Effects of Grassland Restoration Treatments on Ungulate Use of Northwest BC Grasslands

Prepared by Sybille Haeussler[1] and Adrian de Groot[2], Bulkley Valley Research Centre, Smithers, BC., October 2009.

[1]Ecosystem Sciences and Management Program, University of Northern British Columbia
[2]Drosera Ecological Consulting, Smithers, BC.

THIS DOCUMENT HAS NOT BEEN PEER-REVIEWED

Introduction

Dry, south-facing slopes in the SBSdk zone of the Bulkley Valley and Lakes District of Northwest BC provide critical habitat for a wide variety of wildlife and are particularly important as late winter and early spring habitat for mule deer. As part of its grassland restoration project, the Bulkley Valley Research Centre is counting ungulate (cervids) pellet groups on all grassland monitoring sites to assess trends in use of these habitats by cervids (deer, moose, elk) and how they are affected by restoration treatments. This report summarizes early results from pellet group counts in the Spring of 2008 and 2009 at seven grassland sites located between Smithers, BC and Francois Lake (near Burns Lake), BC .

Methods

Shortly after snowmelt (April 1 to May 1) in 2008 and 2009, ungulate pellet groups were counted in a 5 m wide band along five 100 m linear transects established at each site (2008: Call Lake, Toodienia/Hubert Hill, Dieleman, Summit Lake, Colleymount, Red Hills; 2009: same as 2008 plus Det San site). Due to logistical constraints, one transect at Det San and 3 transects at Colleymount in 2009 were only 2.5 m wide. Where portions of a transect had received restoration treatments (prescribed fire, manual cutting) we recorded the treatment and tallied the pellet groups separately for treated and untreated sections of the transect. The pellets were categorized as either old (dull and weathered) or new (glossy and unweathered) and identified to species. A minimum of 10 pellets was required to constitute a pellet group: small numbers of pellets were either grouped with adjacent groups or disregarded. Pellets were collected and discarded outside the plot to avoid recounting. These methods follow the approved standards of the Resources Information Standards Committee of BC (RIC 1998), but sample intensity was customized for our permanent vegetation monitoring plots. In 2009 we also staked some new pellet groups so that they can be re-examined in 2010.

Pellet group counts were converted to pellet groups per hectare within each treatment type on each transect. Response variables were: (1) deer pellet groups/ha, (2) moose pellet groups/ha, and (3) total ungulate pellet groups/ha. Results were analysed using a General Linear Model with transects serving as replicates for within-site analyses, and sites serving as replicates between-site analyses. Sample year (2008 or 2009) was nested within treatments in ANOVAs with multiple treatments. All statistical analyses were carried out using SYSTAT Version 4.0 software with the significance level set at $\alpha = 0.10$ to reduce the risk of a Type II error.

At Red Hills, ungulate pellet counts were carried out in April 2008, several weeks before the prescribed fire was carried out, and one year later, after the burn. The burn boundary cut diagonally across the monitoring plot so that all five 100 m transects had both a burned and an unburned section, but this varied from 50 m burned on transect 1 to 42m burned on transect 5. The unburned section of the plot was open scrub-steppe with abundant kinnickinnick and few aspen, whereas the burned section was partially located within a young aspen stand with little kinnickinnick cover. This habitat type discrepancy (bias) significantly confounded the interpretation of results as deer behaviour is likely to be different in the two habitat types. In 2008, the pellet groups were tallied along the full length of each transect and it was not possible to determine retroactively how many pellet groups were recorded in the "unburned control" section of the transect and how many were in the "to be burned" section of the transect. We used the % of scrub-steppe on each transect section as a co-variable to remove the confounding effect of differences in habitat type.

Results

Region-Wide:

In the first year of sampling, we were concerned that old pellets could be left over from previous winters and could thus over-estimate the degree of wildlife use in 2008. However, we found that pellet group numbers were generally similar or higher in 2009 than in 2008 (despite having removed the 2008 pellets), and that the proportions of old pellets were only slightly lower (55 ± 13 % in 2008; 42 ± 11 % in 2009; p = 0.08) and looked just as decomposed in 2009 as they had the previous year. We therefore concluded that most pellets decompose within one year on these grassland sites and that it is not possible to reliably distinguish pellet age by the state of decomposition. In all further analyses, we have lumped the old and new pellets together.

