Stuart River Provincial Park

Stuart River Prescribed Burn Monitoring Report

Prepared For:
Ministry Of Environment
Environmental Stewardship Division
Ecosystems Branch

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December 2009

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1. Historical Development and Rationale for Monitoring the Stuart River Burn

1.1 History

In May 2002 the Ministry of Water Lands and Parks (MWLAP) now Ministry of Environment (MOE) , the Ministry of Forests and the Vanderhoof Fish and Game Club partnered in conducting a prescribed burn inside the Stuart River Provincial Park. The burn area was approximately 300ha in size, and was conducted on the south slope of the north side of the Stuart River (Simonar and Migabo, 2006). The intent of this burn and proposed future burns is to restore this area to a natural grassland ecosystem. Pre-burn conditions consisted of extensive stands of aspen which had replaced the grasslands. Grasslands are seen as a valuable feature, in part, to support and maintain the elk population in the area (Sharp, 2006)

In March of 2006 a monitoring protocol for the prescribed burn was created by Bio-Geo Dynamics Ltd (Simonar and Migabo, 2006). This monitoring protocol describes the sampling methodologies and procedures to establish monitoring plots and correctly gather data in the burn (Sharp, 2006).

May 1st, 2009 the same area that was originally burnt in 2002 was re-burned again. The funding was provided by the Habitat Conservation Trust Fund and carried out by the Stuart Nechako Ecosystem Restoration Committee. The Ministry of Environment, Environmental Stewardship was the lead for this project.

1.2 Purpose

The purpose of the monitoring project is to collect baseline data, establish permanent fixed plots, and gather subsequent data to measure the changes in vegetation over time. Regular monitoring will provide data indicating if the goals and objectives of the burn are being accomplished (Sharp, 2006).

Monitoring plots were not established prior to the 2002, and no monitoring was conducted in the burn to quantify pre burn conditions. However monitoring commenced and data collected in August 2006, 4 years after the initial burn, but prior to the 2009 burn. Permanent fixed plots were established as part of the 2006 monitoring work, and it is expected that monitoring of future burns will continue after each subsequent burn (Sharp, 2006).

2. Methods and Materials

2.1 Methods

There are several ways to access the burn as described in the 2006 Burn Monitoring Report (Sharp, 2006). In 2009, access to the burn was via jet boat up the Stuart River. The boat was launched at the end of Sturgeon Point Road, proceeding up river in the vicinity of the burn. Using a GPS with recorded UTM coordinates, we attempted to navigate to each plot center.

The same methodology as described in the 2006 burn report was used in collecting burn data in 2009. A detailed description of monitoring methodology can be found in the 2006 Prescribed Burn Monitoring Report (Sharp, 2006).

In 2009, we were able to locate and confirm plot centers by the rebar which were still intact, with the exception of plots 1, 6, and 7.

In plot 1, we were unable to locate the rebar designating plot center, however, based on UTM coordinates and monitoring data descriptors we believe we were within 3m of the designated plot center. Due to significant accumulations of dead fall from the recent burn, it was assumed the rebar had been buried.

In plot 6, we were able to locate burned remains of ribbon on the ground and spray paint on a tree that confirmed we were close to the plot center, however after an extensive search; the plot center was never located. Due to significant accumulations of dead-fall from the recent burn, it was assumed the rebar had been buried. We used the UTM coordinates to establish a center and estimate we were with in 15 meters of the original plot center. Data for plot 6 was collected using this alternate center.

Plot 7 UTM coordinates did not match up at all with plot characteristics described in the data collected from 2006. After an extensive 2 hour search, we were unable to find any evidence of an established plot in the area. We assumed that the UTM coordinates were recorded incorrectly. After consulting with Brady Nelless, Ecosystem Biologist for B.C. MOE, it was decided to move on to the next plot. No data was recorded for plot 7 in 2009.

2.2. Materials

The following is a list of materials used to establish the plots and take measurements at each plot:

- GPS (Garmin, Etrex - Vista CX)
- Digital Camera (Kodak, Z 740)
- Tape Measure (24m is maximum length to measure)
- Diameter Tape
- Calipers
- 30cm Ruler
- Prism (BAF 4 and BAF 5)
- Clinometer
- Compass
- Plant ID guide (Plants of Northern British Columbia, Mackinnon, Pojar and Coupe)

- Field Manual for Describing Terrestrial Ecosystems
- Field Manual for Describing Terrestrial Ecosystems (Forms:FS882 (3) and FS882 (7))
- Wildlife Solutions Field Forms (Fine Woody Debris, Litter Duff, Basal Area)
- Pens/Pencils
- Species List (Sharp 2006).

3. Data Analysis

After data was collected and entered for each plot, we analyzed the data by direct counts per plot, by averaging the data for each plot, or by averaging the data over the entire burn, depending on which information is relevant and can give an accurate description of burn intensity and changes year to year. It is important to note that we were not able to locate plot 7 during the 2009 monitoring. As a result, we excluded plot 7 in all analysis for 2009, and excluded plot 7 for both 2006 and 2009 when we calculated averages over the entire burn.

4. 2009 Burn Condition Data

We have included relevant information dealing with the 2009 Stuart River Park Prescribed Burn.

Note: The Western half (up river) was done with a Heli-Torch and the bottom or Eastern half was done with the AID Machine.

Burn Weather Data:

Time	Temp	Relative Humidity	Location
1:30pm	20C	30%	Bottom of Slope – Dry ground
2:00pm	19C	35%	Bottom of Slope - On snow
2:10pm	20C	30%	Mid Slope
2:30pm	19C	35%	Bottom of Slope – Adjacent to Wetland

Winds: Average Wind Speed 3.5 km -Gusting to 10 km

Ignition Date and Time: May 1st, 2009 at 3:00pm

5. Results and Discussion

5.1 Vegetation

5.1.1 Trees

Figure 1 shows the percent cover of Hybrid White Spruce increased slightly from 4.7% in 2006 to 5.6%in 2009. The percent cover of Paper Birch was 0.2% in 2006, no Birch trees were found in any plot in 2009. The percent cover of Trembling Aspen increased from 19.6% in 2006 to 23.8% in 2009. While increases in the average percent cover of Aspen seems counter intuitive to what is expected after a fire, the increase in the average percent cover can actually be attributed to significant increases in suckering in the shrub layer in many plots (Figure 2); this is typical after a fire.

Figure 1: Average % cover of trees in the tree and shrub layer.

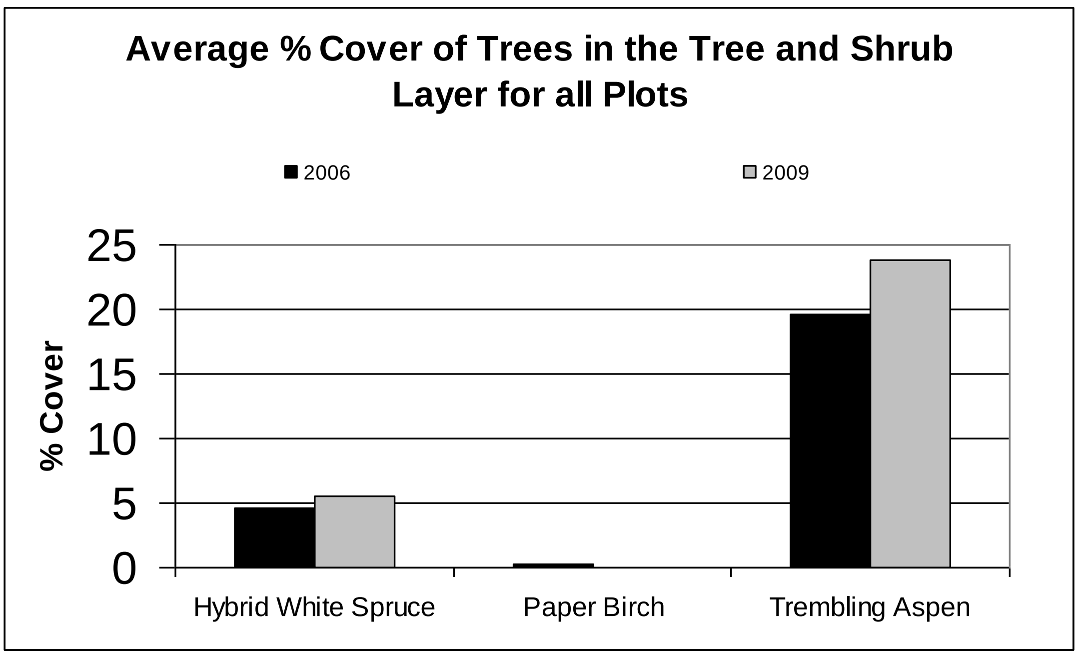
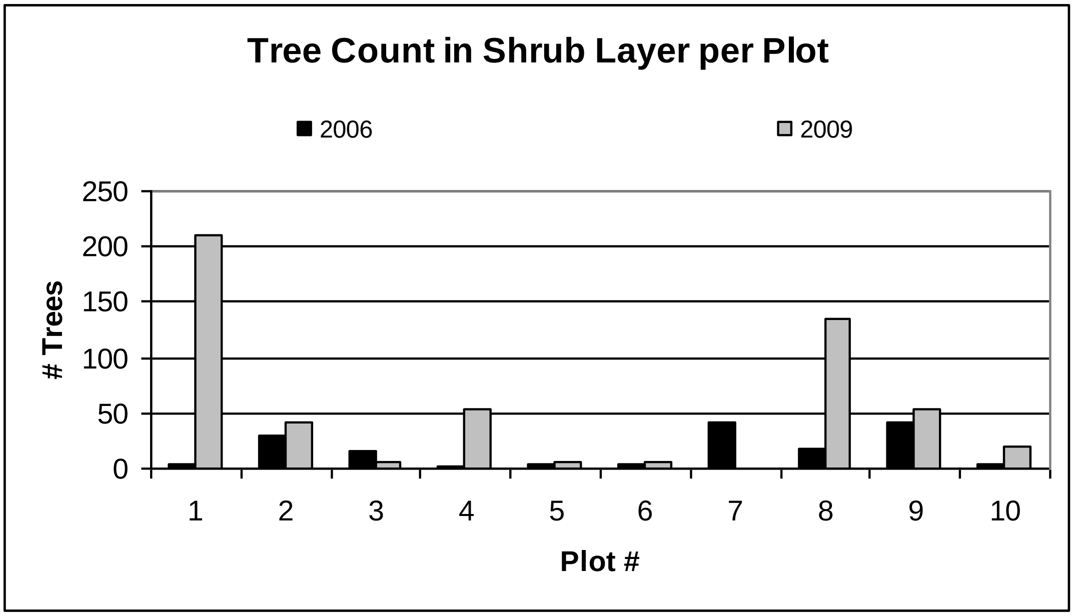


