	
<i>Viola sp.</i>	65	5			30	5			5	

Table 7. Mean percent cover of recorded plant species within the control and clearcut and old clearcut areas adjacent (0 – 100 m) to stream.

Plant Species	Heller Creek Mean % Cover (N = 20)						Heller Creek Mean % Cover (N = 10)						Heller Creek Mean % Cover (N = 20)					
	Control						Clearcut						Old Clearcut					
	0m	5m	10m	20m	50m	100m	0m	5m	10m	20m	50m	100m	0m	5m	10m	20m	50m	100m
<i>Abies lasiocarpa</i>			0.1								9.3			0.6				
<i>Achillea millefolium</i>	0.1	0.1	0.2	0.1										0.4	0.3	0.5	1.5	0.6
<i>Actaea rubra</i>	5.1							0.5	0.1	0.2			4.2					
<i>Alnus sp.</i>	10.7	0.2	1.4	0.7			5.3						14.6	0.3	0.5			
<i>Anaphalis margaritacea</i>													7.8					
<i>Aquilegia formaosa</i>			0.6	0.4	0.5				0.2						2.0			
<i>Arctostaphylos uva-ursi</i>		0.1			0.1													
<i>Arnica cordifolia</i>	1.1	2.1	1.2	0.5	0.7	1.1	0.1	0.8	0.2	0.1	0.3		0.7	1.0	2.0	1.1	0.1	0.2
<i>Aster conspicuus</i>	0.6	1.4	0.9	1.4	0.9	1.8	0.2	0.5	0.3	0.7	1.2		4.2	1.9	0.4	1.2	2.4	0.1
<i>Calamagrostis rubescens</i>		1.7	0.3	0.1	1.1	4.7	0.5			0.3	0.8		0.8	0.2	0.5	11.5	5.5	0.4
<i>Clintonia uniflora</i>		0.1		1.8				0.4		0.1	0.9				0.5			
<i>Cornus canadensis</i>	0.5	3.9	5.6	5.1	2.7	2.3	1.2	0.5	1.3	0.6	1.4		0.9	3.2	3.5	0.8	0.9	0.3
<i>Epilobium angustifolium</i>	2.5	6.2	4.3	1.7	0.9	3.2	0.5	0.1		0.7	0.7		0.3	1.7	2.1	1.4	3.0	4.7
<i>Equisetum arvense</i>										0.6			3.7	0.6			0.1	0.1
<i>Equisetum sp.</i>	16.9	6.2	3.5	0.4	0.1		1.0						25.4	0.5	0.5	0.1	0.2	
<i>Eriogonum heracleodes</i>							0.1											
<i>Festuca sp.</i>							0.4			0.2				0.1		0.5		0.1
<i>Fragaria virginiana</i>	1.7	1.8	4.2	1.3	1.7	4.9	1.7	0.4	1.7	2.4	1.0		3.4	2.3	2.4	1.6	2.3	7.9
<i>Galium boreale</i>		0.1	0.3		0.1			0.6	0.2	0.1			0.1	0.1	0.3	0.1	0.8	0.3
<i>Galium triflorum</i>	1.4	0.1	0.1	0.4			0.3						0.3	0.9				
<i>Geum macrophyllum</i>	1.1		0.1	0.4									0.7	0.4			0.2	
<i>Geum triflorum</i>													0.7					
<i>Goodyera oblongifolia</i>					0.3													
Gramineae family	3.0	2.0	1.3	1.0	11.8	5.6	0.5	0.5	1.1		0.4		1.6	4.0	3.3	0.1	0.2	5.9
<i>Gymnocarpium dryopteris</i>	1.2												0.2					
<i>Heracleum lanaton</i>	4.6	1.0	0.2	0.3	0.1					0.1			3.9	1.6	0.1		0.1	
<i>Hylocomium splendens</i>							0.8											
<i>Juniperus communis</i>		0.1	0.1											0.2		0.2		
<i>Ledum glandulosum</i>														0.8	0.3			
<i>Lillium columbianum</i>		0.3		0.1	0.2	0.3					0.4						0.2	0.3
<i>Linnaea borealis</i>	0.3	4.0	0.9	0.5	0.9	4.1	0.6	0.8	0.3	0.3	0.2		0.1	0.9	4.1	2.8	0.6	0.5
<i>Listera sp.</i>	0.1	0.1	0.2	0.1										0.1				
<i>Lonicera involucrata</i>	1.0	4.2	2.0	2.6	0.7	0.7	0.4			0.9	0.1		2.0	5.9	0.1	0.8	4.0	0.8