Cervid pellets, particularly deer, were abundant at all SBSdk grassland sites, and the same general patterns of abundance and species composition held in 2008 and 2009 (Tables 1 and 2). The Toodienia/Hubert Hill grassland near Telkwa had by far the greatest pellet density, averaging 2099 pellet groups/ha over the two years. Colleymount on Francois Lake, Call Lake and Det San near Smithers, and Dieleman on Hungry Hill near Houston averaged 754 pellet groups/ha. Summit Lake near Houston, and Red Hills on Francois Lake, averaged 243 pellet groups/ha.

Colleymount, Toodienia/Hubert Hill , Red Hills and Det San supported mainly deer (100%, 99%, 97% and 82% of pellet groups, respectively), while the remaining sites supported a mix of species (Call Lake: 62% deer, 38% moose; Summit Lake: 49% deer, 51% moose; Dieleman: 67% deer, 32% moose, 1% elk).

With all sites (Det San excluded) considered together, there was no significant difference in total pellet density between 2008 (742 ± 201 groups/ha) and 2009 (863 ± 201 groups/ha) (p = 0.69), because densities increased on two sites (Toodienia, Red Hills) , decreased on two sites (Call Lake, Summit Lake) and were unchanged on two sites (Colleymount, Dieleman).

Toodienia/Hubert Hill

At the Toodienia/Hubert Hill grassland site near Telkwa, pellet densities more than doubled in 2009 (2829 groups/ha) compared to 2008 (1368 groups/ha) ($p = 0.001$). These were almost entirely mule deer pellets. The site was broadcast burned in 2005, but since the burn was irregularly distributed across the entire treatment plot, we were unable to compare pellet densities on burned and unburned treatment areas. The manual cutting treatments were randomly located within 25 m x 20 m subplots and these subplots could be analysed separately from the uncut matrix. There were very significantly more pellet groups in manually-cut subplots (2382 groups/ha) than in the uncut matrix (1835 groups/ha) ($p = 0.002$). This treatment effect was consistent over both years ($p = 0.80$ for the treatment x year interaction).

Call Lake

The Call Site near Smithers had contrary results to Toodienia/Hubert Hill. Pellet densities (both deer and moose) decreased significantly from 2008 (888 groups/ha) to 2009 (332 groups/ha) ($p = 0.02$). At this site, manual cutting of 50 m x 5 m strips on a randomly assigned half of each transect was carried out for 3 consecutive years. Manually-cut transects had significantly lower pellet densities (488 groups/ha) than uncut subplots (742 groups/ha) ($p = 0.02$). This negative treatment effect occurred in both years ($p = 0.64$ for the treatment x year interaction), and was evident for both species in 2008, but only for moose in 2009. In 2009, deer pellet densities were similar on cut (192/ha) and uncut (182/ha) subplots.

Red Hills

There were very few moose pellets at Red Hills (Tables 1 and 2), so the following analysis is based on deer pellets only. Deer pellet density in 2008 was 160 groups/ha, averaged across unburned scrub-steppe and unburned young aspen forest habitat. In 2009, there were 92 groups/ha in the unburned half of the transects and 330 groups/ha in the burned half of the transects. A straight-forward analysis of the data that does not consider differences between open scrub-steppe and aspen forest habitat indicated that there was no significant difference in deer abundance between 2008 and 2009 ($p = 0.32$) but that the deer very significantly preferred burned habitat over unburned habitat in 2009 ($p = 0.004$).