Figure 2 shows the tree count by plot in the shrub layer. The tree count in the shrub layer can be attributed almost entirely to suckering of aspen after the fire. Suckering rates were highest in plots 1 and 8 where the fire was most intense and Aspen were toppled as a result of the fire. Plot 4 also saw a moderate increase in suckering. Most of the suckering resulting from the 2002 burn was subsequently killed in areas covered by the 2009 burn. Very little suckering has occurred in areas that have now been burned twice.

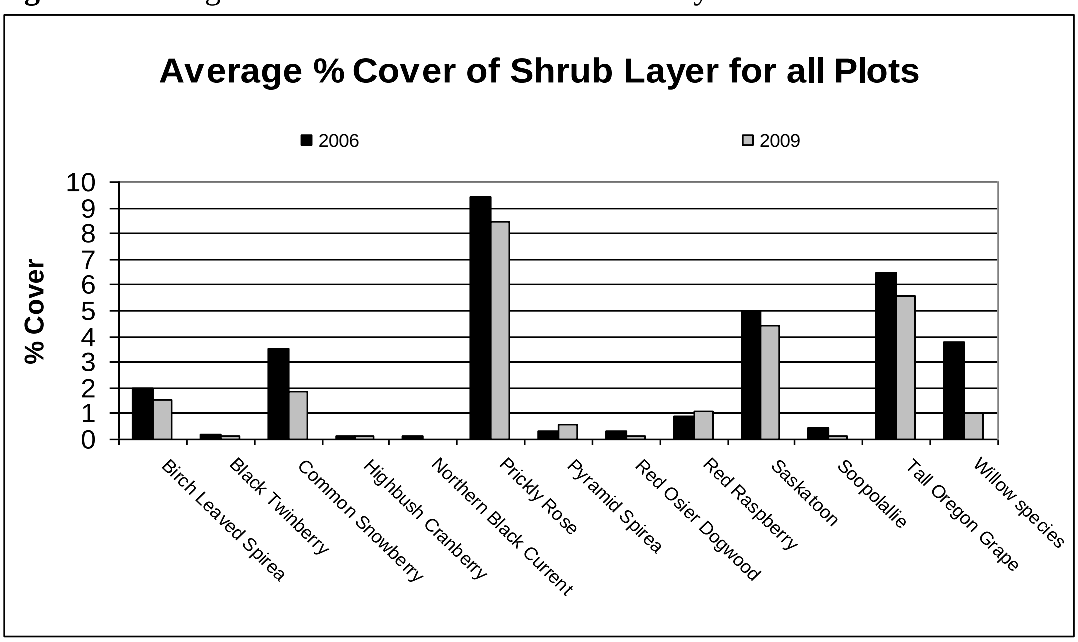
Figure 2. Tree Count in Shrub Layer per Plot



5.1.2 Shrubs

In 2009, the 5 most dominant species in the shrub layer were Prickly Rose, Tall Oregon Grape, Saskatoon, Common Snowberry, and Birch Leaved Spirea. These same five shrubs were also the most common shrubs in 2006. The data shows that the percent cover of most shrub species declined from 2006, however red Raspberry and Pyramid Spirea actually increased. It also appears Willow spp. are not as fire tolerant as other shrubs in the burn directly after a fire, as they decreased from 3.8% cover in 2006 to 1% cover in 2009(Figure 3).

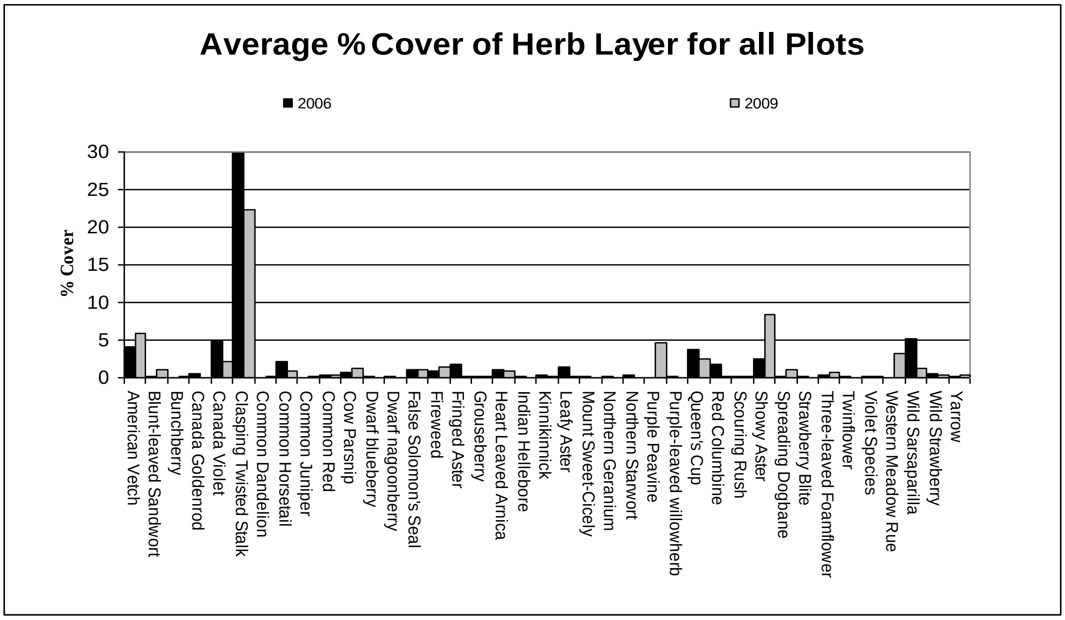
Figure 3. Average % Cover of Shrubs in the Shrub Layer for all Plots.



5.1.3 Herbs

Figure 4 shows the percent cover of the herb layer. Clasping Twisted Stalk remained the most dominant herb in all plots. Showy Aster, American Vetch, Purple Peavine, Canada Violet, Western Meadow Rue, Wild Sarsaparilla, and Queens Cup were also common.

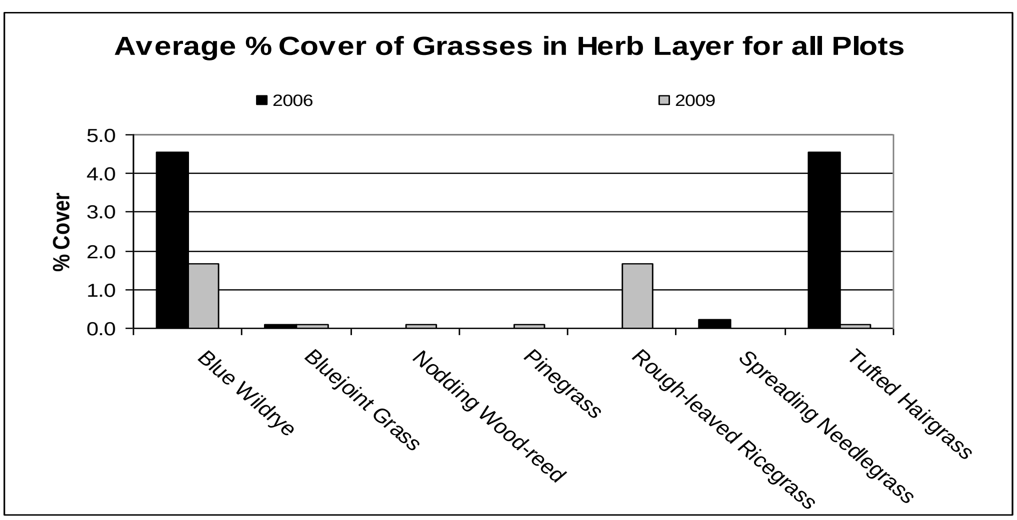
Figure 4. Average % Cover of Herbs in Herb Layer for all Plots.



5.1.4 Grasses

Although the main objective of the prescribed burn in this area is to restore it to a natural grassland ecosystem, grass species are relatively few and the total percent cover of grasses in all plots is very low (Figure 5 and Figure 6).

