The Need for Multifaceted and Sustainable Management Strategies: Fire, Forestry and Range

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With special thanks to my supervisor, Rob Higgins

Introduction

It is important to remember that both industry and resource sector needs must be considered when managing our natural resources. With ninety four percent of British Columbia being Crown land, there are many overlapping resource needs coming from a multitude of legally recognized stakeholders, such as forestry and cattle ranchers [15]. Due to these overlapping needs, much of British Columbia's land management is multifaceted. This understanding of the multiuse landscape is integral to sustainable ecosystem management. Additionally, as the climate is changing significantly, the need for proactive fire management through pre-fire treatments, such as tree or limb removal, is of upmost importance [5]. This study aims to understand how fuel management influences range productivity and evaluates if there is a significant difference in forage availability. The results of this study will benefit the overall scientific development of multifaceted approaches towards resource management of our Crown land.

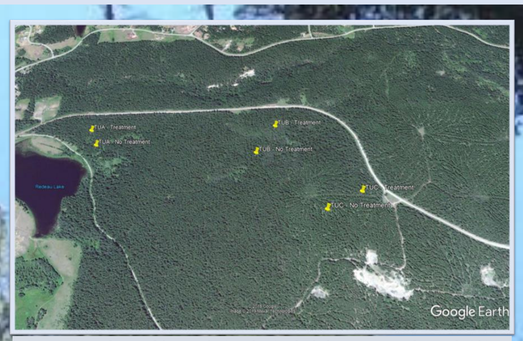

Figure 1: Map of 3 out of the 6 study sites showing both the treatment and control within the IDFdk3/01 BEC zone near Williams Lake, BC (Google Earth, 2019)

Study Site

The six Douglas-fir dominated study sites are located within the Cariboo region, near Williams Lake. The sites sit within the IDFdk3/01 Biogeoclimatic Zone, which is indicated by a dry relative precipitation and a cool relative temperature subzone [6]. This zone sites with the Fraser variant, within a zonal FdPl – Pinegrass – Feathermoss site series [6] [12]. Through edaphic and topographic conditions and historical fire occurrence, large grasslands communities have had the opportunity to develop within the IDF [6]. These grasslands are often used for grazing domestic livestock, such as cattle. Grasslands considered to be in good to excellent range condition are dominated by grasses such as bluebunch wheatgrass, rough fescue, spreading needlegrasses, June grass, and Kentucky bluegrass [6]. Previous historical overgrazing has led the plant communities to transition from a state of dominating bunchgrasses to a state of increasing less palatable "increaser" species and weedy species, such as timber milk-vetch, yarrow, and cheatgrass [6].

Figure 2: Example of treatment site transect line

Figure 3: Example of control site transect line

Methodology

Data Collection Method

The following methods were influenced by Nancy Elliot, Rangeland Analyst, with the Ministry of Forests, Lands, Natural Resource Operations and Rural Development. Six study areas were chosen that had undergone fire fuel management activities the previous year. The study areas were sampled using a 10-meter treatment and control transect line, with 0.5m^2 hoops places every 2-meters. Percent canopy cover was determined using a densiometer and averaged for the transect line. Shrubs, graminoids, and forbs were identified and through visual estimation precent plant aerial canopy was determined. Palatable forbs and graminoids were clipped and dried for 24 hours at 70°C. Percent relative ground cover was estimated for the following variables: bare ground, rock fragment, moss/lichen crust, embedded litter, coarse woody debris, scar and forestry disturbance.

Statistical Methods

The collected data from the six study areas were pooled together to compare the treatment versus the non-treatment sites. Welch Two Sample t-tests were conducted on the variables shown in Table 1.

