An Evaluation of the Use of Mechanical Clearings by Ungulates in Northwest Alberta

Alberta Conservation Association

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EXECUTIVE SUMMARY

Removal of forest and shrub cover through mechanical clearing has historically been used to increase the quantity and quality of browse for ungulates in northwest Alberta. The purpose of this report is to quantify differences in browse density and use by ungulates at six clearings (established between 1988 and 2003) located among three different sites in northwest Alberta. I defined successful clearings, created by reductions in forest and shrub cover communities, as those where the densities of available browse (stems/ha) and use by ungulates (measured as both number of stems browsed [number/ha] and density of faecal pellet groups [number/ha]) exceeded that in adjacent control (i.e., reference) sites. The abundance of browse and pellets were estimated by establishing replicate plots (circular plot size = 3.57 m in diameter = 10 m^2) within clearings. In each plot, I counted and measured the number of stems, stem density (number of stems/ha) and browse height for different cover type (i.e., different species of plants browsed by ungulates). Using these data I calculated: i) mean browse density (number/ha), ii) mean browse height (cm) and, iii) mean pellet density (number/ha) as a measure of use by ungulates. Because the morphology of faecal pellets differs among ungulates species, I used pellet counts to identify the main species of ungulate that was consuming browse.

Analyses showed marked differences in browse density and browse use but not density of pellet groups between the mechanical clearings and the reference sites in the Bear Creek site. Browse production (density of stems/ha) on the hand-cut willow in Bear Creek was significantly higher than that observed in the mechanical clearings or the control area.

At the Nitehawk site, there were marked differences in browse density, browse use and density of pellet groups between the mechanical clearings and the reference sites. Nitehawk Clearings C and D had much higher levels of moose usage (pellet groups/ha) than Clearing B or control areas.

North Smoky clearings did not have significantly greater browse production or utilization than the control area. Similarly, there was little difference evident in the number of moose pellets groups in clearings and control areas.

These results suggest that there are benefits to developing predictors of successful clearing techniques and prospective sites should be assessed for their potential to provide browse for ungulates prior to the completion of clearing. For example, the effectiveness of clearing sites dominated by willow may be increased if a portion of the willow stem is retained to facilitate re-growth. Within a broader context, it may also be beneficial to develop standards for the completion of mechanical clearings and to evaluate their effectiveness to provide browse for ungulates.

ACKNOWLEDGEMENTS

I thank Mike Rosendal, Stephanie Bone, and Ken Wright for assisting in the field data collections and Ken Wright for reviewing an earlier draft of the report. Garry Scrimgeour, Stephanie Grossman and one anonymous reviewer provided helpful comments on earlier drafts of this report.

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1.0 INTRODUCTION

Removal of forest and shrub cover through mechanical clearing has historically been used to increase the quantity and quality of browse for ungulates in northwest Alberta. The purpose of this report is to quantify differences in browse density and use by ungulates at six clearings (established between 1988 and 2003) located among three different sites in northwest Alberta. I also determined whether different species of ungulates displayed preferences for specific clearings and whether such preferences were associated with different cover types (i.e. species of available browse). I defined successful clearings, created by reductions in forest and shrub cover communities, as those where the densities of browse (stems/ha) or use by ungulates (measured as both density of browsed stems and density of groups of faecal pellet [number of pellet groups/ha]) exceeded that in adjacent control (i.e., reference) sites. The study provides insights into which forest sites may have greater potential to provide quality habitat for wildlife and what site clearing treatments may be the most effective at producing browse.

1.1 Objectives of this report

The objectives of the report are to outline the location and history of the selected clearings and to summarize the vegetative re-growth and ungulate usage in these areas. Significant differences between clearings and control areas are highlighted and locations or clearing treatments that resulted in greater browse production or ungulate usage are identified. Recommendations for future clearing techniques are also included.

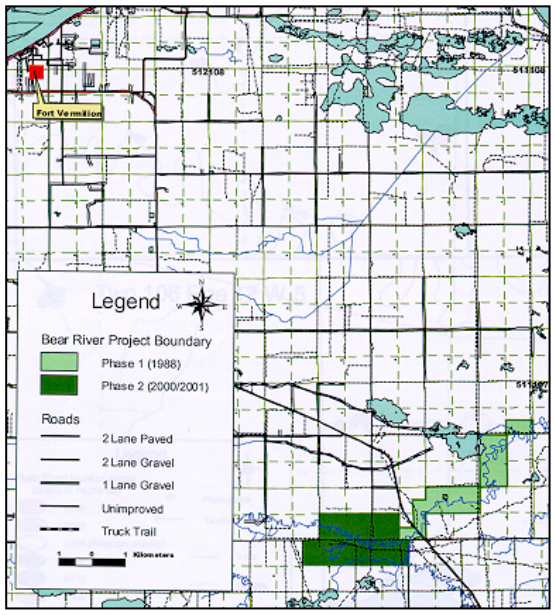
2.0 STUDY AREA

Six clearings were evaluated at three locations in the spring of 2003.