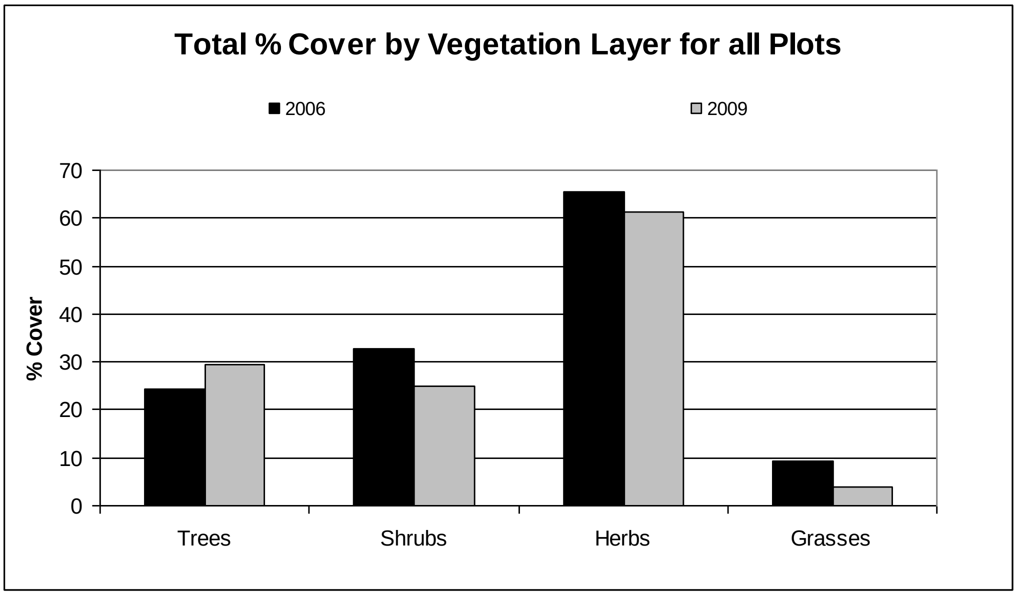
Figure 5. Average % Cover of Grasses in Herb Layer for all Plots.



5.1.5 Vegetation Composition

In 2006 the percent cover for all trees was 24.4%, shrubs 32.7%, herbs 65.4% and grasses 9.4%. In 2009 the percent cover for all trees was 29.3%, shrubs 25%, herbs 61.2%, and grasses 3.8% (Figure 6).

Figure 6. Total % Cover by Vegetation Layer and Type for all Plots

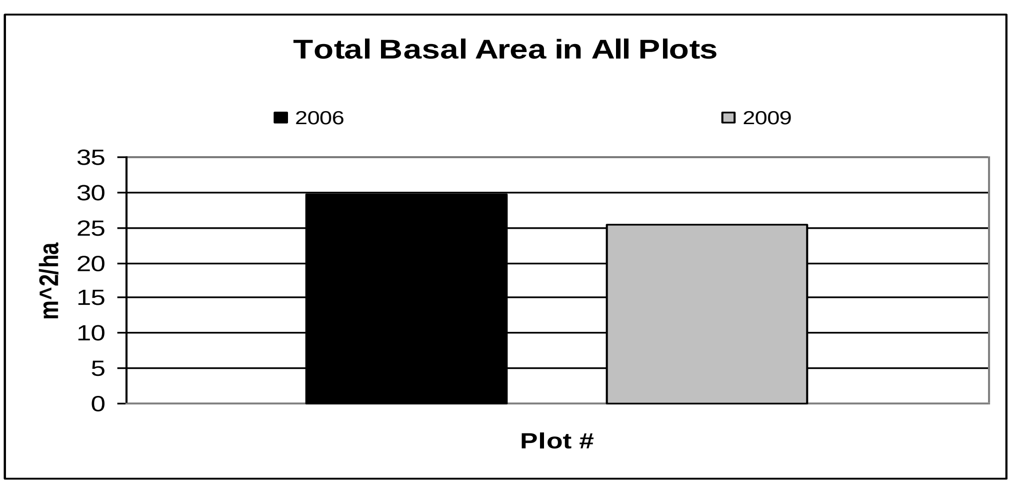


5.2 Basal Area

5.2.1 Total Basal Area

The total Basal Area for all plots decreased from 29.7m^2/ha in 2006 to 25.3m^2/ha in 2009 (Figure 7). The total basal area for live stems decreased from 25.57m^2/ha in 2006 to 22.4m^2/ha in 2009. The total basal area for dead stems decreased from 4.27m^2/ha in 2006 to 3m^2/ha in 2009.

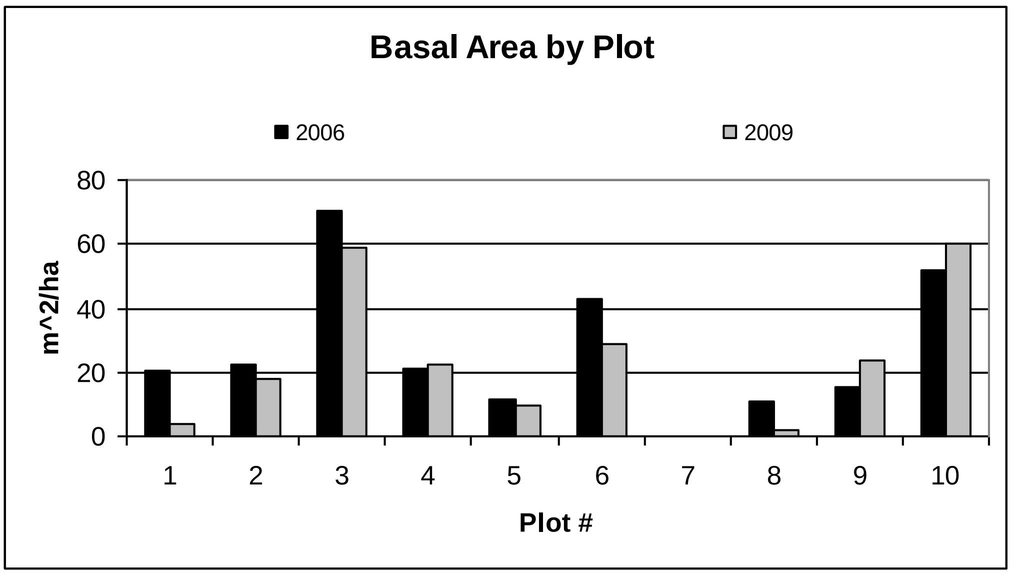
Figure 7. Basal Area for all Plots



5.2.2 Basal Area by Plot

In plots 1and 8 the basal area calculations show a significant decrease. In plot 1 the 2006 basal area was 20.4m^2/ha and in 2009 it was only 4.1m^2/ha. In plot 8 the 2006 basal area went from 10.7m^2/ha to 1.7m^2/ha in 2009. In plots 2, 3, 5, and 6, the basal area decreased somewhat from 2006, likely due to some natural and fire caused mortality. In plots 4, 9, and 10, there were small increases from 2006 in basal area likely due to an increase in diameter of live trees and little tree mortality due to fire (Figure 8).

Figure 8. Basal Area by Plot



5.2.3 Tree Count

In addition to measuring the basal area, the actual tree count and the mean wildlife tree class by basal area of each plot could give a good indication of fire intensity (Figure 9 and Figure 10). In plots 1 and 8, fire activity was intense with a significant amount of standing trees being burned and toppled.

Plot 1 went from 9 trees in 2006 to 2 trees in 2009, and the average class of wildlife tree went from a 2.9 in 2006 to a 6.5 in 2009 indicating a significant increase in decay due primarily to fire.

Plot 8 went from 12 trees in 2006 to 1 tree in 2009. Although the average class of wildlife tree changed only slightly, from 3.8 in 2006 to 4 in 2009, it should be noted that 2006 wildlife tree class data was based on 12 trees, while 2009 data was based on only 1 remaining standing tree.

In plots 2, 4, 5, and 10, there was evidence of recent fire, but not intense fire. The number of standing trees decreased slightly, and remaining tree's average wildlife tree class increased slightly (Figure 9 and Figure 10).

In plots 3 and 9 there was little to no sign of recent fire in the plot area and the number of standing trees and the average class of wildlife tree remained the same (Figure 9 and Figure 10).

In plot six there was evidence of fire; however the number of standing trees actually increased (Figure 9). This can be explained by the fact that the rebar indicating plot center could not be located and we estimated plot center based on UTM coordinates, which means we could have been up to 15 meters from the original plot center.

Figure 9. Total tree count in Basal Area by Plot.

