Lab 5: Landscape Features Influencing Fire Frequency in the Front Range

Ben Atkinson

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Introduction

This study examines which landscape features help us understand the frequency of forest fires in the Colorado Front Range. The dataset includes continuous variables (average elevation, average slope, distance to grasslands, and distance to ravine drainage) and categorical variables (tree cover type and slope steepness category). We hypothesize that high fire frequency areas will be characterized by lower elevation, steeper slopes, and closer proximity to grasslands and ravines, as these factors may promote the occurrence and spread of fires.

Results

Continuous Variables

(a) Average Elevation

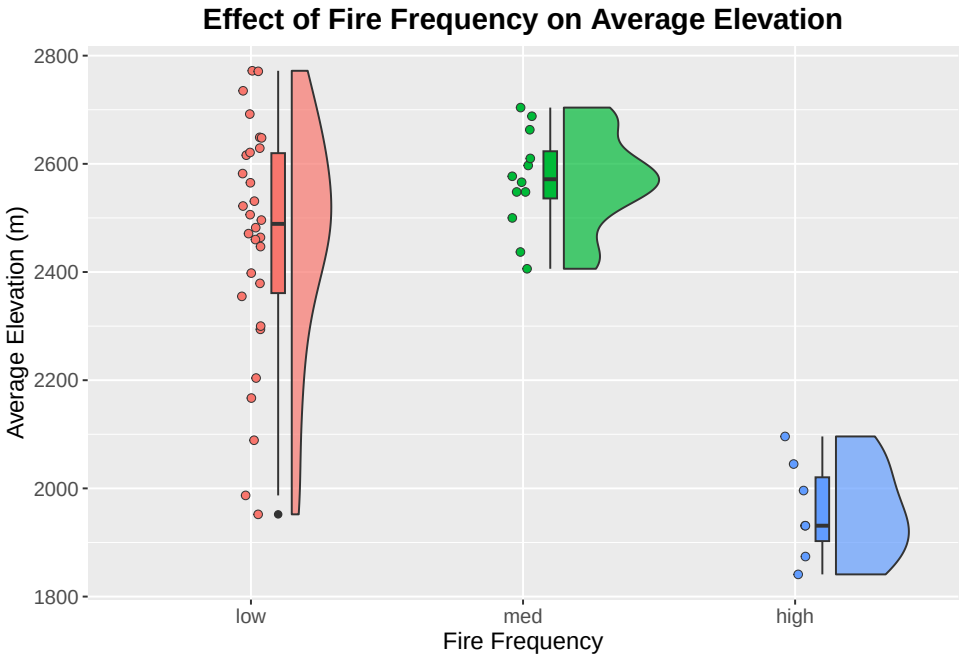

Figure 1: Effect of fire frequency on average elevation.

An ANOVA was used to compare average elevation across fire frequency levels (low, medium, high). The analysis revealed a significant difference in elevation ($p < 0.001$). Post-hoc Tukey tests indicated that low and medium fire frequency sites were at significantly higher elevations than high fire frequency sites.

(b) Average Slope

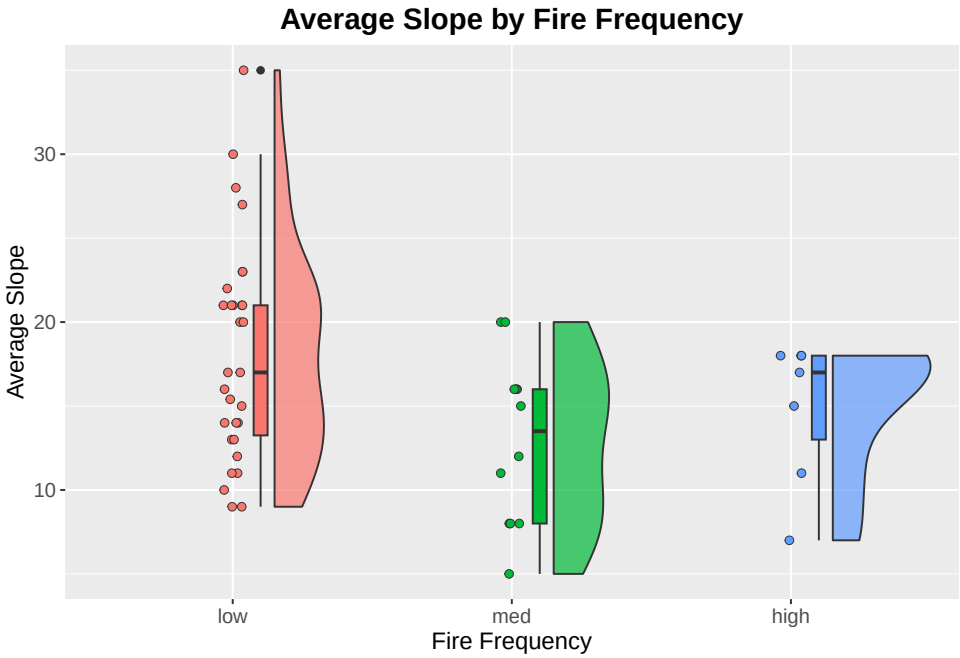

Figure 2: Average slope by fire frequency (raw data).