When we factored out differences in the percentage of open scrub-steppe habitat on each unburned or burned transect, we found that, once again, there was no significant difference between 2008 and 2009 deer abundance ($p = 0.27$). With ANCOVA, however, the apparent preference for burned habitat in 2009 completely disappeared ($p = 0.99$). In other words, it was simply not possible to determine whether the deer actually preferred burned over unburned habitat, or whether they merely preferred young aspen forest to open scrub steppe. There was a non-significant ($p > 0.13$), negative relationship between deer pellet density and the percentage of scrub-steppe habitat that was independent of burning. This result suggests, but does not confirm, that most of the difference between 92 groups/ha on unburned habitat vs. 330 groups/ha on burned habitat, was due to the deer preferring to spend time amongst the aspen trees, rather than due to the deer preferring the burned forage under the aspen trees.

Table 1. Cervid pellet density (pellet groups per hectare) on SBSdk grassland restoration sites after snowmelt in 2008 and 2009.

Site		2008									2009								
		DEER			MOOSE			ALL CERVIDS			DEER			MOOSE			ALL CERVIDS		
		Untreated	Treated	Total	Untreated	Treated	Total	Untreated	Treated	Total	Untreated	Treated	Total	Untreated	Treated	Total	Untreated	Treated	Total
Call Lake	*Mean*	648	464	556	408	256	332	1056	720	888	184	192	188	200	64	132	384	256	320
UNBURNED	*Stdev*	656	271	363	322	134	195	854	346	474	173.4	111	137.3	126.5	45.6	114.8	264.7	96.3	199.6
Cut 2006-08																			
Colleymount	*Mean*	--	--	874	--	--	0	--	--	874			920			0			920
UNBURNED	*Stdev*	--	--	273	--	--	0	--	--	273			794.8			0			794.8
Det San	*Mean*	--	--	--	--	--	--	--	--	--			640			144			784
UNBURNED	*Stdev*	--	--	--	--	--	--	--	--	--			147.7			81.7			146.6
Dieleman	*Mean*	--	--	512	--	--	240	--	--	756*			475			234			709
BURNED 2002	*Stdev*	--	--	272	--	--	62	--	--	336			172.2			150.5			213.1
Hubert Hill	*Mean*	1035	1680	1357	21	0	11	1056	1680	1368	2581	3028	3831			16	2613	3044	3847
BURNED 2005	*Stdev*	337	1024	1112	48	0	48	363	1024	1148	1131.6	614.4	1526			107	1152.7	637.7	1586
Cut 2005-08																			
Red Hills	*Mean*	--	--	160	--	--	8	--	--	168	92	330	211	0	0	0	92	330	211
BURNED 2008	*Stdev*	--	--	68	--	--	11	--	--	63	55.8	157.8	168.1	0	0	0	55.8	157.8	168.1
Summit Lake	*Mean*	--	--	200	--	--	216	--	--	416			92			100			192
UNBURNED	*Stdev*	--	--	95	--	--	210	--	--	289			78.2			78.7			147.4
All Sites	*Mean*	841	1072	610	215	128	134	704	800	716	952	1183	908	100	32	89	1030	1210	998
	Stdev	273	860	450	273	181	146	0	679	459	1411	1599	1321	141	45	89	1379	1589	1290

* includes 4 elk pellets groups per hectare

Discussion

Two years of ungulate pellet counting on seven SBSdk/81 grassland sites have produced mixed results for determining whether the grassland restoration techniques are enhancing ungulate habitat (with a focus on mule deer). The data are weak for several reasons:

(1) Two years of data are insufficient to determine trends because population numbers, weather conditions, grassland responses and many other factors can vary on a year-to-year basis and can obscure longer term, real relationships between habitat restoration and wildlife abundance.

(2) The small scale of the treatments and the location of a single 1 hectare sample plots with 100 linear sampling transects are not ideal for assessing wildlife response-especially large, mobile ungulates. The initial study was established in 2002 to study grassland vegetation change and used a sampling protocol designed for Range Reference Areas (described in Gayton 2003). We have adapted this sampling protocol for the ungulate pellet counts, but we realize that it is not ideally designed for this purpose. For example, due to the small scale and proximity of the treatments and sampling transects, the ungulates could be feeding in one location (eg manually cut grassland) and taking shelter in another location (uncut aspen forest). Alternatively, they could be using manually cut transect strips as movement corridors to access uncut forage in another area.