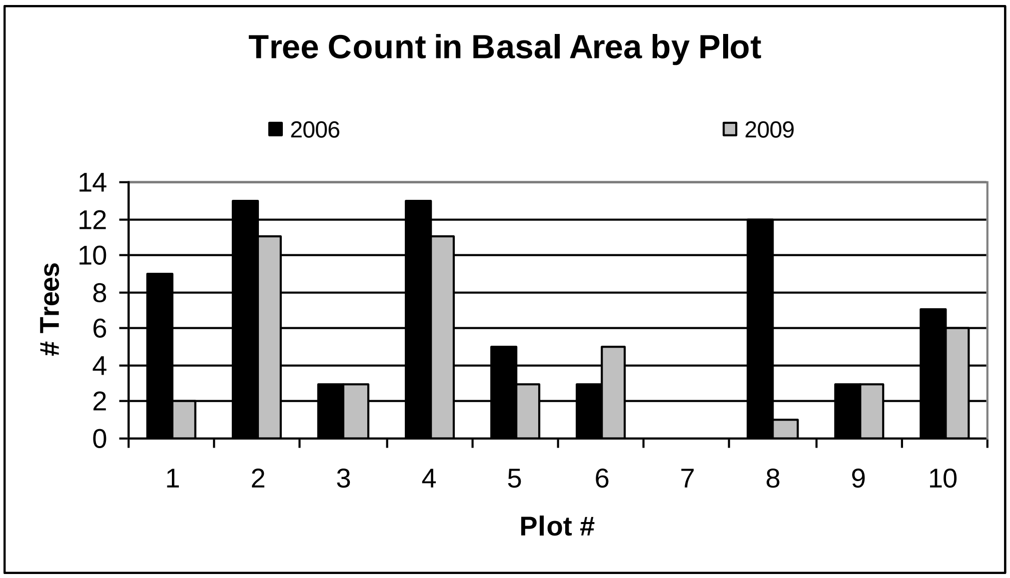
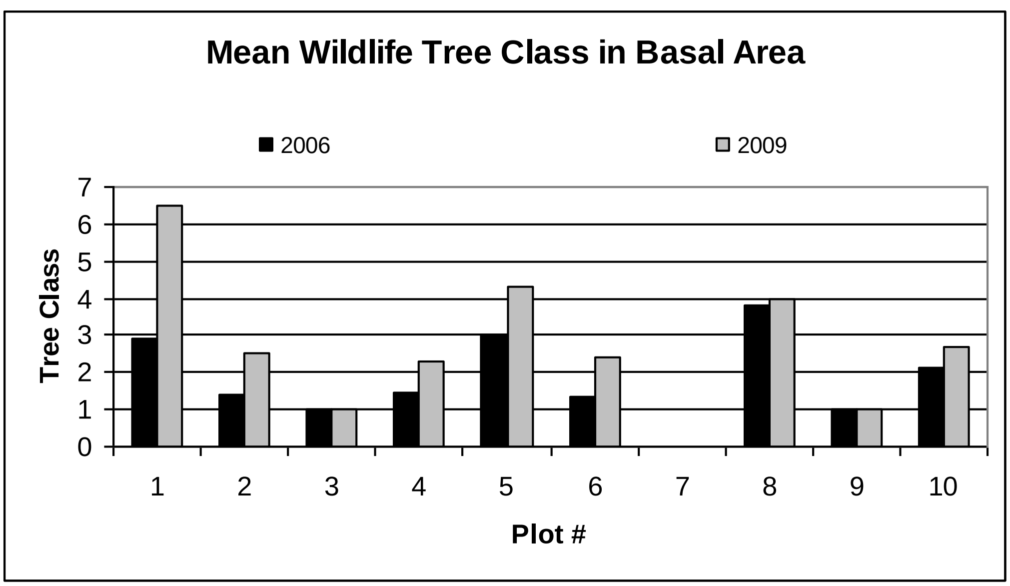


Figure10. Average Wildlife Tree Class in Basal Area by Plot.



5.3 Coarse Woody Debris (CWD)

5.3.1 CWD Count

The total amount of coarse woody debris, 7.5cm diameter and greater, decreased in all calculated plots from 83 pieces in 2006 to 75 pieces in 2009 (Figure 11). Dividing these numbers by 432m (18x24m transects), equals approximately 1 piece of CWD every 5.2m in 2006 and approx. 1 piece of CWD every 5.8m in 2009 in all calculated plots.

Figure 11. Coarse Woody Debris Count in all Plots.

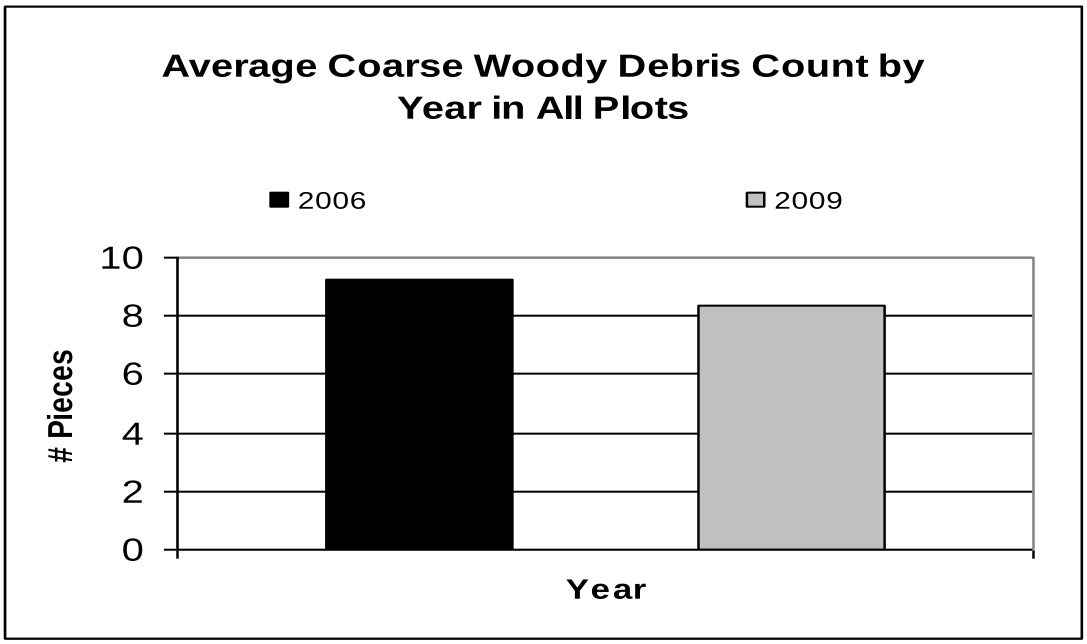


Figure 12 shows CWD count broken down by plot. The piece count of CWD in a plot can be a good indicator of fire activity and intensity.

In plot 1 the CWD count changed little from 2006 to 2009, however the tree count in the basal area changed significantly. It is likely, that with the existing high fuel load in the form of CWD before the 2009 fire, that the intensity of the fire inside the plot area was fairly high during the 2009 burn, consuming much of the existing CWD. This high intensity fire toppled most of the remaining standing Aspen during the fire, but the newly fallen trees were not entirely consumed by the fire. This scenario is confirmed by the reduction of trees found in the basal area from 2006 to 2009 (Figure 9).

In 2006 at plot 8, 7 pieces of CWD had been counted along the transects. After the 2009 burn, the only remaining CWD was one severely charred piece, indicating the rest had been consumed in the fire. The monitoring data suggest that the fire was intense at this site.

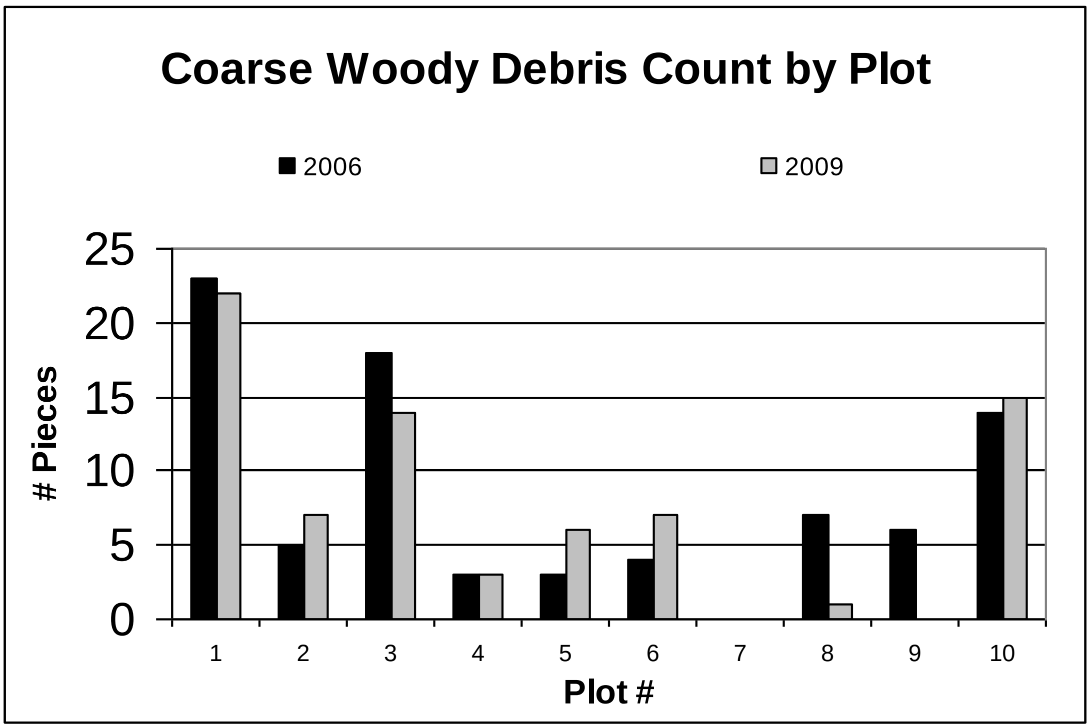
For 2009 in plots 2, 5, 6, and 10 the CWD count increased somewhat from 2006, likely due the toppling of some standing trees due to moderate fire intensity. This is confirmed by a reduction of the tree count in the basal area in these plots (Figure 9).

Plot 3 had little change in decay class, and the slight increase is likely due to natural decay as recent fire activity was not evident in the plot (Figure 9).

Plot 4 had no change in 2009 from 2006, it is likely that the fire consumed some CWD and added some new CWD when standing aspen toppled (Figure 9).

In plot 9, no CWD was found in the 2009 transects, down from 6 pieces in 2006 (Figure 9). A detailed explanation is found in the CWD decay class section.