Results

The following variables were revealed to be statistically significant: canopy cover (<0.001), coarse woody debris (0.04) and forestry disturbance (<0.001). While forestry disturbance increased with the influence of fire fuel management treatments, coarse woody debris and canopy cover decreased. When comparing the dried graminoid and forb weights of the treatment versus the control, the resulting p-value is 0.62, above the p-value threshold of 0.05. When comparing just the forbs, the resulting p-value is 0.91, with a p-value of 0.28 when comparing just the graminoids.

Figure 4: 2-meter photo point at treatment site

Figure 5: 10-meter photo point at treatment site

Table 1: Results of Welch two sample t-tests to determine the differences between fire fuel managed sites and natural control sites (P-value>0.05) using pooled data collected from six sites within the IDFdk3/01, near Williams Lake, BC

Variable	P-value	T value	Degree-freedom	Mean of treatment	Mean of control
Forbs and Graminoids	0.6183	-0.49986	101.97	1.747767	1.962150
Forbs	0.9111	0.1121	57.9	6.331667	6.213000
Graminoids	0.277	-1.0975	57.992	7.686333	8.90667
Canopy Cover	0.000116	-4.4505	29	0	32.6667
Bare Ground	0.1757	-1.388	29	0	3.7
Rock Frag.	0.2187	1.2572	29	0.4333333	0.0
Cryptograms	0.4204	0.81184	29	61.26667	53.0
Embedded Litter	0.3669	-0.90958	56.736	44.1	53.0
CWD	0.04096	-2.0988	49.523	5.466667	11.666667
Scat	0.1834	-1.3528	41.76	0.2000	6.3333
Disturbance	0.0001164	-4.4505	29	0	32.36667
Seedlings	0.2035	1.2943	37.441	23.96552	13.8

Discussion

It was found that the significant variables are canopy cover, coarse woody debris, and forestry disturbance when comparing the difference between the fire fuel managed sites and the natural control sites. While forestry disturbance increased with treatment, coarse woody debris and canopy cover decreased from the treatment.

Forest canopy cover is a major determinant of the microhabitat within the forests, and therefore, has a significant impact on understory [10]. The canopy tree layer influences the vegetation through modifying light levels that reach the forest floor [19]. These modified light levels also affect air humidity, vapor pressure deficit. moisture levels, and carbon gain [10]. This then has an influence on vegetation growth in the understory, leading to long-term impacts on decomposition, nutrient cycling and buildup of nutrients in the soil [14]. This would benefit ranchers as more light reaching the forest floor would encourage graminoid growth leading to an eventual increase in forage availability.

Coarse woody debris has many important roles within the ecosystem. It creates biodiversity, habitat for many plants and animals, and is a main contributor to the carbon and nutrient cycle [2] [17]. There has been many studies emphasizing the importance of coarse woody debris on maintaining the diversity of understory species [7] [11] [4]. Nonvascular species, such as moss and lichen, are also shown to have higher abundance in areas with coarse woody debris that are in their intermediate to later stages of decay [8]. As conifer forests are typically less nutrient dense that deciduous, coarse woody debris is vital to having resource-rich environments [1] [9]. Coarse woody debris being present would be beneficial for ranchers as the additional nutrients through decomposition will help support the growth of vegetation, however, a significant decrease in coarse woody debris may set-back some palatable vegetation growth. However, an excess amount of coarse woody debris would decrease accessibility for cattle.

Disturbance is the key driver of forest composition and structural dynamics, as resources become available for species establishment or release [20]. Several early and mid successional species prefer to establish on exposed mineral soil ground as there is less competition [3]. This opens up opportunity for invasive to establish with little competition, with potential to out-compete valued natural vegetation. Changing disturbance regimes have potential far-reaching impacts on biological diversity and capacity to provide ecosystem services, including providing resources to society [18]. However, disturbance can be emulated through management to utilize the beneficial effects on biodiversity [18]. Thinning, a treatment used in fire fuel management, have shown to be a beneficial disturbance-risk decision with positive economic considerations [16] [18]. And additionally, management decisions such as mimicking natural disturbance regimes to create an elemental process of ecosystem dynamics have been increasingly suggested to be beneficial [16] [18]. However, the increased chance of invasive establishing is a negative outcome for ranchers as invasive are typically non-palatable and can quickly out compete natural vegetation.

