

Fuel Treatment Characteristics in the Calwood Fire, Colorado

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PRESENTED AT:



COLORADO STATE UNIVERSITY



2021

CELEBRATE UNDERGRADUATE RESEARCH AND CREATIVITY

INTRODUCTION



Figure 1. Calwood Fire, Oct. 17, 2020(4).

- The Calwood Fire in Colorado in 2020 damaged 26 buildings (3).
- Fire is an important part of forest ecosystems but serious wildfire can threaten people, property and industry (2).
- The current pre-fire treatment revolves around fuel reduction and forest structure control (1) such as prescribed burn, thinning and wildfire.
- Prescribed burn (RX fire) means the controlled use of fire by a team of experts under specified weather conditions. This can effectively reduce excess shrubs and trees.
- Thinning is the deliberate removal of some of the vegetation to reduce the fuel accumulation in the forest.
- The wildfire is a wildfire that happened before the Calwood Fire.
- I used ArcMap software to organize forest management data provided by multiple groups and analyze the relationship between treatment methods and various factors such as elevation, aspect, vegetation density.

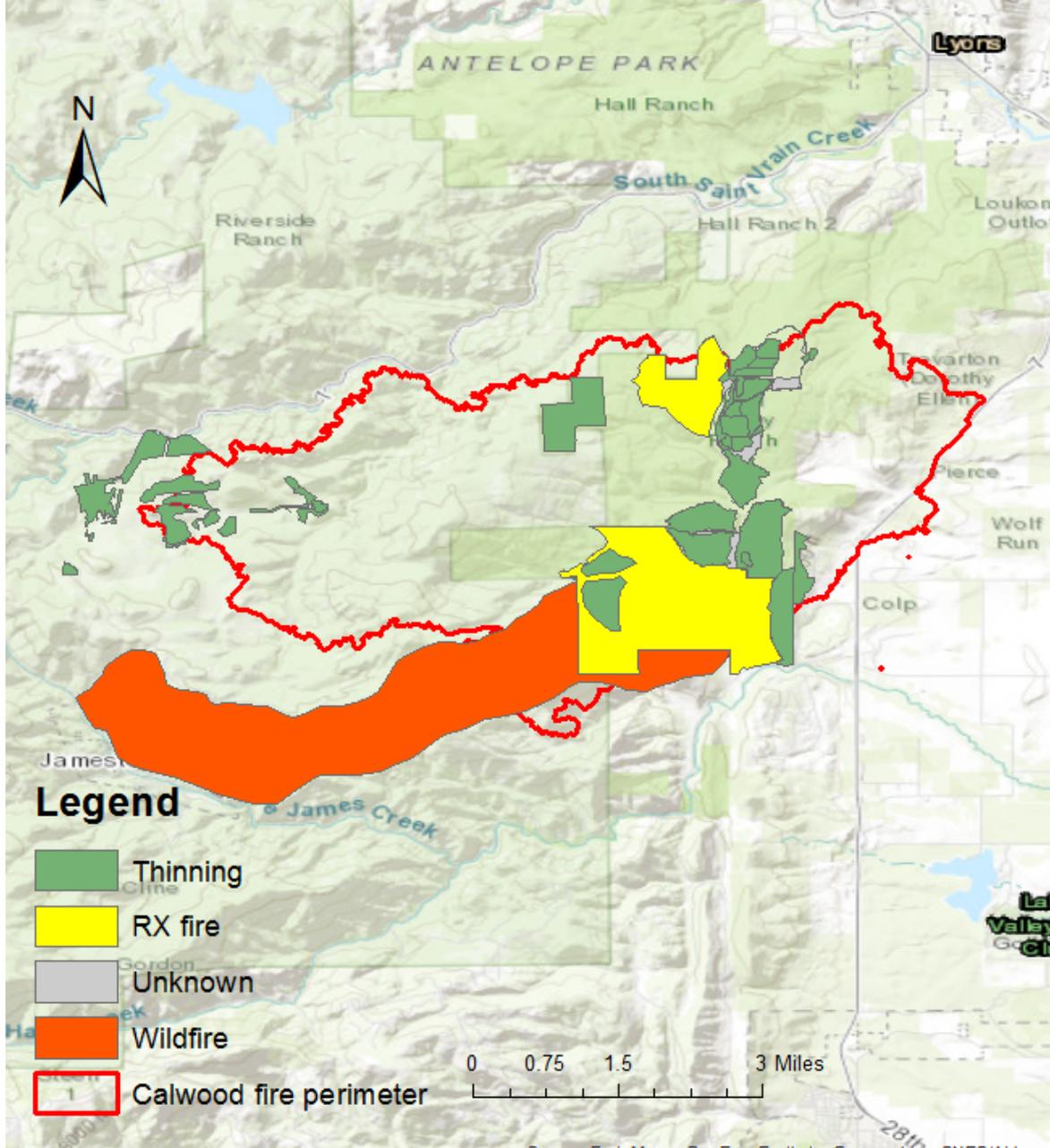


Figure 2. Distribution of different pre-fire treatments within Calwood fire area.

RESEARCH QUESTION & HYPOTHESIS

