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Uncha Mountain Red Hills Provincial Park Grassland Restoration Prescribed Fire: Results of First Year Vegetation Monitoring

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Prepared for:

Bulkley Valley Centre for Natural Resources
Research & Management
Smithers, B.C.

Prepared: October 2008

Acknowledgements

Ian Meier, Fire Centre Manager, Northwest Fire Centre, British Columbia Ministry of Forests and Range, assisted with writing the fire plan and with planning the burn in general. Rob Krause, Forest Protection Officer, Nadina Fire Zone, B.C. Ministry of Forests and Range, carried out the burn with the assistance of fire fighting crews from the Nadina Fire Zone. Craig Paulson, BC Parks, Ministry of Environment, was instrumental in coordinating the burn approvals within the Ministry of Environment, and implementing the burn. Mike Neto, Tweedsmuir North Area Supervisor, BC Parks and Rick Heinrichs, Ecosystem Specialist, Ministry of Environment also assisted in the burn planning and implementation. Olivia Pojar, Leanne Helkenberg and Ruth Lloyd assisted with vegetation monitoring. The Habitat Conservation Trust Fund and the provincial Mountain Pine Beetle Initiative provided funding for this project.

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1.0 Introduction

A prescribed fire in the Red Hills of Uncha Mountain Red Hills Provincial Park, British Columbia, was carried out on May 9th, 2008 by staff of the Nadina Fire Zone of the B.C. Ministry of Forests and Range Northwest Fire Centre. The burn followed the vegetation management prescription and prescribed fire burn plan for the area (de Groot 2008). The objectives of the fire were:

1) To reduce the cover of woody plant species, especially aspen (*Populus tremuloides*), and increase the cover of forbs and graminoids.

2) To assess the effectiveness of burning as a treatment for controlling aspen encroachment on SBSdk/81 grasslands.

2.0 Methods

Vegetation monitoring plots and transects were established in 2007 (de Groot 2008, Helkenberg and Haeussler 2008). On May 9, 2008, fire hoses were set up around the burn perimeter before blacklines were burned on the uphill perimeter of the burn area. Fire was then lit using handheld drip torches in three strips working from the top to the bottom (Figure 1). The weather was warm and dry; cloud cover in the afternoon around ignition time may have reduced the intensity of the fire.

Figure 1. Blackline being lit using drip torches.

The fire was contained entirely within the target area as laid out on the ground. The east half of the monitoring plot is within the area targeted for burning and the west half is in the unburned control. The ground layout closely followed the mapped target area (Figure 2). The burn was patchy. Unburned areas created a mosaic effect over the burn area. Fire intensity was variable, ranging from severely burned where there was heavier fuel loading to light in areas with few fuels.