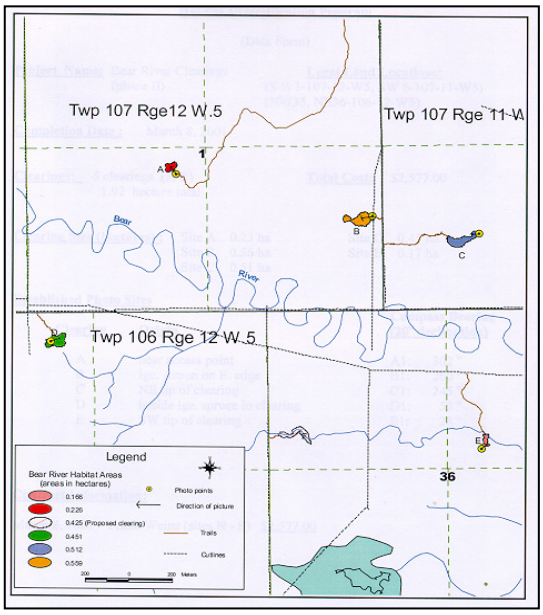
2.1 Clearings at the Bear Creek site

In March of 2001, five clearings (identified as A,B,C,D and E) were created in the Bear Creek area within the white zone of Townships 106 and 107, Ranges 11 and 12, west of

the 5th Meridian (Figure 1). These clearings were located in upland sites dominated by willow (Salix spp.) or aspen (Populus tremuloides) stands. Data on browse density and ungulate use (measured by pellet counts) were collected from four randomly selected plots from Clearings A and D. Clearing A (0.23 ha) had been cleared by a bulldozer, which resulted in the temporary removal of vegetation dominated by decadent willow estimated to be about 40 years old and, on average, 24 cm in diameter. Clearing D (0.48 ha) was also dominated by decadent willow, but had been cleared using chainsaws. Browse and ungulate use surveys were completed in the Bear Creek site because of its northern location and because clearings were completed using different methods, which may influence vegetative regeneration.



Plot A: Location of Bear Creek



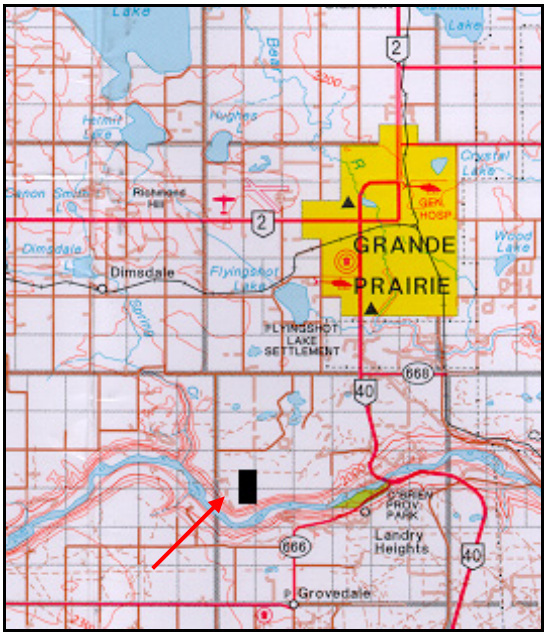
Plot B: Location of Clearings

Figure 1. Location of clearings in the Bear Creek site.

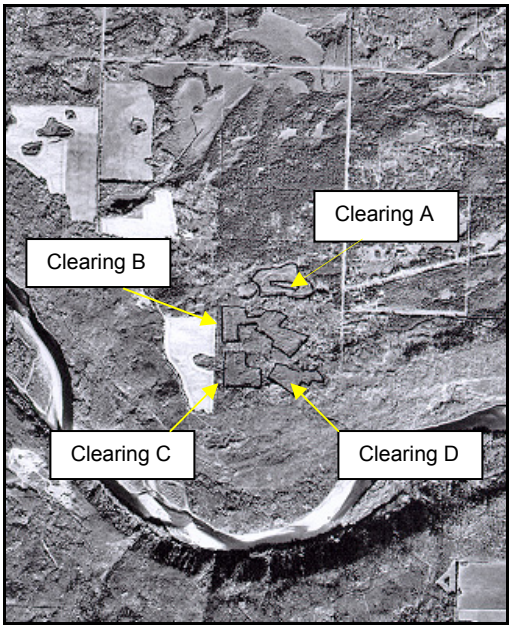
2.2 Clearings at the Nitehawk site

In February of 1988, four clearings were created on upland sites within E18 and SE19-70-6-W6, located about 14 km southwest of Grande Prairie above the breaks of the

Wapiti River valley (Figure 2, Plot A). Browse and ungulate surveys were completed at Clearing B [about 10 ha] and D [about 7 ha] at this site on 14 May 2003. Clearings A and B were cleared from aspen, balsam poplar and willow. Clearing C was established in an area dominated by willow and aspen whereas Clearing D was established within a stand consisting predominantly of willow (Figure 2, Plot B). Clearing D was visually inspected and an ungulate pellet transect was completed.



Plot A: Location of the Nitehawk Site



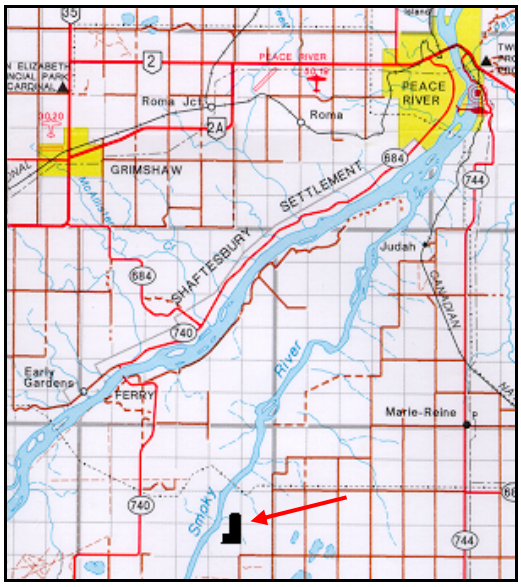
Plot B: Location of the Clearings

Figure 2. Location of clearings at the Nitehawk site.