<i>Lupinus articus</i>		0.1	0.3	0.2	0.4	3.2						0.2	1.4		0.8	0.9
<i>Lupinus sericeus</i>	0.1	0.1	0.2	0.2	1.4	0.6						0.9	4.2	3.3	1.3	1.1
<i>Lycopodium sp.</i>													0.3			
<i>Mitella sp.</i>	0.7	0.5	0.3	0.3	0.4	0.2	0.3	0.2	0.4		10.4	0.4	0.3		0.4	
<i>Moneses uniflora</i>												0.1				
<i>Orthilia secunda</i>	0.2	0.2	0.5	0.3	0.6	0.2	0.1	0.1		0.1	0.2	0.7	0.7	0.9		
<i>Osmorhiza chilensis</i>	0.1	0.1		0.1												
<i>Paxistima myrsinites</i>					0.4		1.2									
<i>Pedasites palmatus</i>	0.5	3.5	1.3	1.7	0.9	2.1	0.6	0.1	0.2	0.4		0.4	2.1	0.1	1.0	0.4
<i>Picea engelmannii</i>		4.4	2.1	5.6	0.8	1.3	0.2			0.2		5.5	5.0	2.5	1.8	
<i>Pinus contorta</i>												0.3	1.8	0.8	6.2	4.0
<i>Platanthera dilatata</i>											0.2		0.1			
<i>Platanthera unalaschensis</i>											0.1	0.1				
<i>Pleurozium schreberia</i>	0.1	2.8	7.4	28.8	23.0	8.1						10.7	8.6	1.2		0.1
<i>Populus tremuloides</i>		0.1	0.1	0.1											0.2	
<i>Pseudotsuga menziesii</i>													0.2			
<i>Ptillium crista-</i>																
<i>castrensis</i>		0.5		0.1			1.4		0.2	0.1		0.2				
<i>Ranaunculus sp.</i>	0.2		0.3	0.4			0.2		0.2		0.2	0.1	0.1			0.1
<i>Ribes hudsonianum</i>											1.1					
<i>Ribes lacustre</i>	1.9	2.8	0.3	3.3	0.2		0.3		1.7		1.8	0.3	2.8		0.3	0.1
<i>Rosa sp.</i>				0.5	1.4	3.7			0.2	1.4		1.4	0.3	0.8	2.0	1.2
<i>Rubus parviflorus</i>	0.1								0.5	1.4		0.1	0.1			
<i>Rubus pedatus</i>	0.1	3.5	2.1	0.6				0.2	0.4		0.1	0.6	1.1			
<i>Rubus pubescens</i>	1.9		1.8								0.7	2.1			0.2	
<i>Salix sp.</i>	0.3				0.1	0.5					1.2	0.7		3.6	7.7	0.5
<i>Senecio pseudoaureus</i>	0.6	0.2		1.0	0.4		0.6	0.8	0.7		1.1	0.8	1.0	0.1	1.2	0.2
<i>Senecio triangularis</i>	0.3										2.5	0.1				0.1
<i>Sheperdia canadensis</i>								0.1				0.4	4.3			
<i>Solidago canadensis</i>											1.4	0.3				
<i>Spirea betuifolia</i>							0.1	0.1	1.4	0.2			0.1	1.8		
<i>Sterptopus sp.</i>	7.2	0.9	1.1	0.1	0.1						1.4	1.6	0.1			
<i>Symphoricarpus albus</i>										0.1						
<i>Tellima grandiflora</i>	0.3															
<i>Thalictrum occidentale</i>						0.1		0.2	0.7	0.4	1.2	0.5	1.2	0.1	0.9	0.3
<i>Tiarella sp.</i>												0.1				
<i>Trollius laxus</i>	0.3										1.1					
<i>Vaccinium</i>																
<i>membranaceum</i>	0.1		0.3	1.1			1.0	0.1	0.1			1.9	5.2	6.0	3.7	0.9
<i>Vaccinium scoparium</i>	1.2	0.9	3.5	3.6	3.0	4.5	0.6	0.6	0.1	0.2		1.2	2.5	1.6	0.3	0.9
<i>Valeriana sithchensis</i>	2.0	1.1		0.2							6.4	0.8	2.5			
<i>Veronica americana</i>									0.1		0.4	0.1				
<i>Viola sp.</i>	0.5	0.1	0.2	0.5	0.2		0.2				0.4	0.2	0.1		1.4	0.1

Table 8. Mean percent Frequency of recorded plant species within the control and clearcut areas adjacent (0 – 100 m) to an S6 stream.
Note: A 50m distance from the stream was used in the clearcut area due to size of the clearcut.