Research Question: What were the characteristics such as (a)elevation, (b)aspect and (c)forest density of pre-fire treatments in areas that burned in the 2020 Calwood Fire?

Hypothesis: Treatments are more likely to occur at high elevation, on the north side of mountains and in areas with high forest density.

(a) Elevation. The various pre-fire treatment areas are at high elevations, and the higher the elevation, the more areas are treated.

(b) Aspect. More pre-fire treatment areas occurred on the north side of the mountain.

(c) Forest density. Pre-fire treatment areas are more likely to occur in areas with higher forest density.

Null hypothesis: Pre-fire treatment is independent of elevation, aspect and forest density.

Explanation: Forest management attempts to influence fire behavior through reducing fuels and modifying forest structure. Fires tend to be more severe where forests are more dense. So people would expect more treatment of dense forest areas. The northern side of the mountain in Colorado tends to have greater moisture availability. Higher elevation also have more moisture. Plenty of water and light will promote the growth of trees. So at higher elevation and on the north side of the mountains, the forest is more dense.

METHODS

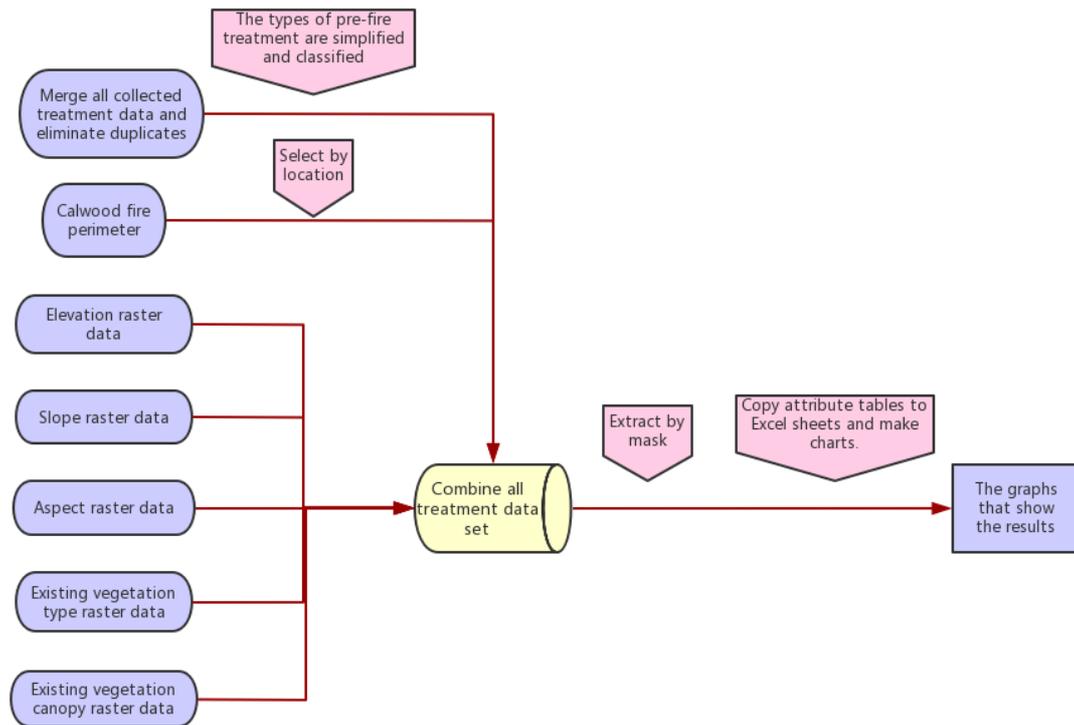


Figure 3. The flow chart of my whole research methods.