2.2 Clearings at the North Smoky site

In the winter of 1985 to 1986 five clearings were created on upland sites within NE14 and SE23-81-23-W5, located about 25 km southwest of Peace River above the breaks of the Smoky River valley (Figure 3, Plot A). The portion of the Smoky River valley extending from the Peace River upstream to the confluence of the Little Smoky River is known to support high densities of moose (Alberta Sustainable Resource Development 1996). Browse and ungulate surveys were completed at Clearing C [about 10 ha] and

Clearing D [about 10 ha] in this site on 3 May 2003. All sites were cleared from aspen about 10 cm in diameter. Clearing C was established in an area dominated by willow and aspen, whereas Clearing D was established in a stand consisting predominantly of willow (Figure 2, Plot B).



Plot A: Location of North Smoky site.

Plot B: North Smoky clearings

Figure 3. Location of clearings at the North Smoky site.

3.0 MATERIALS AND METHODS

Field work was completed in early spring, before leaf-out. At this time, recently browsed vegetation can be easily identified due to the absence of more recent growth. Surveys were completed by characterizing between three (Bear Creek site) and 12 plots (i.e., Nitehawk site, North Smoky site) within each clearing in each of the three study sites. Only three to four plots were established in clearings at Bear Creek because these clearings (0.16 and 0.45 ha) were substantially smaller than those at the other two sites and because vegetation was also relatively uniform at these clearings. Sample plots

were distributed evenly throughout the entire clearing and the spacing was calculated using the following formula:

> Square root of (Clearing area (ha) * 10000 m^2/ha divided by number of plots (in this case 3))

For example, in a 2 ha clearing with 12 plots, the plots might be placed 40 m apart, with the distance between plots measured with a hip chain (or "string box"). Plots were moved half the spacing distance again if they landed on a windrow. For example, if the spacing was originally set at 40 m and the plot landed on a windrow the plot would be placed another 20 m away.

As the surveyor traveled between plots the ground was scanned for ungulate pellet groups within 1.5 m on either side of the transect. The distance between each plot, number of pellet groups, and the dominant ungulate species (i.e., deer, moose or elk) were recorded. Thus, traveling the 40 m distance between the two plots yields a pellet survey area of 120 m^2 (see figure 4).

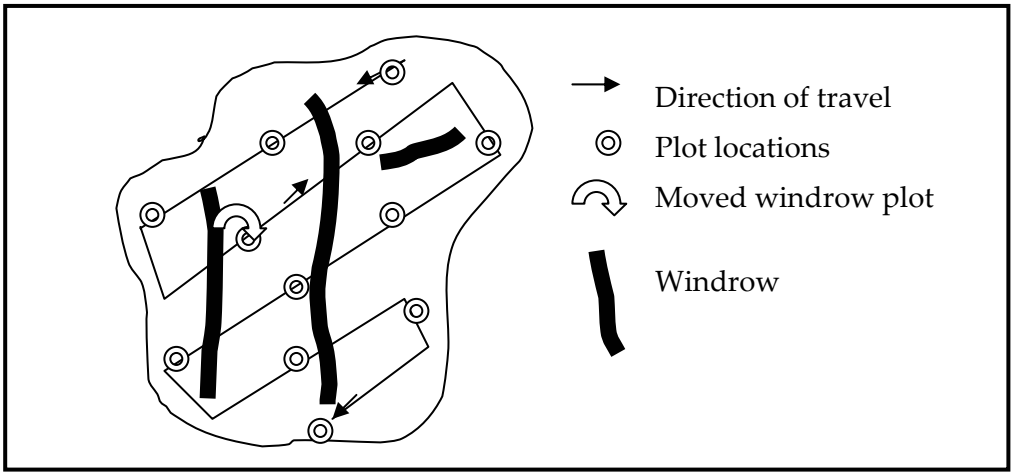


Figure 4. Diagram demonstrating potential plot grid and location of plots in a hypothetical clearing. Plots are equidistance apart, unless the plot ends up on a windrow.

At each 1.78 m radius plot (10 m^2), I calculated the total number of stems of each palatable shrub or deciduous tree species that had grown since the clearing was created. To ensure correct spatial locations, the centroid of each plot was identified with a marker. I also recorded the number of single stems and clumps of stems produced from a single sprout. Each individual stem in a clump (such as that observed in sheared willow stumps) was counted. Additionally, the number of stems that were browsed in the two years preceding the survey was counted. A digital photograph was also taken at each site. Surveys were also completed at an adjacent control site, where mechanical clearings had not been completed using the same protocols as those described above.