Figure 12. CWD Count by Plot



5.3.2 CWD Decay Class

The decay class of CWD can be an indicator of fire activity and sometimes fire intensity as fire expedites the decay process. The higher the decay class the more decayed the CWD (RIC 1998).

From 2006 to 2009: Plots 1 and especially 8 had significant increases in the average decay class in each plot, likely due to recent fire activity and greater fire intensity in 2009 (Figure 13).

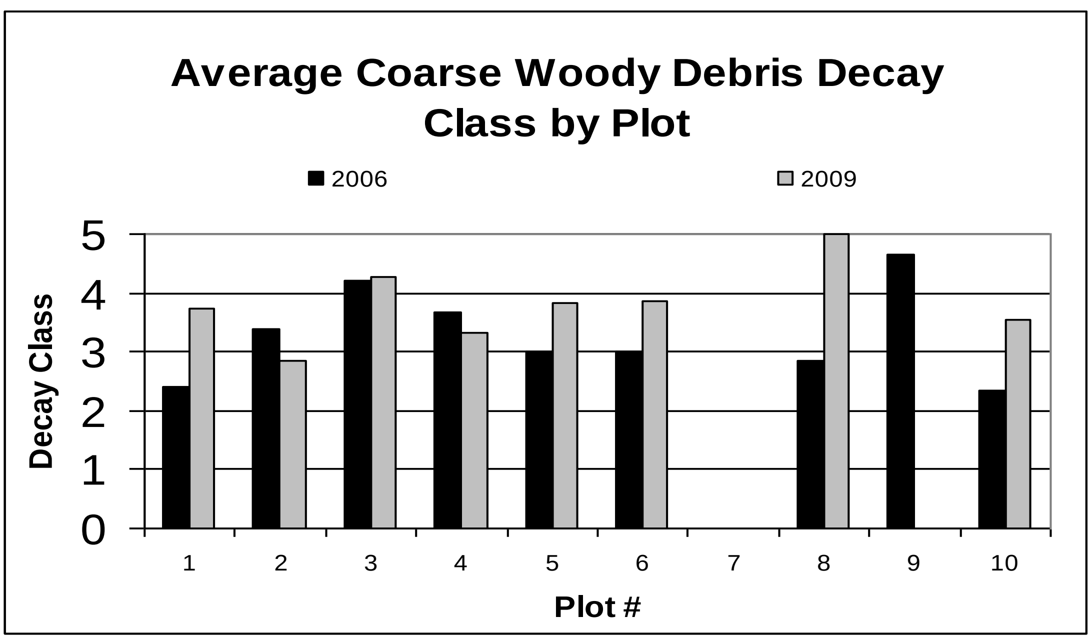
In plots 5, 6, and 10 the average decay class increased somewhat likely due to natural decay and fire activity at low to moderate fire intensities (Figure 13).

Plot 3 had little change in decay class, and the slight increase is likely due to natural decay as recent fire activity was not evident in the plot (Figure 13).

Plots 2 and 4 show a decrease in average decay class, this is likely due to fire activity which may have toppled standing timber after the fire, but was not intense enough to fall and consume the timber during the fire (Figure 13). This added new CWD to the plot, and is confirmed by the decrease in tree count in plots 2 and 4 in the basal area (Figure 9).

In 2009 there was no CWD found in plot 9. This is interesting considering that there were six pieces found in 2006 and no recent fire activity was present in the plot during the 2009 monitoring (Figure 12). The only explanation for this is that in plot 9, the average decay class in 2006 was already high and this likely facilitated quicker than normal decomposition of existing CWD (Figure 13). By observation we note that there were several crumbling and severely decomposed remains of logs in plot 9.

Figure 13. Average Decay Class of CWD by Plot.



5.4 Litter Duff

5.4.1 Litter

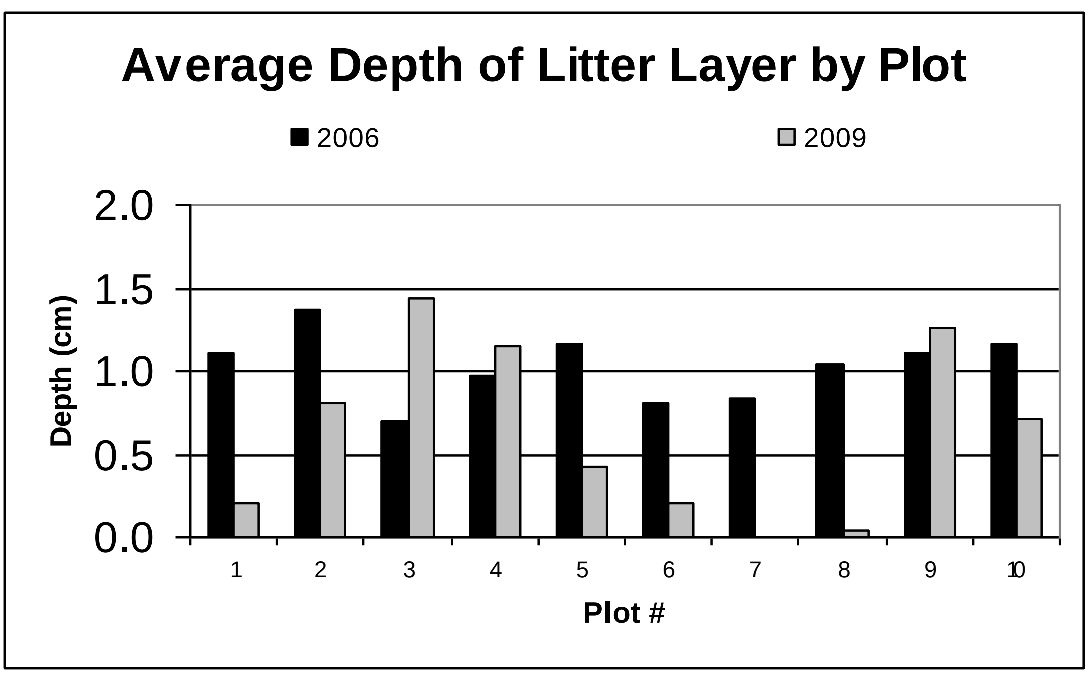
Litter depth can be an excellent indicator of fire activity after a burn, and often a good indicator of fire intensity.

In plot 1 the average litter depth was reduced from 1.1cm in 2006 to 0.2cm in 2009. In plot 8 the average litter depth was reduced from 1.04cm in 2006 to 0.03cm in 2009. It is evident from the 2009 litter data that, in plot 1 and 8, not only was there fire activity, but the fire was more intense than in other plots as substantially all litter was consumed, and based on our observations, what little litter remained consisted of current year plant material (Figure 14).

In 2009 plots 2, 5, 6, and 10 also saw reductions in the average litter depth from 2006 (Figure 14), and we observed evidence of fire activity in all these plots. The level of fire intensity we observed is consistent with and supported by the levels of reduction in litter depths.

Plots 3, 4, and 9 all had increased depths of litter in 2009 when compared to 2006 (Figure 14). In plots 3 and 9, this is consistent with the lack of recent fire evidence from the 2009 fire in our observations. However, based on our observations plot 4 did have evidence of recent fire activity from the 2009 fire. It was evident from our observations that the fire in plot 4 was very low intensity, and the fire had been extinguished only 30m from the plot center to the North as it moved uphill. We hypothesize that the fire was of such low intensity, that it did not consume any litter and added standing vegetation to the litter layer as it moved through.

Figure 14. Average Depth of Litter Layer by Plot



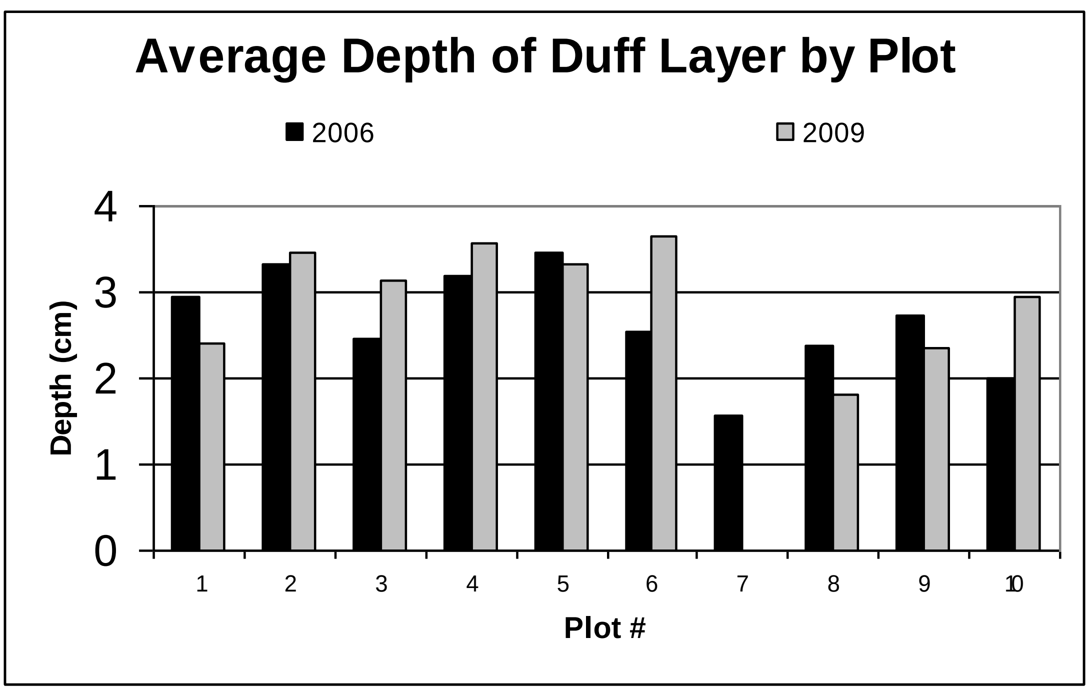
5.4.2 Duff

The extent of duff layer consumption by fire can be a good indicator of fire intensity.