A Kruskal-Wallis test was conducted for average slope. The result was borderline with a p-value of 0.053, suggesting no significant difference in slope across fire frequency groups at the 0.05 significance level.

(c) Distance to Grasslands

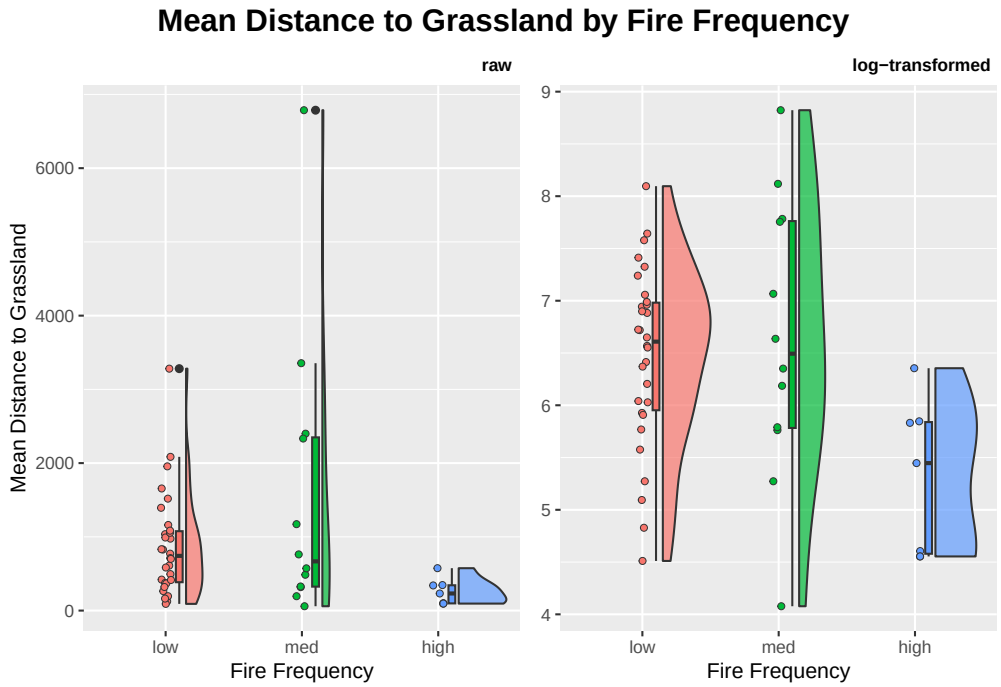

Figure 3: Mean distance to grassland by fire frequency (raw and log-transformed).

Because the distance to grasslands data was skewed, a log-transformation was applied. An ANOVA on the log-transformed data showed a significant difference between fire frequency levels ($p < 0.05$). Post-hoc comparisons revealed that low and medium fire frequency areas are significantly farther from grasslands than high fire frequency areas.

(d) Distance to Ravine Drainage

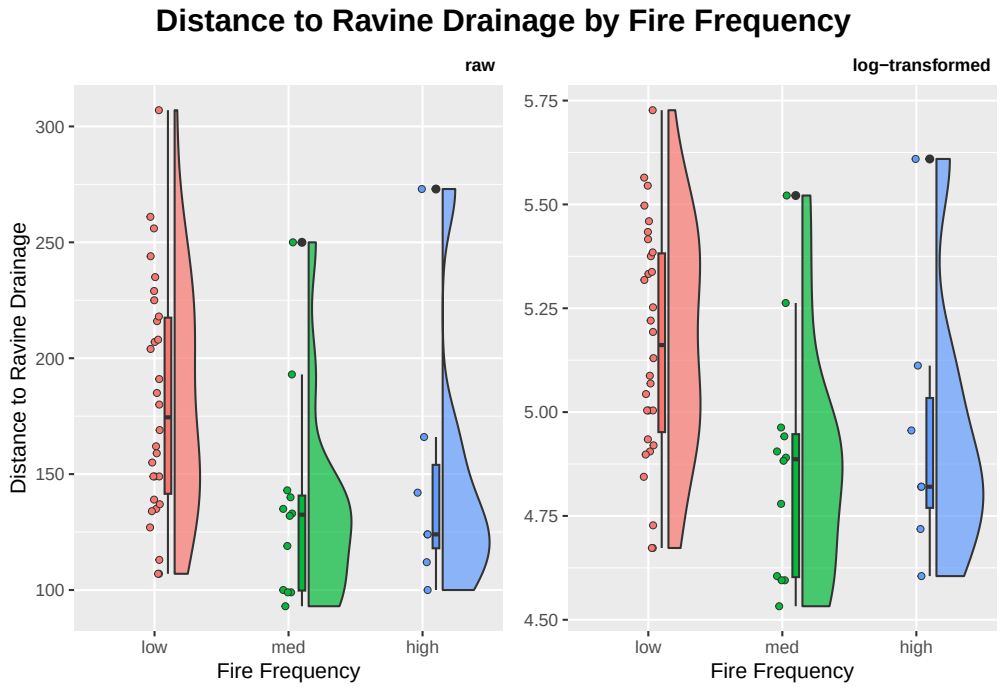

Figure 4: Distance to ravine drainage by fire frequency (raw and log-transformed).