Observations of site conditions (e.g., moisture, aspect and slope), slash residue and the effects of the clearing equipment were also recorded. If it was determined that the surrounding non-mechanically altered forest cover represented the same type of forest that was cleared, then the same browse density, browse usage and pellet group surveys were completed to be used as a reference for the clearing. In some cases the forest was not the same as what was cleared, such as when the clearing removed a discrete stand of willow and the surrounding forest type is aspen. In the 2003 surveys all clearings had suitable reference areas. Calculations for both clearings and control areas included: stems/ha of each available browse species, percentage browsed in the past two years, and the number of pellet groups/ha for each ungulate species.

4.0 RESULTS

4.1 Effects of mechanical clearings at the Bear Creek site

There were noticeable differences in browse density (stems/ha) amongst the Bear Creek sites. Bear Creek Clearing A and the Bear Creek control plots had similar levels of browse density. Browse densities in hand-cut Bear Creek Clearing D had over 1000% more browse than either Clearing A or the control plot (Figure 5, Plot A)

There were no browsed stems counted in the survey on either Bear Creek Clearing A or the control area. Clearing D had approximately 11,000 browsed stems per ha, which is

much higher compared to the other Bear Creek sites, but still relatively low when compared to other surveyed clearing projects (Figure 5, Plot B).

There were no faecal pellet groups counted in any of the Bear Creek sites.

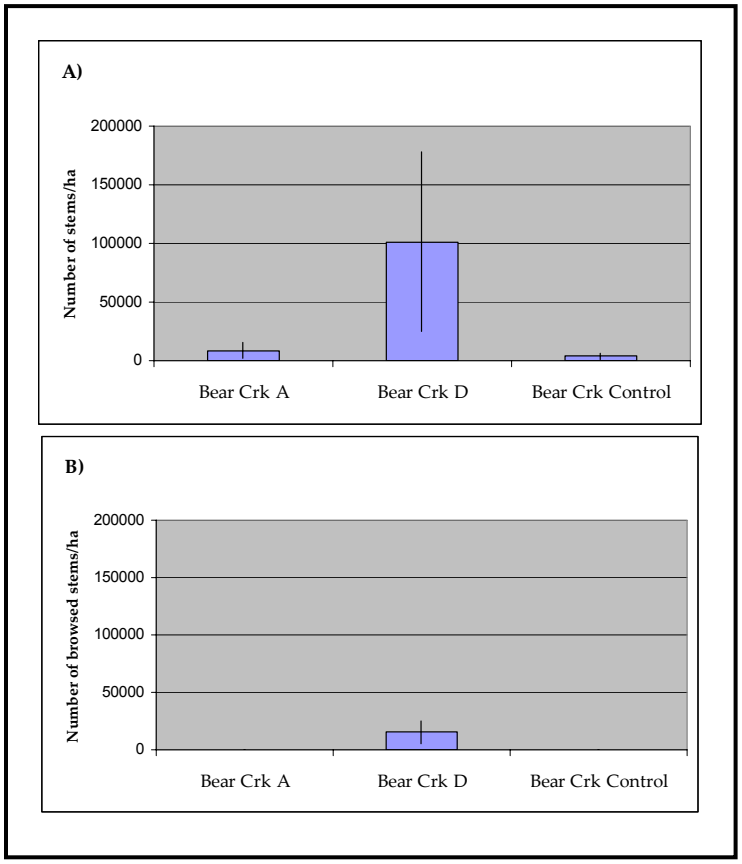


Figure 5. Comparison of mean browse density (A) and density of browsed stems (B) among the two mechanically cleared areas and the control area (i.e. non-cleared) at the Bear Creek site. Vertical bars represent standard deviation from the mean.

4.2 Effects of mechanical clearings at the Nitehawk site

The two surveyed clearings at the Nitehawk site had 200-300% more browse, on average, than the control area (Figure 6, Plot A). The dominant browse in Clearing B was aspen, averaging over 4 m in height. The dominant browse in Clearing C was willow, averaging only 1.5 m in height. Rose (Rosa spp.) was the dominant browse

species in the control area. See Appendix 1 for a complete list of browse densities and usage by species.

The number of stems browsed per ha was similar for Clearing B and the control area. Clearing C had over twice as much browsing as Clearing B or the control area (Figure 6, Plot B).

Figure 6, Plot C summarizes the faecal pellet group counts for the Nitehawk site. An additional clearing (D) was surveyed for pellet groups, but not for browse production due to time constraints. Clearing D had twice as many pellet groups as Clearing C and 10 times more than Clearing B or the control site. Clearing D was dominated by willow and other shrubs, with an estimated average height of 1.5 m. Moose was the dominant ungulate at Nitehawk, with deer pellets only being observed in the control area.