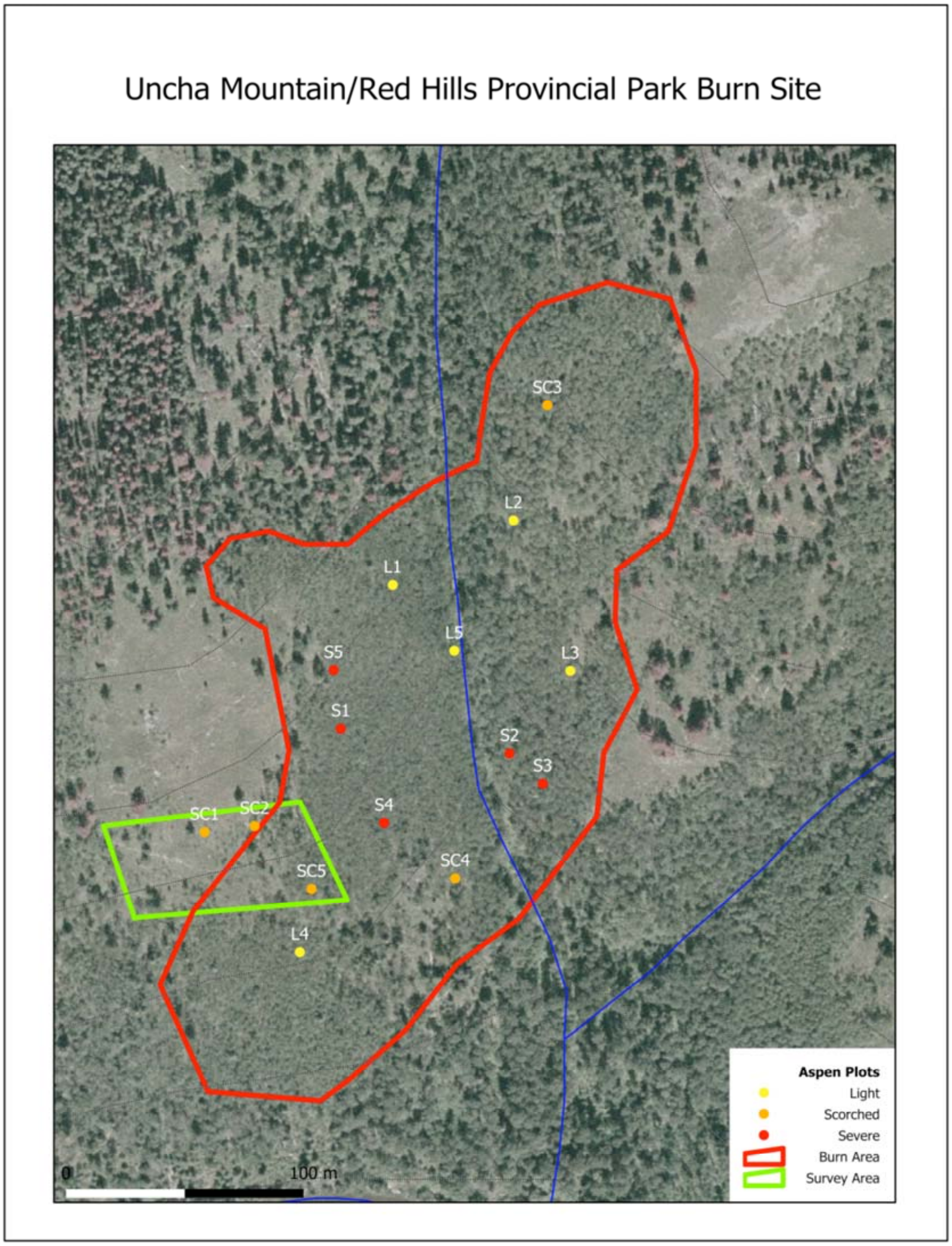

Figure 2. Location of burn and vegetation and aspen monitoring plots.

Postfire burn impact monitoring was done three days after the fire – May 12, 2008. Monitoring included recording fire intensity in each of the Daubenmire quadrats and along the transects established in 2007 and taking photos inward along each of the transects. For the photos, a 2 m long graduated pole with 50 cm graduations was placed 5 m from the transect end and a label was placed 2.5 m from the transect end. All photos were taken with the camera held above the transect marking stake at eye height. Photos were taken with a Fujifilm Finepix E550 camera with a focal length of 28.8 mm (35 mm camera equivalent). The vegetation along the transects and in the quadrats was remeasured July 29 to 31, 2008, following the methods used in de Groot (2008) and Veenstra and Haeussler (2002).

Three classes of fire severity as described by Wang (2003) were used to describe the impact of fire on the vegetation (depth of burn): Scorched (litter not burned or partially burned); lightly burned (litter burned but without or with very limited duff consumption); and severely burned (forest floor completely consumed and possible consuming of organic matter in the Ah horizon). This fire classification was relative to conditions found within the burn area. As this was a spring burn, shortly after snowmelt, the duff layers had not dried out. Thus, the severe class does not imply an extremely hot fire that would cause soil degradation such as might occur in late summer after a prolonged dry period.

Figure 3. Lightly burned area along transect three.

Fifteen aspen monitoring plots were subjectively located three days after the burn (Table 1, Figure 2). Five plots were sited in scorched, five in lightly burned and five in severely burned areas. In each aspen monitoring plot, the ten trees closest to plot centre were marked with numbered aluminium tags and diameter at breast height (dbh) was measured. Live aspen suckers were counted within a 1.78 m radius plot at plot centre. There were no live suckers in any of the plots. These plots were revisited to record aspen tree mortality and sucker production on July 17, 2008. Tree and sucker vigour was measured following the classes given in Table 2, and the height of the tallest aspen sucker per plot was recorded.