- All collected data sets of pre-fire treatments were integrated in ArcMap and delete all data outside the Calwood Fire affected area.
- All types of pre-fire treatment are reclassified for easy understanding and analysis.
- Use the Select by Attribute to separate all the different types of pre-fire treatment.
- Use the Extract by Mask, Raster to Polygon tool to process elevation, slope, aspect, existing vegetation canopy and existing vegetation type raster data.
- Import the attribute table information for the processed data into an Excel spreadsheet and create different types of charts to show the results.

RESULTS

1. Figure 4 is a box plot of the variable (a) : elevation. The figure shows the elevation distribution of the four treatment types. All treatment zones occur between 1700 m and 2700 m. The height span of thinning area is the largest. Most of the treatment area occurs between 1900m and 2300m.

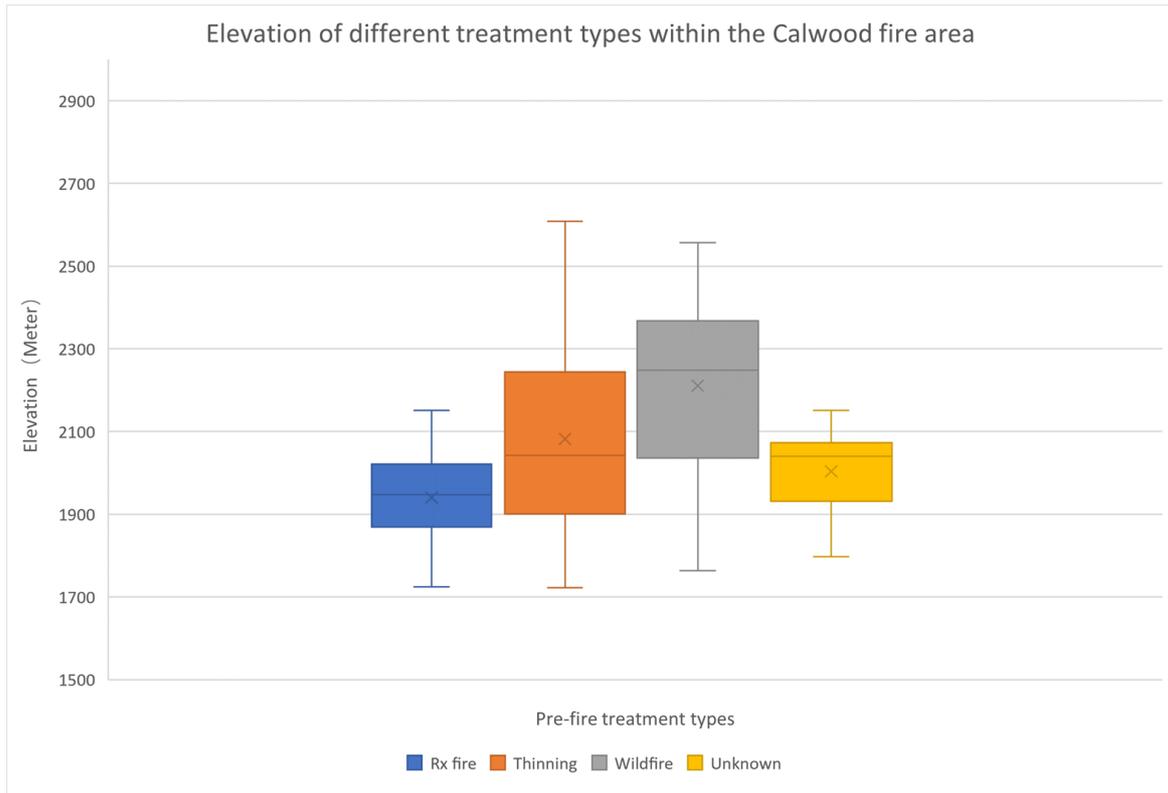


Figure 4. Elevation distribution of different types of pre-fire treatment.

2. Figure 5 is a stack bar chart of the (b) variable: aspect. The figure shows the area comparison of each type of pre-fire treatment in different directions. The treatment area facing east has the largest area, while the area facing northwest has the smallest area. There is no obvious correspondence between treatment type and area aspect.