Plant Species	Heller Creek Mean % Frequency (N = 20)						Heller Creek Mean % Frequency (N = 10)						Heller Creek Mean % Frequency (N = 20)					
	Control						Clearcut						Old Clearcut					
	0m	5m	10m	20m	50m	100m	0m	5m	10m	20m	50m	100m	0m	5m	10m	20m	50m	100m
<i>Abies lasiocarpa</i>			5								30			10				
<i>Achillea millefolium</i>	5	5	15	10										25	20	40	85	40
<i>Actaea rubra</i>	40							20	10	20			30					
<i>Alnus sp.</i>	50	15	25	15			30						65	10	15			
<i>Anaphalis margaritacea</i>													35					
<i>Aquilegia formaosa</i>			15	10	25				10						10			
<i>Arctostaphylos uva-ursi</i>		5			5													
<i>Arnica cordifolia</i>	30	80	75	40	35	35	10	70	20	10	20		25	55	90	65	10	10
<i>Arnica sp.</i>																	5	
<i>Aster conspicuus</i>	25	55	40	65	45	40	20	30	30	60	90		30	40	20	40	75	5
<i>Aster sp.</i>			60	90											35			45
<i>Calamagrostis rubescens</i>		15	30	10	30	50	50			30	60		10	10	20	100	90	40
<i>Clintonia uniflora</i>		5		10				20		10	50				20			
<i>Cornus canadensis</i>	30	95	95	95	100	70	90	50	70	50	100		25	85	85	30	55	15
<i>Epilobium angustifolium</i>	60	90	80	70	60	60	50	10		60	60		20	35	80	85	95	95
<i>Equisetum arvense</i>										60			50	45			5	10
<i>Equisetum sp.</i>	100	85	80	30	10		80						50	35	40	5	15	
<i>Eriogonum heracleodes</i>							10											
<i>Festuca sp.</i>							40			20				5		25		10
<i>Fragaria virginiana</i>	85	90	70	40	75	100	70	40	80	100	70		40	80	85	80	75	100
<i>Galium boreale</i>		5	25		5			10	20	10			5	5	20	5	45	10
<i>Galium triflorum</i>	70	5	5	35			20						25	25				
<i>Geum macrophyllum</i>	45		5	15									35	15			5	
<i>Geum triflorum</i>													30					
<i>Goodyera oblongifolia</i>					10													
Gramineae family	85	70	45	60	50	40	50	50	100		40		45	90	80	5	15	55
<i>Gymnocarpium dryopteris</i>	35												10					
<i>Heracleum lanaton</i>	50	10	5	5	5					10			50	20	5		5	
<i>Hylocomium splendens</i>							40											
<i>Juniperus communis</i>		5	5											5		5		
<i>Ledum glandulosum</i>														5	5			

<i>Lillium columbianum</i>		15		10	15	20					30					20	25	
<i>Linnaea borealis</i>	15	55	65	40	50	65	40	60	20	30	20		5	45	70	75	35	20
<i>Listera sp.</i>	5	5	15	5										5				
<i>Lonicera involucrata</i>	20	45	25	25	10	20	30			40	10		30	45	5	10	20	5
<i>Lupinus articus</i>		5	20	5	25	45								5	35		15	40
<i>Lupinus sericeus</i>	5	10	10	10	40	20								25	40	65	45	35
<i>Lycopodium sp.</i>															5			
<i>Mitella sp.</i>	40	30	30	25	40	10	30		20	40			75	30	25		5	
<i>Moneses uniflora</i>														5				
<i>Orthilia secunda</i>	15	20	40	25	60	15	10		10		10		10	35	40	40		
<i>Osmorhiza chilensis</i>	5	5		5														
<i>Paxistima myrsinites</i>					20		30											
<i>Pedasites palmatus</i>	30	70	80	95	40	50	60	10		20	40			35	60	5	65	40
<i>Picea engelmannii</i>		25	20	20	10	5	20				10			10	30	15	20	
<i>Pinus contorta</i>					10									10	30	5	15	30
<i>Platanthera dilatata</i>													20		10			
<i>Platanthera unalaschensis</i>													5	5				
<i>Pleurozium schreberia</i>		25	50	80	80	65								45	25	30		5
<i>Populus tremuloides</i>		5	5	5													5	
<i>Pseudotsuga menziesii</i>															5			
<i>Ptillium crista-castrensis</i>		10		5			60			20	10			5				
<i>Ranaunculus spp.</i>	15	15		25			20			20			15	5	5			5
<i>Ribes hudsonianum</i>													25					
<i>Ribes lacustre</i>	55	55	15	45	5		30			80			45	15	10		5	5
<i>Rosa sp.</i>				25	45	50				20	80			20	10	25	50	60
<i>Rubus parviflorus</i>	5									40	50			5	5			
<i>Rubus pedatus</i>	5	60	55	20				20		40			10	35	80			
<i>Rubus pubescens</i>	35			10									25	40			5	
<i>Salix sp.</i>	5				5	15							10	15		25	45	15
<i>Senecio pseudoaureus</i>	20	15		40	15		30		50	40			15	35	30	5	45	15
<i>Senecio triangularis</i>	5												55	5				20
<i>Sheperdia canadensis</i>								10						10	15			
<i>Solidago canadensis</i>													35	25				
<i>Spirea betuifolia</i>								10	10	80	20				5	25		
<i>Sterptopus sp.</i>	85	15	30	10	5								40	45	5			
<i>Symphoricarpus albus</i>											10							
<i>Tellima grandiflora</i>	15																	
<i>Thalictrum occidentale</i>						20			20	40	20		20	5	10	5	20	10
<i>Tiarella sp.</i>														5				
<i>Trollius laxus</i>	25												40					
<i>Vaccinium</i>	5		20	25				10	10	10				15	30	50	30	15