Table 1. Location of aspen monitoring plots

Plot	Severity	Code	Zone	Easting	Northing
1	Scorched 1	SC1	10U	329693	5991127
2	Scorched 2	SC2	10U	329714	5991130
3	Severe 1	S1	10U	329750	5991170
4	Light 1	L1	10U	329772	5991231
5	Scorched 3	SC3	10U	329837	5991307
6	Light 2	L2	10U	329823	5991258
7	Light 3	L3	10U	329847	5991195
8	Severe 2	S2	10U	329821	5991160
9	Severe 3	S3	10U	329835	5991147
10	Scorched 4	SC4	10U	329798	5991107
11	Severe 4	S4	10U	329768	5991131
12	Scorched 5	SC5	10U	329738	5991103
13	Light 4	L4	10U	329733	5991077
14	Light 5	L5	10U	329798	5991203
15	Severe 5	S5	10U	329747	5991195

Table 2. Tree vigour (modified from B.C. Ministry of Environment and B.C. Ministry of Forests 1998) and Venturia classes

Vigour or Venturia Class	Vigour description	Venturia attack level
0	Dead	No attack
0.5	Moribund (almost dead but a bit of green cambium or a few leaves)	
1	Poor - a few clumps of live leaves but most of crown dead	Very light
2	Fair - crown partly developed but with some dieback	Light
3	Good - healthy crown, tree typically has some stem scarring	Moderate
4	Excellent - full crown and a clear stem	Moderately-heavy
5		Heavy
6		Very Heavy

Aspen tree and sucker vigour and mortality as well as burn severity varies with slope position and soil moisture regime, thus we recorded slope position and soil moisture regime at each plot and used it as a covariate in our analysis so that we could separate out the effects due to burn severity alone.

Ocular estimates of percent cover on grasslands vary substantially from year to year because of changes in the sampling crew, weather conditions and phenological condition at the time of sampling even without any restoration treatments. Our analysis uses the unburned portions of the transect to control for these sources of variability. However, we also had significant differences in aspen, total woody plant and herbaceous cover between the eastern (burned) and western (unburned) halves of the monitoring plot. These differences were also factored into the analysis.

Cervid faecal pellet counts were also done along the transects; only deer pellets were found, with a density of 160 pellet groups per hectare (Helkenberg and Haeussler 2008).

3.0 Results and Discussion

3.1 Burn Severity

Of the fifty Daubenmire quadrats 29 were unburned, 13 were scorched, 6 were lightly burned, and 3 were severely burned (Table 3). Along the transects 59% of the transect length was unburned (Table 4). The number of unburned quadrats and the portion of the transects unburned was slightly higher than planned due to the patchy nature of the fire.

Table 3. Burn severity in Daubenmire quadrats

Transect	Quadrat									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
1	0	0	0	0	1	1	1	1	1	2
2	0	0	0	0	1	0	1	3	3	2
3	0	0	0	0	1	1	0	1	2	2
4	0	0	0	0	0	0	0	0	1	2
5	0	0	0	0	0	0	0	2	1	1

0 – unburned, 1 – scorched. 2 – lightly burned, 3 – severely burned

Table 4. Summary of burn severity along transects

Severity	Total length (m)	% of total length
Unburned – 0	293.6	58.7
Scorched – 1	155.4	31.1
Lightly burned - 2	33.5	6.7
Severely burned - 3	17.5	3.5

There was no significant difference in the diameter of the aspen trees among the three different burn severities (p = 0.65).

Table 5. Mean diameter at breast height (dbh) of aspen trees in monitoring plots

Burn Severity	Mean DBH (SD)
Scorched (n=50)	11.53 (6.85)
Light (n=49)	12.44 (4.06)
Severe (n=50)	11.52 (3.53)
Mean DBH	11.83

3.2 Aspen Response

In the year of the burn, aspen tree mortality was significantly greater in plots with higher burn severity (p = 0.009) (Figure 4), and tree vigour was significantly lower in plots with higher burn severity after the soil moisture regime was factored in (p = 0.008) (Figure 5). Conversely, there was a tendency for more aspen suckers to be produced in the more severely burned areas than in lightly burned areas (p = 0.192) (Figure 6), and there was a tendency for the suckers in severely burned areas to have lower levels of attack by aspen shoot and leaf blight (*Venturia macularis*) than suckers in lightly burned areas (p = 0.112) (Figure 7). Sucker height was not significantly different among burn severity classes (p = 0.477) (Figure 8).