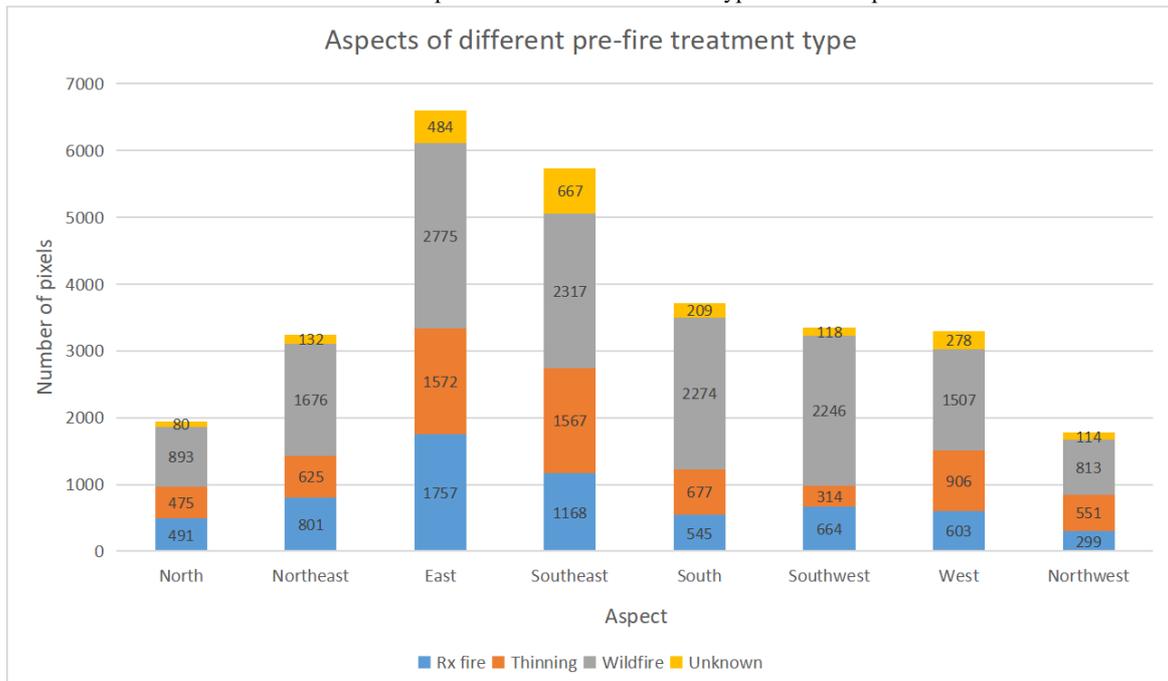


Figure 5. Stacking histogram reflecting the aspect of the pre-fire treatment area. The number of pixels corresponds to the area.

3. Figure 6 is a stacked bar chart of the variable (c) : forest density. The vertical axis is the canopy cover of different types of vegetation. This figure shows the canopy coverage of the four types of pre-fire treatments. Thinning occurs more often in areas with tree cover greater than 20%. Thinning rarely occurs in other vegetated areas such as shrub and

herb. Thinning is positively correlated with tree density.

