The post-harvest effect on the growth of Lodgepole pine (*Pinus contorta var. latifolia*) on the perimeter of harvested strips

Gillian Spencer, Bachelor of Natural Resource Sciences
Dr. Lauchlan Fraser and Dr. John Karakatsoulis

Introduction

The site used in this study is referred to as Goudie, as it is located on Goudie Rd., and it consists of four blocks that were harvested using strip logging in 2017. Goudie is near Kelowna, British Columbia and is within the Montane spruce Biogeoclimatic zone. Each block was harvested with strips of three different widths, 10, 15, and 20 m, which can be seen in Figure 1, a map of Block 1209. There is no plan to regenerate trees in these strips, and instead it has been seeded with agronomic species for an Agro-Forestry research project. Two blocks were used in this study, Block 1209, which has trees of North and South aspect (Figure 1), and Block 1212, which has trees of East and West aspects (Figure 2). Trees on the edge of openings are faced with unique conditions that are not like trees in an opening or in a canopy, but a mix of the two. These unique conditions are referred to as "edge effects", and they can result in different soil moisture, soil radiation, wind speed, decomposition of litter (Chen et al. 1995), and snowmelt (Lopez-Moreno and Latron 2008). This study focuses on the effect of solar radiation and whether varying levels of exposure, by width of harvested strip and aspect, will stimulate growth differently.

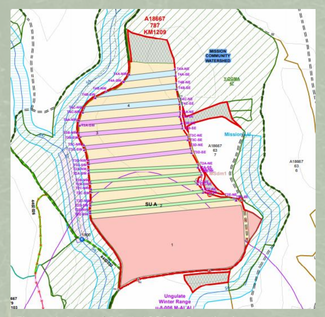

Figure 1. Map of Block 1209 in Goudie site near Kelowna, BC Canada. This image is taken from a map made by Tolko.

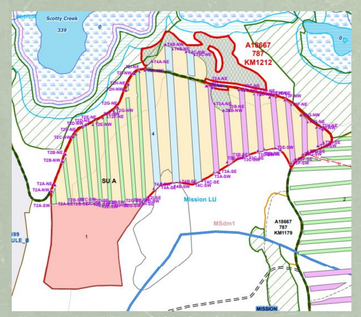

Figure 1. Map of Block 1212 in Goudie site near Kelowna, BC Canada. This image is taken from a map made by Tolko.

Objectives

- Identify any trends in tree growth (height and volume) post-harvest and strip width and/or aspect
- Determine whether there is any significance between tree growth (height and volume) and strip width and/or aspect
- Distinguish future research that could aid in understanding the edge effects of width and aspect on trees after strip harvesting

Methodology

In November 2020, data was collected to represent each combination of width (10, 15, and 20 m) and each aspect (North, South, East, and West). There were 12 treatments total and two controls. Trees measured were selected by five randomly generated distances along a 60 m transect, and there were two transects per measured strip (Figure 3).

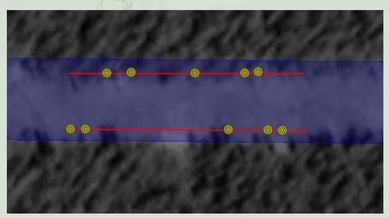

Figure 3. A picture of a Google Earth map that gives an example of the trees measured along a 60 m transect.

Methodology Continued…

Along each transect, the following measurements were taken and analyzed:

- Three increment cores were extracted from three trees per transect and five tree trees per control, so 56 increment cores were extracted in total. They were analyzed using WinDendro, an application that scans the cores and measures growth rings. The trends of annual increment growth in treatments, since the 2017 harvest, were compared to the controls.
- During data collection, it was noted whether trees that were supposed to be measured were standing dead, windthrown, or had multiple apical meristems. As there were many trees noted with multiple apical meristems and standing dead, these factors were analyzed to determine their relationship to strip orientation (East to West or North to South). This was done using a Chi-Square Test for Association to see if there is any significant relationships.
- Height was calculated using the diameter at breast height (DBH) and slope measurements taken. Volume was measured using calculated height and DBH. The averages of height and volume from each of the 12 treatments were compared to controls graphically and by using Two-way ANOVA tests, with some outliers removed prior. Not all the assumptions were met due to the small sample sizes and because some trees measured were close together, therefore, not independent of each other.