The average duff depth in plots 1, 5, 8, and 9 decreased in 2009 when compared with 2006 (Figure 15). The reductions in average duff layer in plots 1 and 8 can likely be attributed to burn intensity as the monitoring data has indicated both these plots experienced higher burn intensities when compared to other plots in 2009. With higher burn intensities it is likely that in addition to consuming the litter layer, some of the duff layer was also consumed. Plot 9 varies from the expected, as we can not attribute fire to the average decrease in duff depth. It may be explained however by the presence of a game trail which intersected both transects. This may have reduced the average duff layer slightly while not impacting average litter depth in the absence of fire, as litter tends to accumulate much faster than it is converted into duff. The average duff depth in plot 5 did decrease, however the decrease was slight, and it would be difficult to derive any conclusion from the data.

In plots 2, 3, 4, 6, and 10 the average duff depth increased in 2009 when compared with 2006 data. This may be attributed to the conversion of litter into duff by low to moderately intense fire in 2009. The 2009 fire may have burned varying amounts of the litter layer depending on fire intensity in the respective plot, but did not entirely consume it, converting it to duff.

Figure 15. Average Depth of Duff Layer by Plot



6. Wildlife Use of Burn

Wildlife utilization is evident throughout the burn; however, not all use is distributed equally. We compared our observed wildlife utilization classifications (mostly elk, some moose and deer), with monitoring data for evidence of recent fire, fire intensity, and tree count in basal area. We found that ungulates utilized areas that had recent high burn intensities and few trees the least. Areas where recent burn intensity was low to moderate and still had 3 -11 standing trees in basal area had moderate to high wildlife utilization. Previously burned areas that did not burn in 2009, and had at least 3 standing trees in the basal area had moderate amounts of wildlife utilization. Based on this data, we found that following the 2009 burn, wildlife tend to utilize areas with low to moderate fire intensity, and at least 3-11 standing trees (cover) in the basal area, more than areas of high burn intensity and fewer than 3 trees in the basal area. There are likely many additional factors influencing wildlife utilization in the burn; however we looked at only some factors as they relate to burn intensity for this report. It is important to note, that our observations are reflective of a finite period of time since the prescribed burn occurred in the spring of 2009. Substantially more monitoring over a longer period of time is required to fully understand wildlife utilization of the burn. Wildlife utilization of the burn may change seasonally (i.e. winter and early spring when south facing slopes may have lower snow depths and provide more access to forage), and are likely to change in the future as conditions in the burn change.

Figure 16. Wildlife use in relation to evidence of fire, fire intensity, and tree count in basal area, by plot location.

Plot #	Wildlife Use	Evidence of Recent Fire (Yes/No)	Fire Intensity (L/M/H)	Tree Count in Basal Area
1	Low	Yes	High	2
2	Moderate	Yes	Moderate	11
3	Moderate	No	NA	3
4	High	Yes	Low	11
5	High	Yes	Moderate	3
6	High	Yes	Moderate	5
7	NA	NA	NA	NA
8	Low	Yes	High	1
9	Moderate	No	NA	3
10	Moderate	Yes	Moderate	6

7. Ignition Mode and Fire Intensity

Based on the 2009 monitoring data, there does not appear to be a correlation between burn intensity and the mode of fire ignition. When observing the ignition of the 2009 burn from a distance, it appeared that the portion of the burn lit with the drip torch ignited more quickly and burned more intensely than the portion burned with the AID Machine. However, the monitoring data suggests that burn intensity is likely to be correlated more with site specific variables (aspect, slope, fuel load, location of ignition drop, moisture level) at ignition site, than ignition mode. Plot 1 was ignited using the AID machine, and plot 8 was ignited with a heli-torch; both plots experience higher intensity burns. Other plots burned with less intensity, and some did not burn at all. As there is no recognizable trend in fire intensity based on ignition mode, we cannot make a positive correlation from the results.

8. Summary and Conclusions

Wildlife Solutions was contracted by the British Columbia Ministry of Environment Ecosystems Branch to conduct monitoring following the 2009 prescribed burn in the Stuart River Provincial Park. Monitoring commenced and was completed in August 2009. The burn monitoring results are as follows.

The average percent cover in the tree layer decreased by 35 % from 27.5 % in 2006, to 16.8 % in 2009. The average percent cover in the shrub layer increased by 27 % from 20.8 % in 2006, to 28.3 % in 2009. The average percent cover in the herb layer decreased by <3 % from 53.9 % in 2006, to 52.4 % in 2009. The basal area decreased by 15% from 29.7m^2/ha in 2006, to 25.3m^2/ha in 2009. The CWD count for all plots decreased by 10% from 83 pieces in 2006, to 75 pieces in 2009. The average litter layer for all plots, decreased by 33 % from 1.05cm in 2006 to 0.69cm in 2009. The duff layer increased by 7 % from 2.8 cm in 2006, to 3 cm in 2009.

Burn intensity was analyzed by plot using basal area, CWD, and Litter/Duff data, as well as observations in the field. Based on this data, fire intensity in each plot was rated as high, moderate, low, or not applicable if no evidence of fire was found in a plot. The basis for this rating system is relative to the plots in the burn, and not based on other agency rating systems. Burn intensity in plot 1: high; plot 2: moderate; plot 3: not applicable; plot 4: low; plot 5: moderate; plot 6: moderate; plot 8: high; plot 9: not applicable; plot 10: moderate. Detailed explanations of the results from basal area, CWD, and Litter Duff can be found in the results section.

Based on monitoring data and our observations of wildlife use for the period between the 2009 spring burn and when we commenced monitoring at the end of August 2009, we found that wildlife tend to utilize areas with low to moderate fire intensity, and at least 3-11 standing trees (cover) in the basal area, more than areas of high burn intensity and fewer than 3 trees in the basal area.

Based on analysis of the basal area, CWD, and Litter/Duff data, there is no noticeable trend in fire intensity based on ignition mode (i.e. heli-torch vs. AID machine), and a correlation cannot be supported from the results.

Only 10 plots were established in 2006 due to time and budget constraints (Sharp 2006). However, a minimum of 30 plots and preferably 40 plots was requested to achieve statistically reliable data (Simonar and Migabo, 2006). However, operational fire effects monitoring objectives can be achieved with as few as 5 plots. In 2006, 10 plots were established, and plot placement was stratified and selected randomly for the best representation of fire activity throughout the burn. With only 10 plots in this large of a burn, what occurred in a given plot may not necessarily be representative what happened 30-50m from plot center. For example, plots 3 and 9, both were located at the bottom of the burn (3) adjacent to a lake and (9) adjacent to a wetland, and did not burn in 2009; in each case the fire was ignited 30-50m up slope. Because of the areas close proximity to lowland wet areas, it is likely fire ignition was attempted further up the slope. Having only ten plots is not a perfect scenario for statistical reliable data, however when data is averaged over all 10 plots, it may give a reasonably accurate description of operational fire effects over the entire burn, but not necessarily on a site by site, or plot by plot basis.

9. Recommendations

Based on the results of the 2009 monitoring data, and field observations, we recommend the following.

1) The main objective of the Stuart River Park prescribed burn is to reverse forest succession and convert this area back to a grassland and shrubland (Simonar and Migabo, 2006). Although the area is well on it’s way to achieving this objective, there is still much to be done. We recommend that prescribed burns continue at 3-5 year intervals, until it is determined that all objectives have been met.

2) We also recommend that monitoring of the burn continue, following each prescribed burn. Often there is a limited window of opportunity to burn based on weather and snow pack conditions each spring. If burn conditions are not right, the burn must be attempted the following year. This can prolong periods between prescribed burns. In such cases monitoring should be conducted every five years in order to analyze and understand how the burn is changing over time and where the burn is at, in relation to objectives.

3) One of the main objectives of the Stuart River Burn is to reestablish the area into a grassland ecosystem (Sharp 2006). However, in 2006 the average percent cover of grasses in all plots was 9.4 %. In 2009 the average percent cover of grasses in all plots was 3.8 %. It appears we may actually be losing grasses in the burn; long term data may provide a more accurate conclusion as

to why, but this may be partially due to grass and grass seed destruction in areas of high burn intensity. It is clear that in both 2006 and 2009 the percent cover of grasses in all plots is quite low. We hypothesize that there are too few grasses present to provide a large enough seed base for grasses to compete, and there are too many seeds and intact root systems of shrubs and herbs which are out competing the grasses. We recommend aerial seeding of the burn to establish a substantial grass seed base. A list of desired grasses for the burn should be developed, a seed mixture procured, and following shortly after the next burn, the burn seeded.

It may be beneficial for future burn projects to understand the results of the seeding project. This could be done by dividing the burn in half, east and west, control and treatment, and seed only one half of the burn. Following monitoring and data analysis of the treatment and control, a determination may be made if, the project was effective, achieved the desired results, the project benefits justified the expenditure (following a cost-benefit analysis).