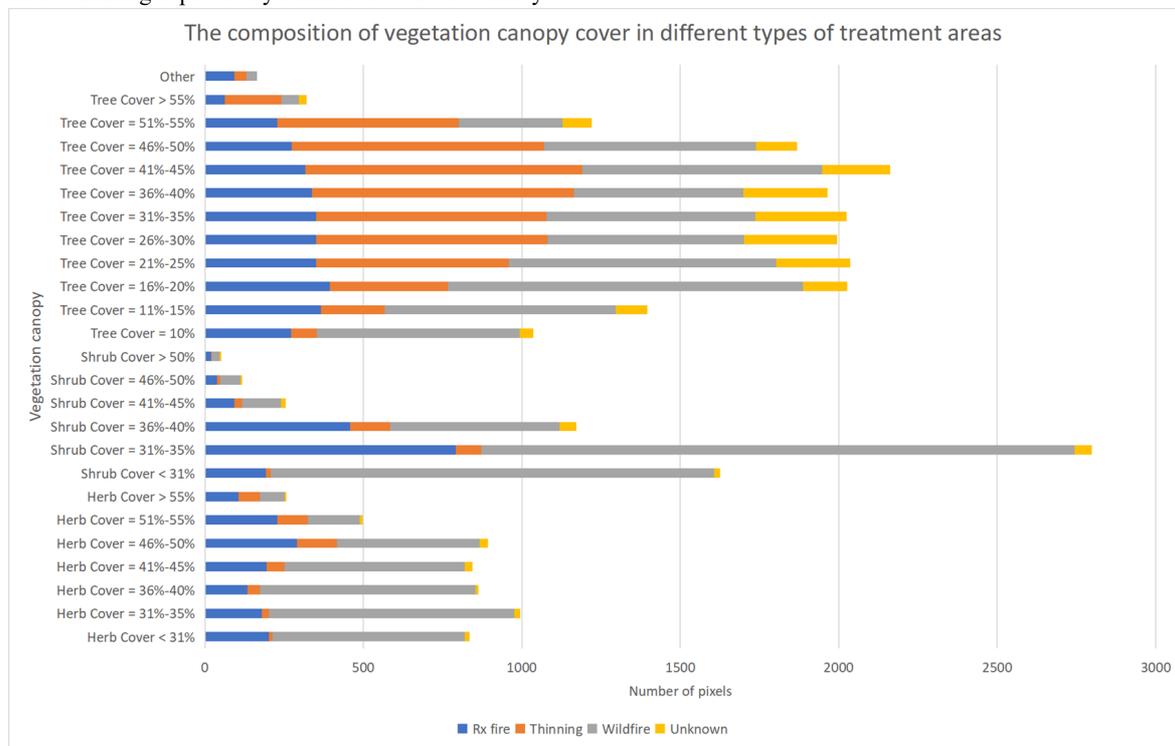


Figure 6. A stacking bar chart reflecting canopy coverage of different vegetation in different pre-fire treatment areas. The data was recorded in 2016 and the number of pixels corresponds to the area.

DISCUSSION & CONCLUSIONS

My research has some limitations. My study did not set up all the data from Colorado for comparison.

- I don't have data below 1700 meters. I'm not sure if the type of land cover below 1700 meters can cause a fire.
- I did not compare the aspect data with the entire topography of Colorado. Maybe a lot of the area is facing east so that leads to my results showing that most of pre-fire treatment area is facing east.
- I don't have data on total vegetation cover density for Colorado. Maybe Colorado doesn't have that many areas of high vegetation density, so that leads to my results showing that pre-fire treatment didn't deal with many areas of high vegetation density.

Although my results have some limitations, they are able to show the characteristics of pre-fire treatment areas performed by various agencies over the past 40 years. These characteristics show that pre-fire treatment in the affected area of Calwood Fire is mainly concentrated in the elevation range of 1900m-2300m and the area with high vegetation density. Understanding these characteristics can help forest management make effective pre-fire management plans and reduce the negative effects of fire.

REFERENCES & ACKNOWLEDGEMENTS

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This work is supported by the National Institute of Food and Agriculture (NIFA) of the United States Department of Agriculture (grant number 2019-67019-29469). This project was completed as part of the Ecosystem Science and Sustainability SUPER Program (Skills for Undergraduate Participation in Ecological Research).

ABSTRACT

Colorado experienced a severe wildfire season in 2020. The Cameron Peak Fire and other wildfires have not only caused huge damage to these areas, but also rewritten Colorado's Fire history. Over the past few decades, agencies such as the United States Forest Service and the Colorado State Forest Service have completed extensive forest treatments to reduce fuels in Colorado's forests. These agencies have adopted a variety of pre-fire treatments to managing forest structures and reducing fuel accumulation. This study analyzed the characteristics of these treatments in the Calwood fire area. We hope to find the relationship between the pre-fire treatment methods and various factors to inform the implementation of the subsequent treatment methods. We used ArcMap to analyze the data of the pre-fire treatment area in recent decades. These data are compared with elevation data, aspect data and vegetation density and displayed in charts. Here we show that some box plots to illustrate the topographic distribution of different types of pre-fire treatments and I made some other diagrams to show other characteristics of pre-fire treatment. Finally, we find the characteristics of pre-fire treatment in Calwood Fire area and provide basic research information for future forest management.