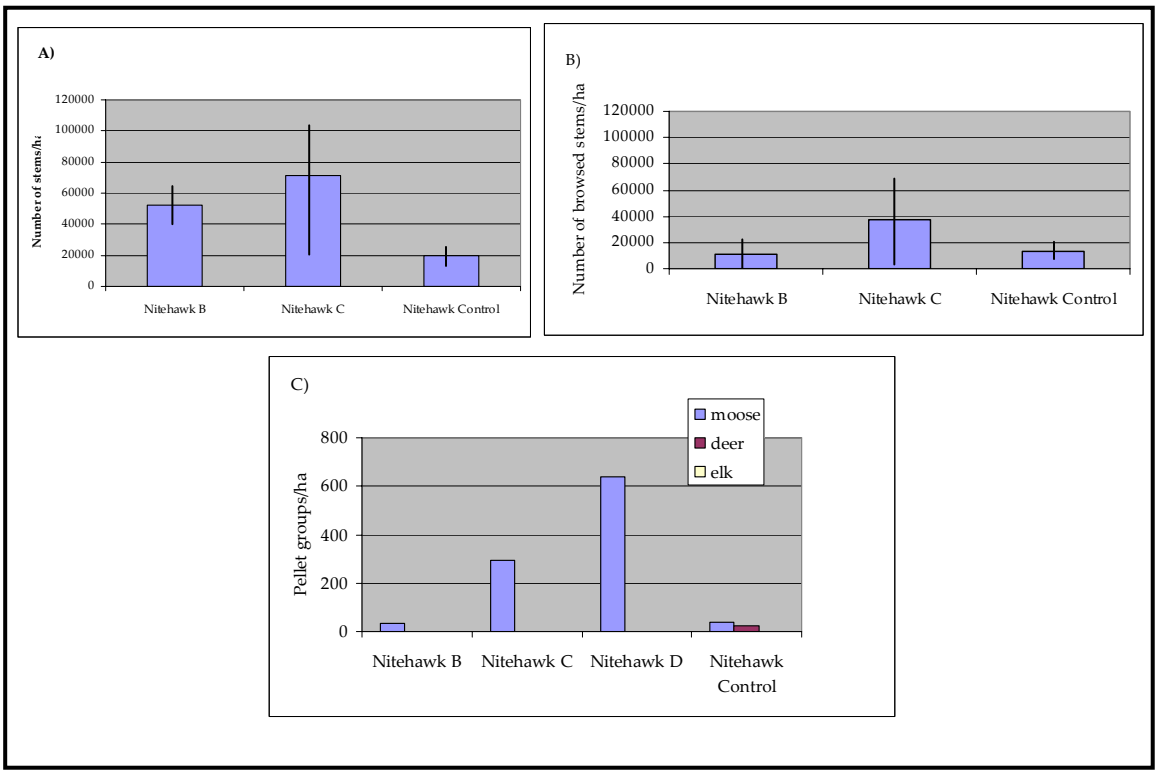


Figure 6. Comparison of mean browse density (A), density of browsed stems (B) and faecal pellet groups (C) among mechanically cleared areas and a control area (i.e. non-cleared) at the Nitehawk site. Vertical bars represent standard deviation from the mean.

4.3 Effects of mechanical clearings at the North Smoky site

No marked differences in browse production were observed between the mechanical clearings and the control area at the North Smoky site (Figure 7, Plot A). Likewise, there was no obvious difference in the density of browsed stems between the mechanical clearings or the control area (Figure 7, Plot B).

The faecal pellet group counts at North Smoky showed little difference in the number of moose pellet groups between the clearing and the control. However, elk pellets were only found within the mechanical clearings, while the number of deer pellet groups was approximately 250% higher in the control area compared to the clearings (Figure 7, Plot C). This was consistent with findings in previous surveys, where deer seemed to prefer un-cleared areas to clearings (Hallett 2003).