The higher density of suckers in more severely burned areas was consistent with the results of AMEC (2002) following prescribed burning in the Peace River grasslands, but not with those of Wang (2003), who studied suckering after wildfire in aspen mixedwood forests of Manitoba. In other studies, the number of aspen suckers was found to decrease rapidly in the first few years post-burn (Bartos and Mueggler 1981, Brown and DeByle 1987, Wang 2003). At Grouse Mountain, between Smithers and Houston, six years post-burn aspen mortality was higher and aspen regrowth was less than expected based on the first year post burn monitoring. This was due to decay fungi gradually killing fire scarred aspen trees and Venturia and ungulate browsing reducing the size and number of aspen suckers (Haeussler 2008). Many of the suckers we observed in our study will likely die due to the effects of Venturia. Callan (1998) reported that Venturia is the major cause of mortality in young aspen suckers in years of mild spring weather, such as occurred at Red Hills in 2008.

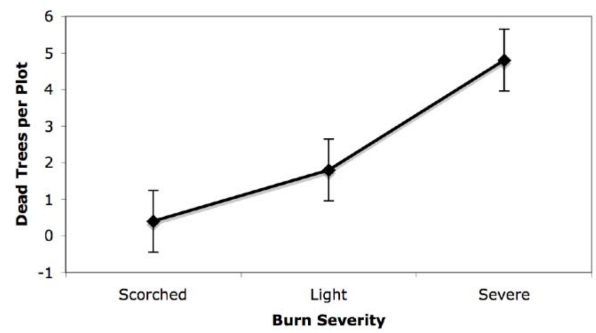

Figure 4. Effect of burn severity on aspen tree mortality[1].

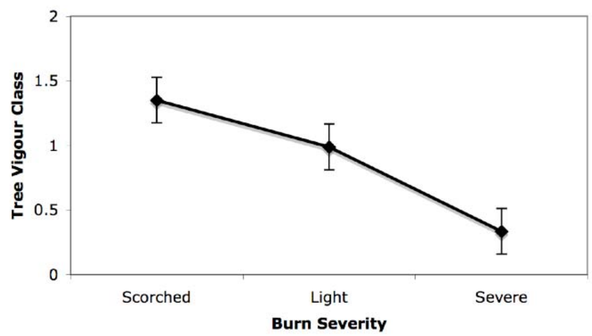

Figure 5. Effect of burn severity on aspen tree vigour after factoring in the effects of differences in soil moisture.

[1] All error bars +/- one standard error

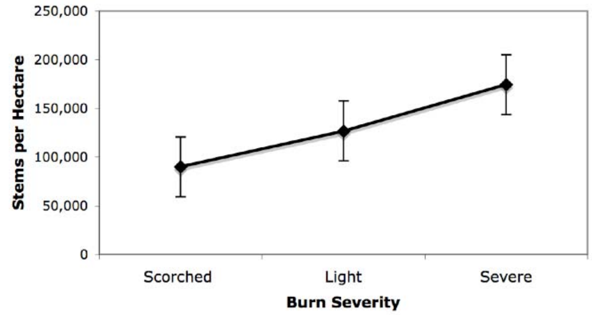

Figure 6. Effect of burn severity on the density of aspen suckers.

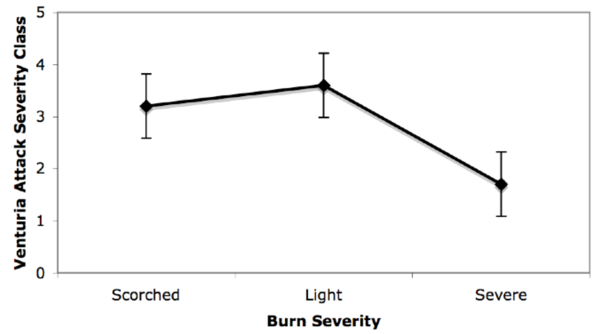

Figure 7. Effect of burn severity on the severity of Venturia fungus attack on young aspen suckers.