4) Currently, little monitoring data has been collected on wildlife or wildlife utilization of the burn. We recommend the development of more comprehensive wildlife monitoring protocols and data collection sheets designed to produce thorough and descriptive data. This will increase our understanding of wildlife utilization of the burn.

5) Plot centers for plots 1, 6, and 7, need to be reestablished. All plot centers should be replaced with a sturdier metal post such as a metal fence post to ensure the plot center is not buried, bent or destroyed. The metal tags used to identify each plot were flimsy and likely melted in the fire. In only two out of the ten plots did the tags remain intact, and these plots had not burned intensely. New sturdy metal tags which are heat resistant, should be constructed and attached by metal ring to the post itself and not an adjacent tree.

10. References

Resources Inventory Committee. (RIC) 1998. Field Manual for Describing Terrestrial Ecosystems. Land Management Handbook 25. Co-published by B.C. Ministry of Forests and B.C. Ministry of Lands and Parks.

Sharp, Barb, 2006. Stuart River Provincial Park Prescribed Burn Monitoring Report. B.C. Ministry of Environment - Environmental Stewardship - Parks and Protected Areas Section. Prince George, B.C.

Simonar, Ken, and Saphida Migabo, 2006. Stuart River Prescribed Fire Monitoring Protocol. Bio-Geo Dynamics., Prince George, B.C.

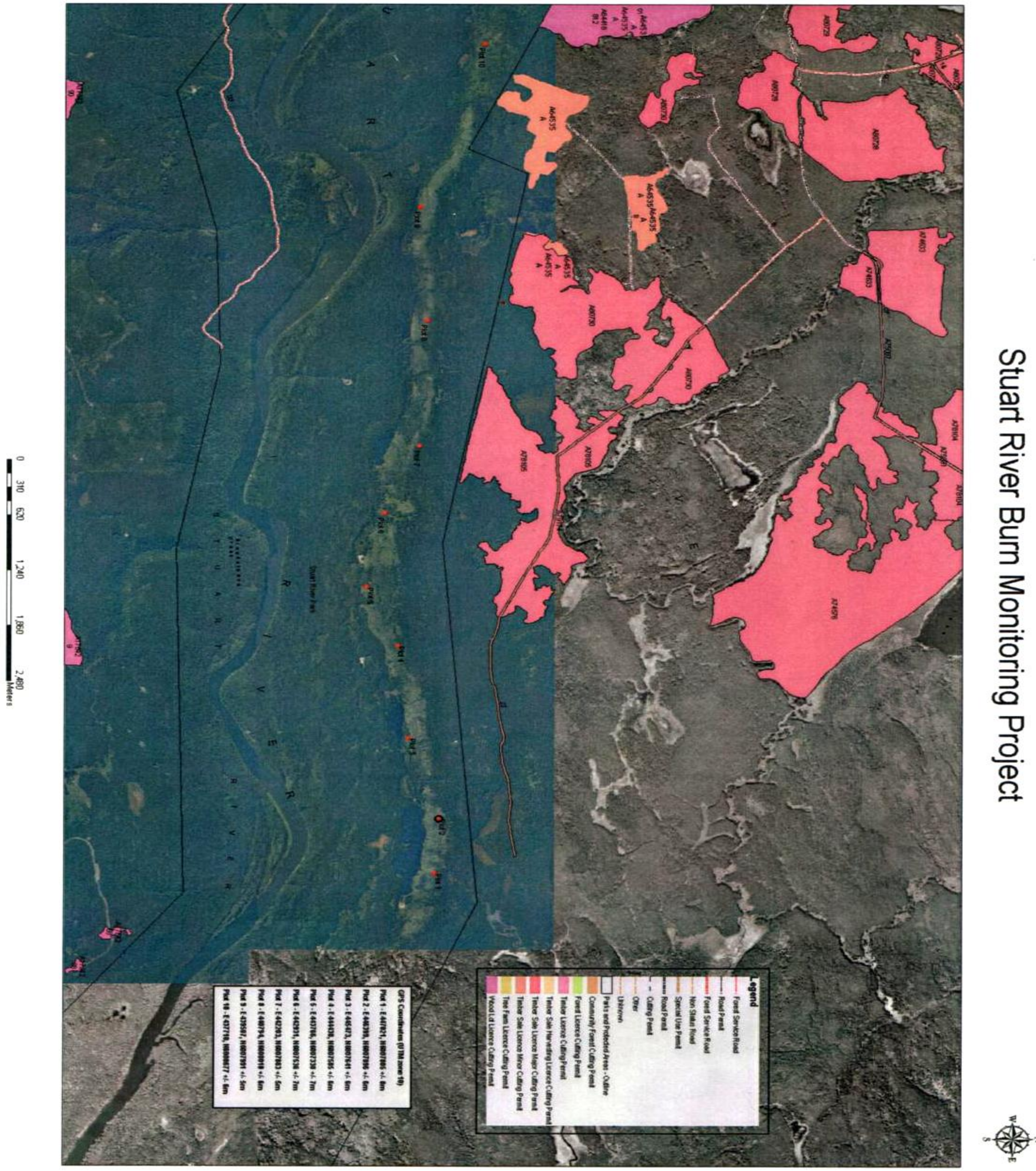
11. Appendices

Appendix 1. Species List for the 2009 Stuart River Burn Monitoring

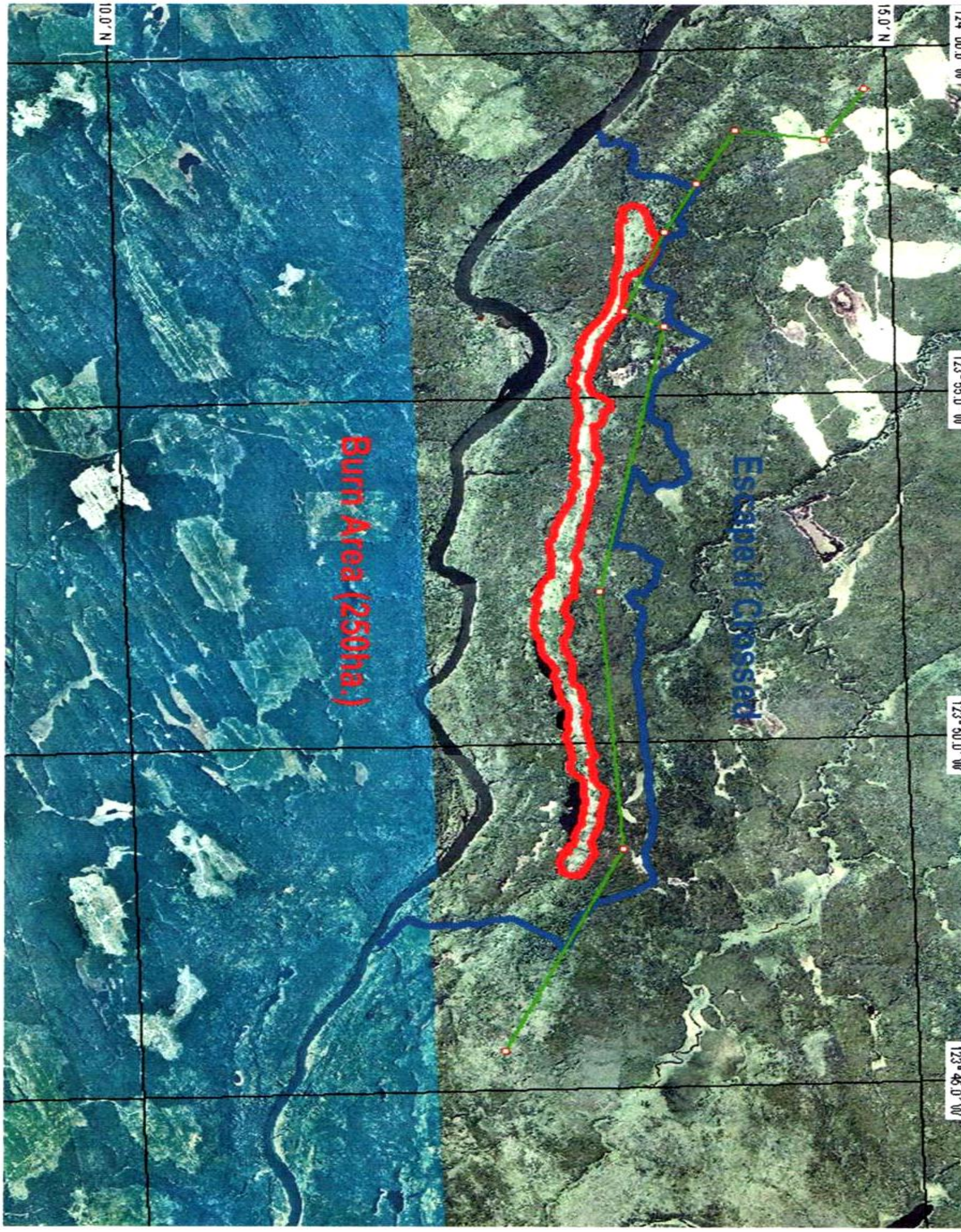
Common Name	Latin Name	Species Code
Tree Layer		
Hybrid white spruce	*Picea glauca x engelmannii*	Sx
Paper birch	*Betula papyrifera*	Ep
Trembling aspen	*Populus tremuloides*	At
Shrub Layer		
Birch-leaved spirea	*Spiraea betulifolia*	SPIR/BET
Black twinberry	*Lonicera involucrate*	LONI/INV
Common snowberry	*Symphoricarpos albus*	SYMP/ALB
Highbush cranberry	*Viburnum edule*	VIBU/EDU
Northern black current	*Ribes hudsonianum*	RIBE/HUD
Prickly rose	*Rosa acicularis*	ROSA/ACI
Pyramid spirea	*Spiraea pyramidata*	SPIR/PYR
Red raspberry	*Rubus idaeus*	RUBU/IDA
Red-osier dogwood	*Cornus stolonifera*	CORN/STO
Saskatoon	*Amelanchier alnifolia*	AMEL/ALN
Soopolallie	*Shepherdia canadensis*	SHEP/CAN
Tall oregon-grape	*Mahonia aquifolum*	MAHO/AQU
Willow species	*Salix species*	SALIX/SPP
Herb Layer		
American vetch	*Vicia americana*	VICI/AME
Blunt-leaved sandwort	*Moehringia lateriflora*	MOEH/LAT
Bunchberry	*Cornus canadesis*	CORN/CAN
Canada goldenrod	*Solidago Canadensis*	SOLI/CAN
Canada violet	*Viola canadensis*	VIOL/CAN
Clasping twisted stalk	*Streptopus amplexifolius*	STRE/AMP
Common dandelion	*Taraxacum officinale*	TARA/OFF
Common horsetail	*Equisetum arvense*	EQUI/ARV
Common juniper	*Juniperus communis*	JUNI/COM
Common red paintbrush	*Castilleja miniata*	CAST/MIN
Cow parsnip	*Heracleum lanatum*	HERA/LAN
Dwarf blueberry	*Vaccinium caespitosum*	VACC/CAE
Dwarf nagoonberry	*Rubus arcticus*	RUBU/ARC
False solomon's seal	*Smilacina racemosa*	SMIL/RAC
Fireweed	*Epilobium angustifolium*	EPIL/ANG
Fringed aster	*Aster ciliolatus*	ASTE/CIL
Grouseberry	*Vaccinium scoparium*	VACC/SCO
Heart leaved arnica	*Arnica cordifolia*	ARNI/COR