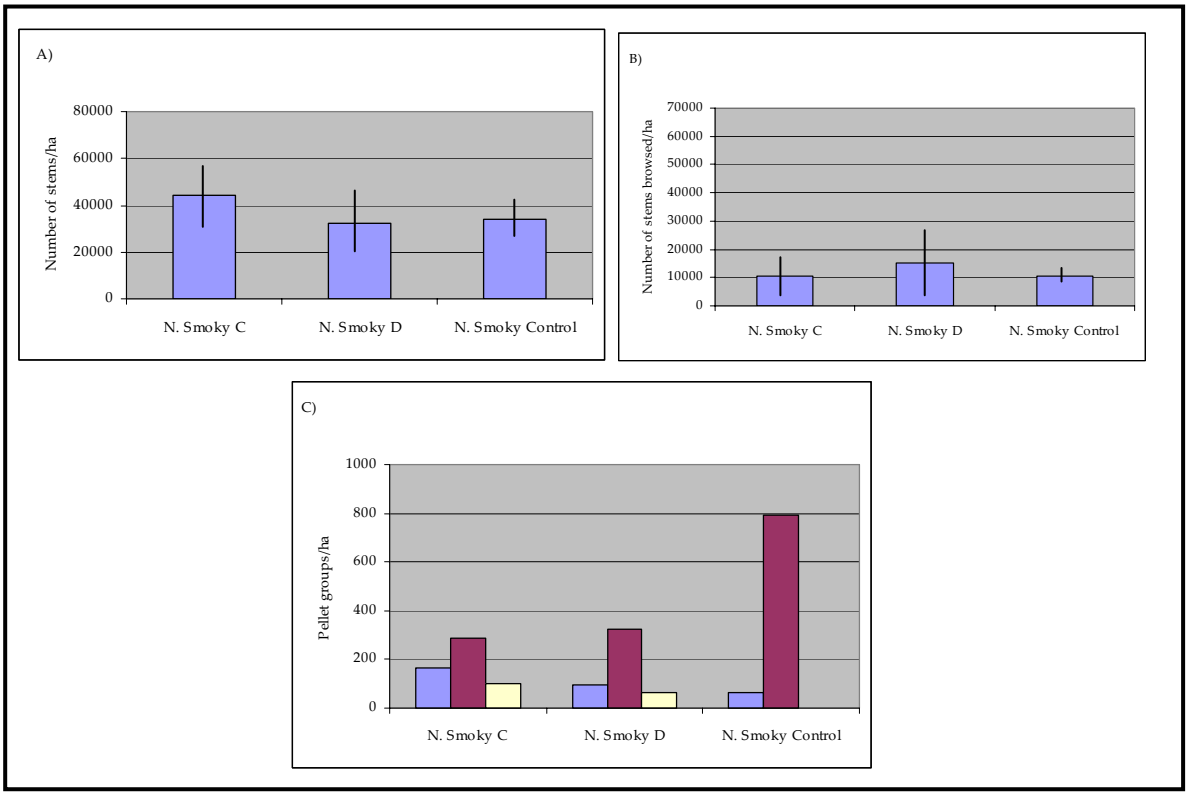


Figure 7. Comparison of mean browse density (A), density of browsed stems (B) and faecal pellet groups (C) among mechanically cleared areas and a control area (i.e. non-cleared) at the North Smoky site. Vertical bars represent standard deviation from the mean.

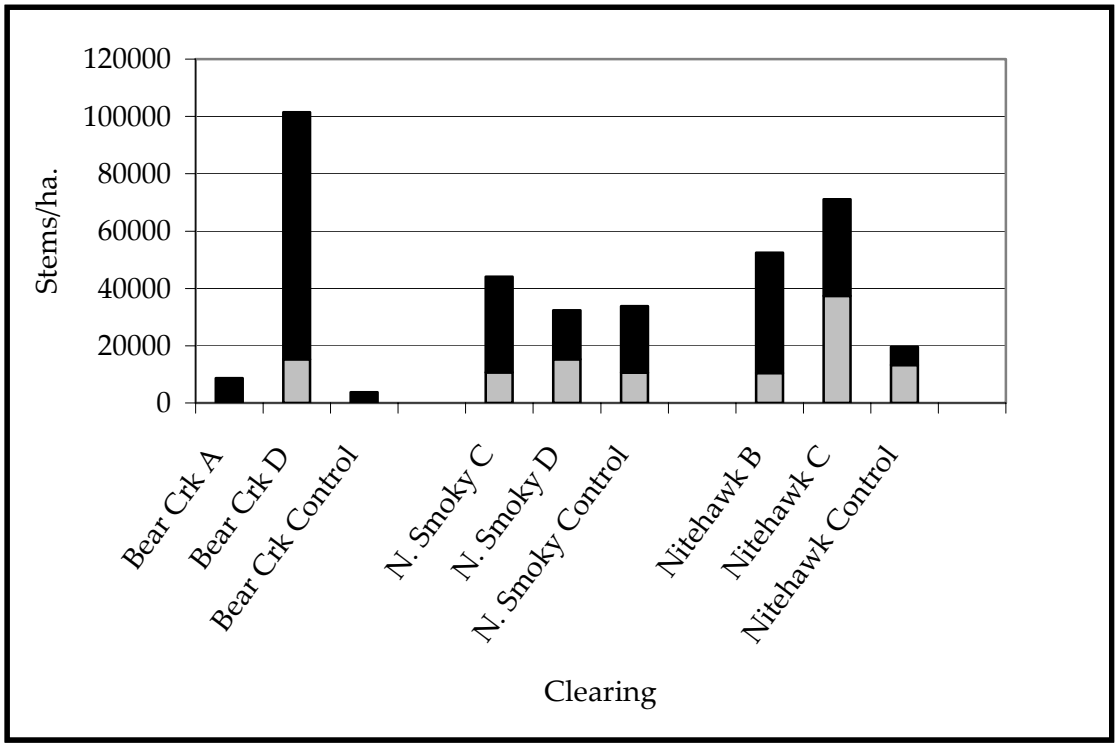


Figure 8. Browse production and utilization in the various clearing sites. Black areas represent the total number of stems available per ha, grey areas represent the total number of stems browsed per ha.

In Figure 8 the browse production and usage is summarized for all the surveyed sites. Bear Creek has the lowest browse usage of all the sites, but hand-cut clearing D had the greatest browse production. Only in Nitehawk Clearing C and the Nitehawk control did the number of stems browsed exceed 50 percent of the total stems available.

4.4 Summary and recommendations

Results from this study suggest that the effects of mechanical clearing on browse production and use by ungulates were highly variable and that the benefits of clearings may not be as wide spread as initially thought. For instance, mechanical clearings of forest and willow at Bear Creek with a bulldozer were not accompanied by substantial increases in available browse relative to the non-cleared control site. In contrast, density of browse in the clearing established using a chain saw was substantially higher than that in the control site. Differences in density of browse between areas cleared by a bulldozer versus those cleared with a chain saw likely reflect differences in how the

two methods remove vegetation. When clearing willows with a chainsaw, the removal of above-ground vegetation, leaving some biomass above the surface, can result in shoot coppicing. In contrast, removal of vegetation with a bulldozer can result in massive disruption of the entire soil horizon, removal of substantial above and below-ground plant biomass and loss of the above ground portions of the stem required to produce sprouts. Thus, results from Bear Creek suggest that hand clearing methods, such as those employing a chain saw, may be a more effective means to increase browse production in willow stands than the large-scale removal of vegetation using a bulldozer. However, bulldozing a willow-dominated site does not always result in poor regeneration of willow. My personal observations are that clearing of younger willows, which still have relatively small and flexible stems, can result in substantial re-growth. However, clearings in northwestern Alberta typically have been undertaken in old, decadent willow and re-growth in these situations is usually very poor. Aspen, which suckers from roots and not above ground stems does regenerate well after clearing with a bulldozer - as was observed in North Smoky and other sites surveyed in previous years (Hallett 2003).