Similarly, after log transformation, ANOVA results for distance to ravine drainage indicated a significant effect ($p < 0.05$). Post-hoc tests showed that areas with low fire frequency are significantly farther from ravine drainage compared to high fire frequency areas.

Categorical Variables

Tree Cover Type

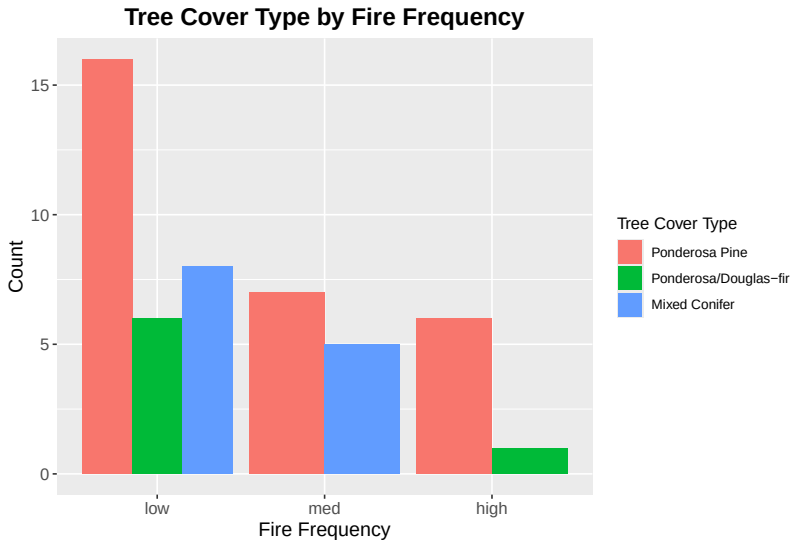

Figure 5: Tree cover type by fire frequency.

A Chi-squared test for the tree cover type produced a borderline result ($p \approx 0.178$), suggesting a potential relationship that is not statistically significant at the 0.05 level.

Slope Steepness Category

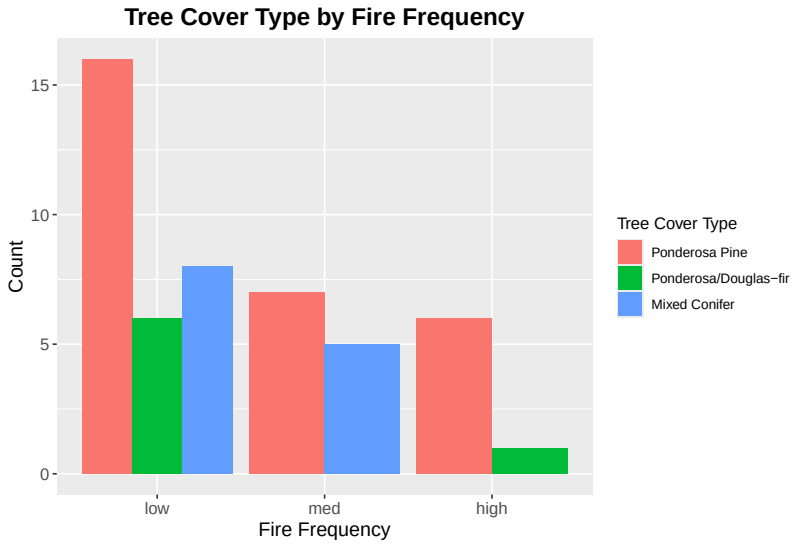

Figure 6: Slope steepness category by fire frequency.

A Chi-squared test for the slope steepness category produced a borderline result ($p \approx 0.055$), suggesting a potential relationship that is not statistically significant at the 0.05 level.

Conclusion

The findings reveal that some of the landscape characteristics are highly correlated with fire frequency in the Front Range. Elevation, distance to grasslands, and ravine drainage distance are all significantly varied among the various fire frequency classes. High fire frequency regions tend to occur at lower elevations and nearer to grasslands and ravine drainage's. Although the findings for average slope and slope steepness category were marginal or non-significant, the variables can still prove to be useful in fire dynamics research if used in conjunction with other variables.

In all, my results confirm the assumption that variation in landscape features, especially reduced elevation and nearness to fuel sources such as grasslands and ravines, significantly affects wildfire occurrence in Front Range forests. Box plots, rain plots, and bar charts also bring out these variations, presenting a visual confirmation to complement statistical tests conducted.