Indian hellebore	*Veratrum viride*	VERA/VIR
Kinnikinnick	*Arctostaphylos uva-ursi*	ARCT/UVA
Leafy aster	*Aster foliaceus*	ASTE/FOL
Mount sweet-cicely	*Osmorhiza chilensis*	OSMO/CHI
Northern geranium	*Geranium erianthum*	GERA/ERI
Northern starwort	*Streptopus amplexifolius*	STRE/AMP
Purple peavine	*Lathyrus nevadensis*	LATH/NEV
Purple-leaved willowherb	*Epilobium ciliatum*	EPIL/CIL
Queen's cup	*Clintonia uniflora*	CLIN/UNI
Red columbine	*Aquilegia formosa*	AQUI/FOR
Scouring rush	*Equisetum hyemale*	EQUI/HYE
Showy aster	*Aster conspicuus*	ASTE/CON
Spreading dogbane	*Apocynum androsaemifolium*	APOC/AND
Strawberry blite	*Chenopodium capitatum*	CHEN/CAP
Three-leaved foamflower	*Tiarella trifoliate*	TIAR/TRI
Twinflower	*Linnaea borealis*	LINN/BOR
Violet species	*Viola species*	VIOL/SPP
Western meadow rue	*Thalictrum occidentale*	THAL/OCC
Wild sarsaparilla	*Aralia nudicaulis*	ARAL/NUD
Wild strawberry	*Fragaria virginiana*	FRAG/VIR
Yarrow	*Achillea Millefolium*	ACHI/MIL
Grasses		
Blue wildrye	*Elymus glaucus*	ELYM/GLA
Bluejoint grass	*Calamagrostis canadensis*	CALA/CAN
Nodding wood-reed	*Cinna latifolia*	CINN/LAT
Pinegrass	*Calamagrostis rubesens*	CALA/RUB
Rough-leaved ricegrass	*Oryzopsis asperifolia*	ORYZ/ASP
Spreading needlegrass	*Stipa richardsonii*	STIP/RIC
Tufted hairgrass	*Deschampsia caespitose*	DESC/CAE

Appendix 2.1: Map of Burn and Surrounding Area with Plot Location



Appendix 2.2: Map of Burn and Surrounding Area



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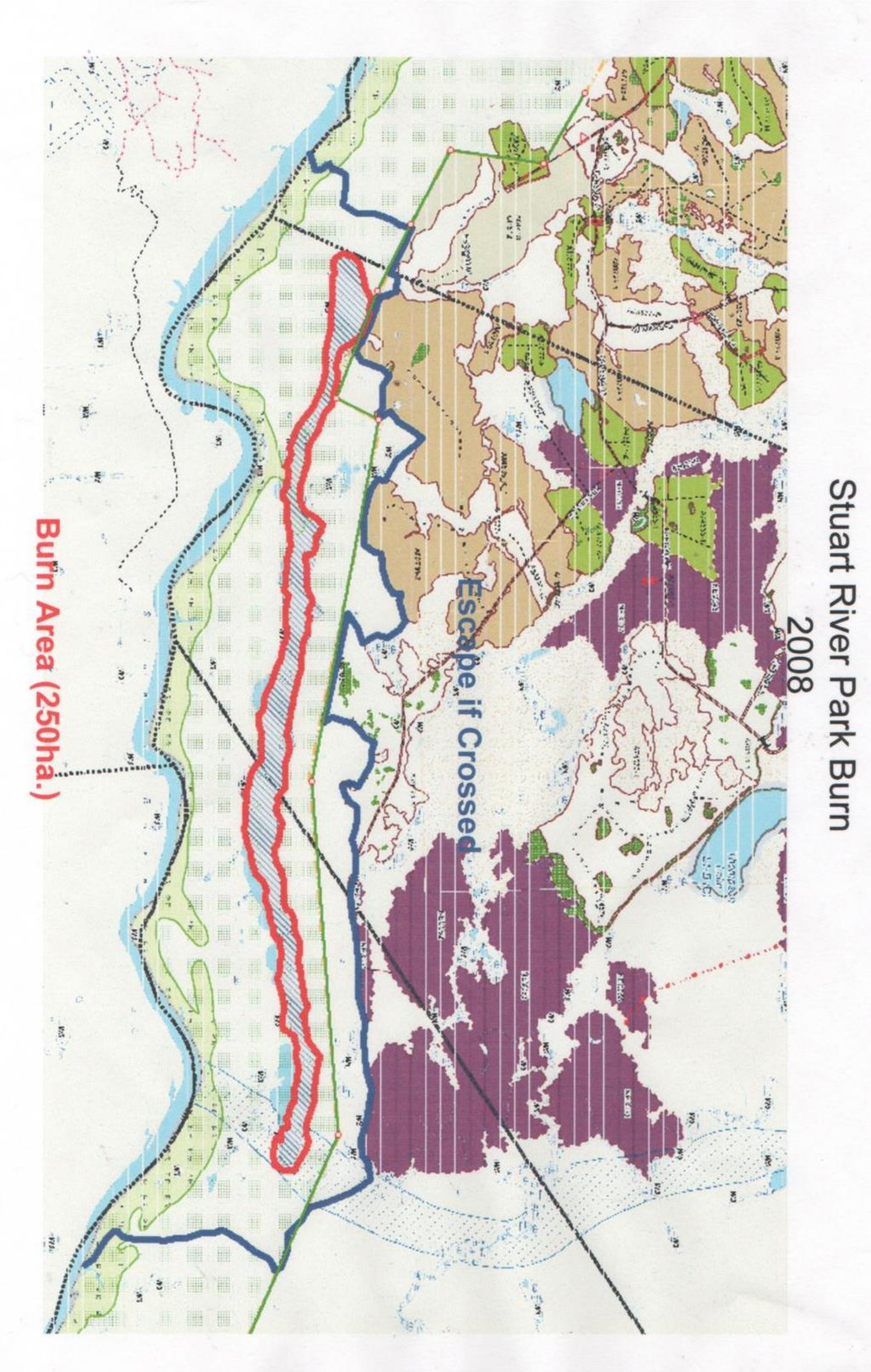
Appendix 2.3: Map of Burn and Surrounding Area with Adjacent Cut Blocks.



Appendix 3.1: Plot 1 Photos

Plot 1: Plot Center.

Plot 1: Azimuth 110°

Plot 1: Azimuth 290°

Appendix 3.2: Plot 2 Photos

Plot 2: Plot Center.

Plot 2: Azimuth 80°.

Plot 2: Azimuth 260°.

Appendix 3.3: Plot 3 Photos

Plot 3: Plot Center.

Plot 3: Azimuth 70°.

Plot 3: Azimuth 250°.

Appendix 3.4: Plot 4 Photos

Plot 4: Plot Center.

Plot 4: Azimuth 52°.

Plot 4: Azimuth 232°.

Appendix 3.5: Plot 5 Photos

Plot 5: Plot Center.

Plot 5: Azimuth 94°.

Plot 5: Azimuth 276°.

Appendix 3.6: Plot 6 Photos

Plot 6: Plot Center.

Plot 6: Azimuth 114°.

Plot 6: Azimuth 294°.

Appendix 3.7: Plot 8 Photos

Plot 8: Plot Center.

Plot 8: Azimuth 80°.

Plot 8: Azimuth 260°.

Appendix 3.8: Plot 9 Photos

Plot 9: Plot Center.

Plot 9: Azimuth 140°.

Plot 9: Azimuth 230°.

Appendix 3.9: Plot 10 Photos

Plot 10: Plot Center.

Plot 10: Azimuth 84°.

Plot 10: Azimuth 264°.