Results

- The graphical comparison of increment cores showed similar trends in of growth in treatments and controls since the strips were harvested in 2017. Therefore, the treatments had no impact on radial growth since harvest.
- Statistical analysis done on the relationship between observed tree condition and strip orientation found that there was a significant relationship between strip orientation and number of trees with multiple apical meristems. However, there was no relationship between the number of standing dead trees and strip orientation. There were six trees out of 30 noted with multiple apical meristems in Block 1209, orienting North-South, and zero noted in Block 1212, orienting East to West.
- The results of the two-way ANOVA test to measure the significance of width and aspect on tree height, revealed that aspect was the most significant factor affecting tree height. The most significant aspects were the North and East. Although width as a factor was not significant, the 15 m width had a significant effect on tree height. There were no combinations of width and aspect that had a significant effect on tree height.
- As seen in Figure 4 the 10 m treatments all have similar averages, and the 15 and 20 m treatment averages vary quite a bit. The North aspect treatments are the lowest for the 10 and 15 m treatments, but not the lowest for the 20 m treatment. With the significance of the North aspect, this could indicate that North-facing trees have lower heights on average.

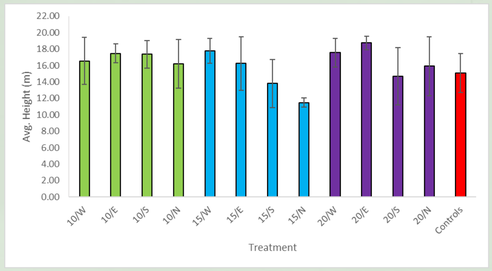

Figure 4. The average height of trees was measured in November 2020 at a site near Kelowna, British Columbia. Treatments in the x-axis consist of controls and treatment that are strip width/aspect as there are varying aspects and strip widths at this site. (N=48)

Results Continued…

- Just like tree height, volume was significantly affected by aspect. The specific aspects that were significant were the South and West aspects. The width/aspect interaction and width had no significant effect on volume.
- As seen in Figure 5 the standard deviations of average volume are relatively larger than the deviations of average height (Figure 4). The South aspect treatments have low averages compared to the controls and to other aspect treatments. The West aspect 15 and 20 m treatments have higher average volumes than the controls and the 10 m/ West aspect treatment is lower than the controls.

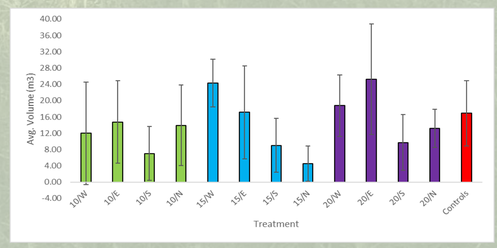

Figure 5. The average volume of trees calculated from height and diameter at breast height measurements taken in November 2020 at a site near Kelowna, British Columbia. Treatments in the x-axis consist of controls and treatment that are strip width/aspect as there are varying aspects and strip widths at this site. (N=48)

Conclusion and Future Research

Aspect had the most significant effect on tree height and volume. The effects of North aspects regarding tree height and West aspects regarding tree volume supported the hypotheses. However, the effects of East aspects on tree height and South aspects on tree volume did not. Additionally:

- High temperatures of South-facing trees may be hindering growth. It is also possible that an Eastern aspect is more ideal for tree growth considering the possible negative effects of too much heat on Lodgepole pine trees. More significant growth differences based on strip width may come with higher sample sizes as well.
- Sampling was only done three years after harvest, so it is likely that there hasn't been enough time for the trees to respond to the opening in canopy and/or for there to be obvious differences in growth response. This is supported by the lack of difference in annual growth increments shown by the increment cores, and the large standard deviations of average tree height and volume.
- The significance of multiple apical meristems noted in the North-to-South orientation could be wind-caused stem breakage, but this will need to be examined more extensively in further research.
- The sources of error in this experiment, like small sampling sizes, samples lacking independence, and sampling too soon after harvest, likely resulted in insufficient results.
- In future research, a more in-depth assessment of litter decomposition, solar radiation, snowmelt, and wind speed inside and outside the canopy, as well as on the edge, would help to support the analysis made about the variation of edge effects on tree growth with different orientations and strip widths.

Acknowledgments

Thank you to the Undergraduate Research Experience Award Program (UREAP) for the grant, to the Fraser lab and the Natural Resource Sciences Department for the equipment, and my supervisors for all the support.

References

- Chen J, Franklin JF, Spies TA. 1995. Growing-season microclimatic gradients from clearcut edges into old-growth douglas-fir forests. Ecological Applications [Internet]. [cited 2021 Mar 26]; 5(1): 74-86. 10.2307/1942053. Available from: https://www.jstor.org/stable/1942053
- Lopez-Moreno JI, Latron J. 2008. Influence of canopy density on snow distribution in a temperate mountain range. Hydrological Processes [Internet]. [cited 2021 Mar 26]; 22(1): 117-26. 10.1002/hyp.6572. Available from: http://agris.fao.org/agrissearch/search.do?recordID=US201300839411