<i>membranaceum</i>																	
<i>Vaccinium scoparium</i>	15	40	75	85	55	60	30	30	10	10		45	45	55	15	40	
<i>Valeriana sithchensis</i>	30	10		15							30	10	5				
<i>Veronica americana</i>									10		10	5					
<i>Viola sp.</i>	45	10	15	40	10			20			35	10	5		15	5	



Skeetchestn Indian Band

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Skeetchestn Cultural Resource Management Zones (CRMZ)

Updated May 1, 2008

To address the deterioration of our watersheds and the loss of fisheries and riparian habitats, as well as, other important cultural values Skeetchestn Indian Band has implemented the management strategy of Cultural Resource Management Zones (CRMZ) throughout our Area Of Interest within Secwepmecul'ecw.

For any resource development or activity within our Area of Interest the following applies:

C.R.M.Z.s are to be established within 100 meters of all water and riparian features in Skeetchestn Traditional Territory.

All C.R.M.Z.s require a Skeetchestn Cultural Heritage Assessment and Inventory

The forest canopy within these management zones is to be managed for:

1. Traditional culturally significant plants for medicinal, food, technological, ceremonial, spiritual and other uses.
2. Wildlife habitat, biodiversity, travel corridor and connectivity values.
3. Fisheries habitat in terms of:
 - water temperatures
 - contributions to stream processes and biology
 - amelioration of spiking in the hydrograph
 - sediment filtration capacity
4. Wind firmness of residual stands.

Applicable management strategies within C.R.M.Z.s:

- No more than 50 % basal area removal in any single pass within 50 meters of water.
- Use of selection and shelterwood silviculture systems.
- Use of light impact equipment and harvesting methods.
- Assessment and protection of all potential and existing wildlife trees.
- Inventory and protection of all regeneration and non-merchantable stems.
- Aspen, birch, sub-alpine fir, spruce, and Douglas -fir will be considered preferred species within these zones and are to be encouraged for their wildlife habitat, medicinal and other Traditional Use values.
- Minimal road building within Cultural Resource Management Zones
- Minimum 20 meter reserves on all fish bearing and direct tributary streams, with consideration for Coarse Woody Debris (CWD) values

During this period of intense Mountain Pine Bark Beetle infestation, due to the unpredictable rates and duration of attack it is very difficult to determine if and when unacceptable E.C.A.s (Equivalent Clear-cut Areas) will occur within any one watershed or portion thereof. These unacceptably high E.C.A.s can have extremely detrimental effects to important First Nation Cultural values and will impact Aboriginal Rights of the Skeetchestn people. In the case of Mountain Pine Beetle Blocks, where harvesting is occurring primarily to address forest health issues further constraints will therefore apply.

This constraint includes:

- The retention of all advanced regeneration and species other than pine within 100 meters of water and riparian areas.

Appendix B – Skeetchestn Cultural Resource Management Zones (CRMZ)

Originally dated Sept. 20, 2002
Chief Eddy Jules
Skeetchestn Indian Band

Updated May 1, 2008
Chief Ron Ignace
Skeetchestn Indian Band

Chief Ron Ignace
Skeetchestn Indian Band

Date