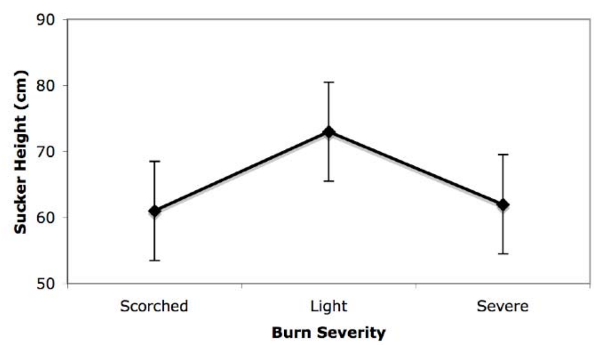

Figure 8. Effect of burn severity on the mean height of the tallest aspen sucker.

3.3 Vegetation Response

Burning significantly reduced the cover of trees and shrubs as a group ($p < 0.05$) (Figure 9), and of kinnikinnick (*Arctostaphylos uva-ursi*) (Figure 10, Figure 12) and trembling aspen individually ($p < 0.05$) (Figure 11) in the first growing season after wildfire. Reductions in cover were on the order of 20-30% and are not expected to persist as most species (other than conifers) have resprouted or suckered. Kinnikinnick may be slower to recover than some of the other woody plants, thus the burn could result in some longer-term reductions in kinnikinnick abundance.

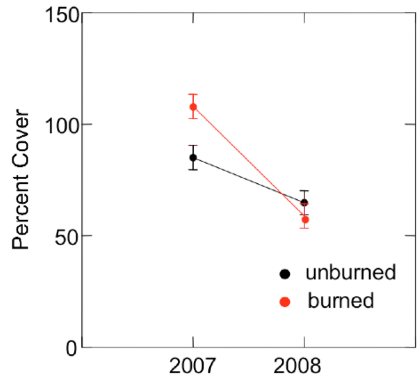

Figure 9. Change in percent cover of trees and shrubs in burned and unburned portions of the transects.

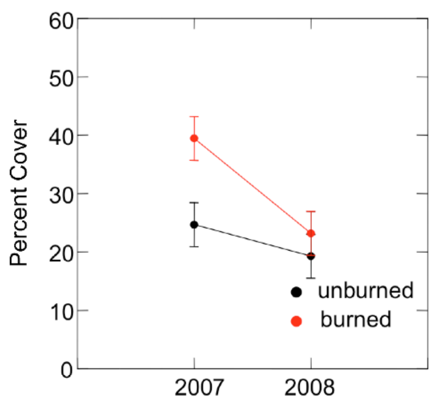

Figure 11. Change in percent cover of aspen in burned and unburned portions of the transects.

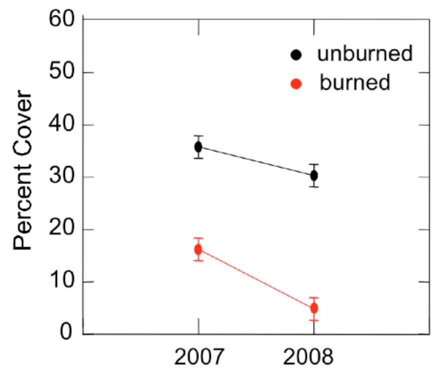

Figure 10. Change in percent cover of kinnikinnick in the burned and unburned quadrats.

Figure 12. Response of kinnikinnick five months post-burn left side of person unburned and right side burned

For low shrubs, prescribed burning caused an 11% reduction in absolute cover and a 22% reduction in relative cover at the end of the first growing season. There was no difference in 2007 low shrub cover between the unburned and burned portions of the transects. In 2008, there was a significant overall reduction in low shrub cover ($p < 0.05$), but the change was much more substantial on burned portions of the transects which decreased from 49% cover to 27% cover, than on unburned portions which decreased from 49% cover to 38% cover (Figure 13).