It is important to acknowledge that the sampling done is only one year post fuel management, and through time and a longer growing period more differences may appear.

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Bartemucci P, Messier C, and Canham C. 2006. Overstory influences on light attenuation patterns and understory plant community diversity and composition in southern boreal forests of Quebec. Can. J. For. Res. 36(9): 2065–2079.
Bunnell F, and Houde I. 2010. Down wood and biodiversity — implications to forest practices. Environ. Rev. 18: 397–421.
Carlton G, and Bazzaz F. 1998. Regeneration of three sympatric birch species on experimental hurricane blowdown microsites. Ecol. Monogr. 68: 99–120.
Caruso A, and Rudolphi J. 2009. Influence of substrate age and quality on species diversity of lichens and bryophytes on stumps. Bryologist, 112(3): 520–531.
Climate Analytics and NewClimate Institute [Internet]. c2019. Climate Action Tracker; [cited 2019 Oct 31]. Available from: https://climateactiontracker.org
Hope G, Mitchell W, Lloyd D, Erickson W, Harper W, Wikeem B. 1991. Chapter 10: Interior Douglas-Fir Zone. In: Meidinger D and Pojar J, editors. Ecosystems of British Columbia. Victoria: Ministry of Forests. p. 153-166.
Kruys N, and Jonsson B. 1999. Fine woody debris is important for species richness on logs in managed boreal spruce forests of northern Sweden. Can. J. For. Res. 29(8): 1295–1299.
Kumar P, Chen H, Thomas S, and Shahi C. 2018. Effects of coarse woody debris on plant and lichen species composition in boreal forests. Can. J. For. Res. 48: 399–411.
Macdonald S, and Fenniak T. 2007. Understory plant communities of boreal mixed wood forests in western Canada: natural patterns and response to variable-retention harvesting. For. Ecol. Manage. 242(1): 34–48.
Majuusalmi T and Raatiainen M. 2020. The impact of tree canopy structure on understory variation in a boreal forest. Forest Ecology and Management. 466 (2020).
Mills S, and Macdonald S. 2004. Predictors of moss and liverwort species diversity of microsites in conifer-dominated boreal forest. J. Veg. Sci. 15(2): 189–198.
Ministry of Forests and Range. c2019. Biogeoclimatic Ecosystems Classification Program; [cited 2019 Nov 1]. Available from: https://www.for.gov.bc.ca
Newton A, Echeverría C, Cantarello E, and Bolados G. 2011. Projecting impacts of human disturbances to inform conservation planning and management in a dryland forest landscape. Biol Cons. 144, 1949–1960.
Nilsson M, Wardle D. 2005. Understory vegetation as a forest ecosystem driver: evidence from the northern Swedish boreal forest. Front. Ecol. Environ. 3, 421–428.
Province of British Columbia [Internet]. c2014. Land use policy permissions; [cited 2019 Oct 27]. Available from: https://www2.gov.bc.ca
Schelhaas M. 2008. The wind stability of different silvicultural systems for Douglas-fir in the Netherlands: a model-based approach. Forestry 81, 399–414.
Stokland J, Siitonen, J, and Jonsson B. 2012. Biodiversity in dead wood. Cambridge University Press, New York.
Thom D and Seidl R. 2015. Natural disrubance impacts on ecosystem services and biodiversity in temperate and boreal forests. Biol Revis. 91, 760-781.
Tonteri T, Salemaa M, Rautio P, HallikainenmV, Korpela L. Merilä P. 2016. Forest management regulates temporal change in the cover of boreal plant species. For. Ecol. Manage. 381, 115–124.
Turner M. 2010. Disturbance and landscape dynamics in a changing world. Ecology. 91, 2833–2849.

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