Results from clearings established in the North Smoky site demonstrate the need to critically evaluate existing levels of browse before embarking on mechanical clearing programs. For instance, the evaluation of the control area indicated that it produced moderately high levels of browse and that, at the time of the survey, local ungulate populations have utilized only one third of browse production. Whether this was true when the clearings were made in 1985 is conjecture, but the current, dense re-growth of aspen in the clearings suggests that there was light browsing pressure in the years immediately following clearing.

Lastly, evaluations of clearings established at the Nitehawk site suggested that initial vegetative cover types might influence the use of mechanically cleared areas by ungulates. In fact, data from this manipulation showed that ungulate usage (as measured by pellet groups/ha) of the aspen-dominated Clearing B was similar to the un-cleared aspen area, although portions of clearings C and D, dominated by regenerating willow, were used more frequently by moose than those dominated by other cover types. Aspen, a highly preferred browse species, dominated clearing B, but

the average height of this re-growth (4.6 m) was beyond the preferred height range of most ungulates.

Data presented in this report suggest highly variable responses of vegetation re-growth to mechanical clearing and subsequently, variable use of these cleared sites by ungulates. Mechanisms for predicting whether a site will respond favourably to mechanical clearing are not well understood. The development and testing of criteria that could be used to predict favourable outcomes (i.e., increased browse production combined with increased browsing by ungulates) would be highly beneficial. These criteria, and associated practices, could also be used to: i) identify sites that represent good candidates for treatment, and ii) predict potential increases in browse production and browse use by ungulate.

5.0 LITERATURE CITED

Hallett, J.J. 2003. Evaluation of selected mechanical clearings in the northwest region in 2002. Activity report produced by the Alberta Conservation Association, Peace River, Alberta, Canada. 36 pp.

Alberta Sustainable Resource Development. 1996. Ungulate population density map of the Peace River Region. Peace River, Alberta, Canada.

6.0 APPENDICES

6.1. Appendix 1. A summary of the data collected at each clearing site.

Bear Creek Phase 2 Clearing A

Species	Average height (cm)	% Browsed in past 2 years	Stems/ ha	Standard deviation	90% C.I.	% of total	Stems utilized per ha (%)
Aspen	140	0	5000	5.292	2795	57.7	0
Saskatoon							0
Low bush cranberry	50	0	333	-	-	3.8	0
Rose	40	0	1000	-	-	11.5	0
Balsam poplar							0
Dogwood	60	0	1000	-		11.5	0
Willow	130	0	1333	0.577	305	15.4	0
Alder							0
Honeysuckle							0
Prunus							0
White Birch							0
Total			8667				0
Number of moose pellet groups per ha			0.0				
Number of deer pellet groups per ha			0.0				
Number of elk pellet groups per ha			0.0				

6.1 Appendix 1. Continued.

Bear Creek Phase 2 Clearing D

Species	Average height (cm)	% Browsed in past 2 years	Stems/ ha	Standard deviation	90% C.I.	% of total	Stems utilized per ha (%)
Aspen	96	7	26000	32.868	17364	25.6	1750
Saskatoon							
L.B. cranberry							
Rose	80	0	1250		-	1.2	0
Balsam Poplar							
Dogwood	100	0	3750		-	3.7	0
Willow	169	19	70500	79.605	42055	69.5	13500
Alder							
Honeysuckle							
Prunus							
White Birch							
Total			101500				15.0%
Number of moose pellet groups per ha			0.0				
Number of deer pellet groups per ha			0.0				
Number of elk pellet groups per ha			0.0				

Bear Creek Phase 2 Control

Species	Average height (cm)	% Browsed in past 2 years	Stems/ ha	Standard deviation	90% C.I.	% of total	Stems utilized per ha (%)
Aspen	60	0	250		-	6.7	0
Saskatoon	90	0	500		-	13.3	0
L. B. cranberry							0
Rose							0
Balsam Poplar							0
Dogwood							0
Willow	138	0	3000	5.196	2745	80	0
Alder							0
Honeysuckle							0
Prunus							0
White Birch							0
Total			3750				0.0%
Number of moose pellet groups per ha			0.0				
Number of deer pellet groups per ha			0.0				
Number of elk pellet groups per ha			0.0				

6.1 Appendix 1. Continued.

North Smoky Clearing C

Species	Average height (cm)	% Browsed in past 2 years	Stems/ ha	Standard deviation	90% C.I.	% of total	Stems utilized per ha (%)
Aspen	617	8	16000	14.80	7819	36.3	1250.0
Saskatoon	121	90	2583	6.35	3353	5.9	2333.3
Low bush cranberry	125	26	9750	7.70	4066	22.1	2583.3
Rose	89	14	10417	4.95	2615	23.6	1416.7
Balsam Poplar	540	18	1833	2.89	1525	4.2	333.3
Dogwood	60	100	833	-	-	1.9	833.3
Willow	222	72	2667	4.39	2321	6.0	1916.7
Total			44083				0.2
Number of moose pellet groups per ha			166.7				
Number of deer pellet groups per ha			287.0				
Number of elk pellet groups per ha			101.9				