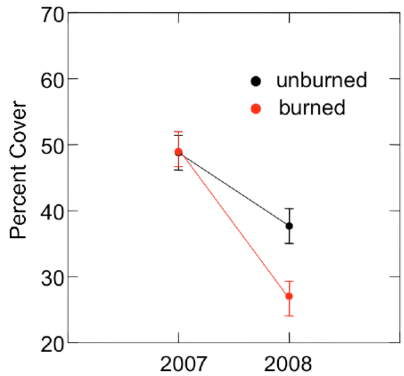

Figure 13. Change in percent cover of low shrubs in the burned and unburned quadrats.

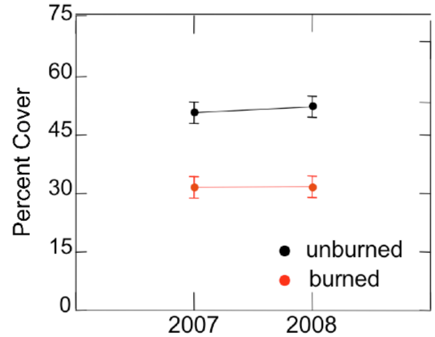

Figure 14. Change in percent cover of herbs in the burned and unburned quadrats.

Burning had no significant effect on the cover of grasses or other herbs (Figure 14, Figure 15). Herbaceous species recovered very quickly after the burn, but so far, no increase in herbaceous forage species has been observed. Changes in understory herb production may take several years to take full effect (Bartos and Mueggler 1981, Wang 2005), and we can expect substantial year-to-year variability in herbaceous cover in response to weather conditions, wildlife browsing and other factors. Further analysis of plant responses by regeneration strategy - invader, seed banker and resprouter - may be informative in plant species responses (Wang 2005), and may be done when data from additional years is available. Burning may have caused a minor reduction (1 species per quadrat, on average) in species richness in the first growing season after the burn. This reduction is most likely due to temporary losses of mosses and lichens. Only one new species, Bicknell's geranium (*Geranium bicknellii*), appeared following the burn. This is a biennial native herb with seeds that persist in the soil and germinate after fire. There were no alien invasive weeds recorded on the monitoring plots either before or after burning.

Figure 15. Vegetation in burned forest area five months post-burn

4.0 References

AMEC Earth and Environmental Limited. 2002. Evaluation of the Peace Sub-Region prescribed burn program in the Fort St. John Forest District. *For* B.C. Ministry of Water, Land and Air Protection, Environmental Stewardship Division, Fish and Wildlife Allocation Section, Fort St. John, B.C. Volume 1 of 2.

Bartos, D.L. and W. F. Mueggler. 1981. Early succession in aspen communities following fire in Western Wyoming. J. Range Management 34:315-318.

B.C. Ministry of Environment, Lands, and Parks and B.C. Ministry of Forests. 1998. Field manual for describing terrestrial ecosystems. Land Management Handbook 25. Victoria, B.C.

Brown, J.K. and N.V. DeByle. 1987. Fire damage, mortality and suckering in aspen. Can. J. For. Res. 17:1100-1109.

Callan, B.E. 1998. Diseases of *Populus* in British Columbia: a diagnostic manual. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, B.C.

de Groot, A. 2008. Uncha Mountains Red Hills Provincial Park grasslands description and restoration. Bulkley Valley Centre for Natural Resources Research & Management, Smithers, BC.

Helkenberg, L. and S. Haeussler. 2008. Conservation and restoration of Northwest BC grasslands. Bulkley Valley Centre for Natural Resources Research & Management, Smithers, BC.

Veenstra, V. and S. Haeussler. 2002. Grouse mountain post burn vegetation inventory. Unpublished report by Skeena Forestry Consultants, Smithers, B.C. for Bulkley Forest District, Smithers, BC

Wang G.G. and K. J. Kemball. 2005. Effects of fire severity on early development of understory vegetation. Can. J. For. Res. 35:254–262.

Wang, G.G. 2003. Early regeneration and growth dynamics of *Populus tremuloides* suckers in relation to fire severity. Can. J. For. Res. 33:1998–2006.