(3) Because the study is an adaptive management trial rather than a formal research installation, the types and timing of treatments has varied greatly among the sites, making region-wide comparisons difficult. Moreover, because carrying out prescribed burns is difficult enough to do without research constraints, we have not attempted to randomly allocate and replicate the burned and unburned treatments.

(4) Restoration treatments designed to restore SBSdk grasslands are inherently different from restoration treatments designed to optimize mule deer habitat, because the deer use a variety of ecosystems and vegetation types at different times of the year. This study is focussed on restoring only one of those habitats and is intended to enhance all grassland-dependent species (coarse filter approach), rather than deer alone.

Despite these constraints, we are still learning a great deal from the ungulate pellet counts. Most importantly, regular monitoring provides a structured context for making wildlife observations. For example, at Toodienia/Hubert Hill we have observed that the deer spend much of their time under the cover of the aspen trees, but graze very intensively on the wild onion and early spring grasses that characterize the scrub steppe ecosystem. They prefer our uppermost manually- cut subplot (2880 groups/ha in 2008; 3807 groups/ha in 2009) because it has a high concentration of forage but also contains dead and dying overtopping trees and has close access to escape cover. They consistently make less use of the fully open area lower on the slope (920 groups/ha in 2008; 2393 groups/ha in 2009). We believe that the huge increase in pellet densities from 2008 to 2009 was related to the presence of a dense ice crust at the ground surface in 2009 that made both walking and foraging difficult for the deer. That ice crust melted early on the steep south slope at Toodienia/Hubert Hill when it still constrained the deer activity in the surrounding landscape. In mid-winter, the deer don't particularly like Toodienia/Hubert Hill, because rapid temperature shifts cause frequent ice crusts to develop, but these are gone in early spring when the grass arrives.

The conflicting results at Call Lake are not particularly surprising because this is quite a different habitat with considerable coniferous cover and a mix of deer and moose use. To date, the manual cutting treatments have largely resulted in a reduction in the amount of woody browse with little increase in herbaceous forage. We think the deer may be starting to use the manually cut strips in early spring as the forage begins to develop there, whereas moose prefer the areas with more woody browse. If our grassland restoration treatments are successful at creating herbaceous deer spring forage at the expense of woody moose browse, then they will have partially achieved our restoration objectives.

At Red Hills, we are fairly certain that the high pellet densities in the burned habitats reflects a combination of preferred forested habitat and forage enhancement after the burn, but our plot design makes it difficult to tease these apart. The Red Hills scrub-steppe ecosystem has very low herbaceous cover (dominated by kinnickinnick) and the burn does not appear to have reversed the situation, but it has increased the amount of fresh browse in the aspen forest understory. We will incorporate these findings into the design of monitoring plots when larger burns are carried out at Red Hills.

Conclusions

Grassland restoration treatments in the SBSdk including prescribed fire and manual cutting of woody browse appear to have produced significant effects on ungulate use of these habitats, which are a mosaic of scrub-steppe, young aspen forest, with scattered patches of conifers. The effects of treatments on deer and moose use appear to be highly idiosyncratic: for example manual cutting significantly increased deer use at a site near Telkwa, but decreased deer and moose use at a site near Smithers, apparently because it stimulated herbaceous growth at one site, but has not yet produced the same effect at another site.

The lack of randomized controls at our prescribed burns prevents us from drawing clear conclusions about the effects of burning on deer and moose use. These burns were of low severity and have stimulated the growth of new browse rather than causing a shift towards herbaceous species. This result may affect the timing and species composition of ungulate use (e.g, winter vs. spring, moose vs. deer), more than absolute numbers of animals.

Our results so far show that deer preferentially use habitats with some tree cover or located close to escape cover, rather than wide open scrub-steppe habitats. Treatments designed to optimize deer use should include a mix of open and wooded areas, whereas treatments that seek to reduce deer damage (e.g. to protect Rocky Mountain juniper seedlings or reduce weed invasion) should remove nearby aspen cover.

References

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