North Smoky Control

Species	Average height (cm)	% Browsed in past 2 years	Stems/ ha	Standard deviation	90% C.I.	% of total	Stems utilized per ha (%)
Aspen	63	100	833	0.46	245	2.5	833.3
Saskatoon	72	100	750	0.84	442	2.2	750.0
Low bush cranberry	66	41	11000	7.91	4180	32.5	4500.0
Rose	77	22	21250	5.83	3081	62.8	4583.3
Total			33833				31.5
Number of moose pellet groups per ha			65.2				
Number of deer pellet groups per ha			789.9				
Number of elk pellet groups per ha			0.0				

6.1 Appendix 1. Continued.

North Smoky Clearing D

Species	Average height (cm)	% Browsed in past 2 years	Stems/ ha	Standard deviation	90% C.I.	% of total	Stems utilized per ha (%)
Aspen	512	41	12333	11.13	5880	38.0	5083.3
Saskatoon	87	86	583	2.12	1121	1.8	500.0
L. B. cranberry	83	9	2667	2.88	1521	8.2	250.0
Rose	89	31	9833	4.82	2547	30.3	3000.0
Balsam Poplar	800	0	250	-	-	0.8	0.0
Dogwood	59	94	3000	8.64	4565	9.3	2833.3
Willow	133	98	3667	6.62	3499	11.3	3583.3
Alder	0	0	0	0.00	0	0.0	0.0
Honeysuckle	0	0	0	0.00	0	0.0	0.0
Prunus	0	0	0	0.00	0	0.0	0.0
White Birch	150	100	83	-	-	0.3	83.3
Total			32417				0.5
Number of moose pellet groups per ha			97.8				
Number of deer pellet groups per ha			326.1				
Number of elk pellet groups per ha			65.2				

Nitehawk Clearing B

Species	Average height (cm)	% Browsed in past 2 years	Stems/ ha	Standard deviation	90% C.I.	% of total	Stems utilized per ha (%)
Aspen	461	12	20889	10.36	5474	39.8	2556.0
Saskatoon	80	0	333	-	-	0.6	0.0
L.B. cranberry	68	32	8111	4.67	2467	15.5	2556.0
Rose	50	4	11778	7.31	3859	22.5	444.4
Balsam Poplar	600	0	1889	2.63	1389	3.6	0.0
Dogwood	58	54	2667	5.35	2829	5.1	1444.0
Willow	95	60	5889	15.47	8172	11.2	3556.0
Alder	0	0	0	0.00	0	0.0	0.0
Honeysuckle	56	0	889	1.41	747	1.7	0.0
Prunus	0	0	0	0.00	0	0.0	0.0
White Birch	0	0	0	0.00	0	0.0	0.0
Total			52444				0.2
Number of moose pellet groups per ha			34.9				
Number of deer pellet groups per ha			0.0				
Number of elk pellet groups per ha			0.0				

6.1 Appendix 1. Continued.

Nitehawk Clearing C

Species	Average height (cm)	% Browsed in past 2 years	Stems/ ha	Standard deviation	90% C.I.	% of total	Stems utilized per ha (%)
Aspen	373	17	2000	5.29	2795	2.8	333.3
Saskatoon	0	0	0	0.00	0	0.0	0.0
L.B. cranberry	80	67	2000	0.00	0	2.8	1333.0
Rose	55	0	500	0.00	0	0.7	0.0
Balsam Poplar	328	11	8750	5.59	2954	12.3	1000.0
Dogwood	69	91	917	2.08	1100	1.3	833.3
Willow	151	64	51500	33.13	17502	72.5	32917.0
Alder	418	0	2583	2.08	1100	3.6	0.0
Honeysuckle	55	0	1833	1.41	747	2.6	0.0
Prunus	0	0	0	0.00	0	0.0	0.0
White Birch	180	100	1000	-	-	1.4	1000.0
Total			71083				52.6
Number of moose pellet groups per ha			291.7				
Number of deer pellet groups per ha			0.0				
Number of elk pellet groups per ha			0.0				

Nitehawk Control

Species	Average height (cm)	% Browsed in past 2 years	Stems/ ha	Standard deviation	90% C.I.	% of total	Stems utilized per ha (%)
Aspen	165	67	1200	2.16	1141	6.1	800.0
Saskatoon	0	0	0	0.00	0	0.0	0.0
L.B. cranberry	54	58	3600	6.23	3291	18.4	2100.0
Rose	68	67	12300	4.37	2310	62.8	8200.0
Balsam Poplar	190	100	200	-	-	1.0	200.0
Dogwood	0	0	0	0.00	0	0.0	0.0
Willow	157	90	2000	1.37	722	10.2	1800.0
Alder	0	0	0	0.00	0	0.0	0.0
Honeysuckle	80	67	300	-	-	1.5	200.0
Prunus	0	0	0	0.00	0	0	0.0
White Birch	0	0	0	0	0	0	0.0
Total			19600				0.7
Number of moose pellet groups per ha			37.5				
Number of deer pellet groups per ha			25.0				
Number of elk pellet groups per ha			0.0				

The Alberta Conservation Association is a non profit, non government association working collaboratively to conserve and enhance Alberta's wildlife, fisheries and habitat.

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