Wildfire Risk Assessment in Western Montana

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Introduction

In western Montana, the risk of wildfires is an ongoing concern. With large amounts of forested land, remote locations, and low population density, wildfires have the potential to burn unchecked for long periods of time. The goal of this project is to utilize historical fire data and various topological features to determine the risk of wildfire in this area.

Area of Study

Although the eastern half of the state is mostly plains, the west consists of vast mountain ranges that form a portion of the Rocky Mountains. For this project, the area of study includes a 29-county area encompassing virtually the entire mountainous portion of the state. This includes the major cities of Missoula and Helena, as well as the resort areas of Whitefish and Kalispell. In addition, numerous parks including Glacier National bring thousands of visitors each year. (See Figure 1)

Methodology

A DEM was used in conjunction with Montana county boundaries to establish the area of study. Counties included in the analysis were chosen based on the appearance of significant areas of mountainous terrain. County boundaries were then dissolved into a single polygon in order to clip the data used in this study.

Historical wildfire data (1980-2014) was obtained from the USGS Federal Wildland Fire Occurrence dataset. To provide a more accurate assessment of wildfire risk, all fires with a human or unknown origin were eliminated, as were all fires with a total burn area of less than 10 acres.

Major physical components of wildfire growth includes slope, aspect, wind speed, and natural fuel load. For this analysis, slope and aspect data were generated from the DEM. Based on research findings, slope values were reclassified into three integer categories (0, 1, and 3) reflecting typical impacts on wildfire growth. Although slope can have a significant impact on wildfire growth and development, there is little to no effect shown at slopes less than approximately 25°. The aspect values were reclassified into four integer categories based on sunlight exposure. Wind power classes provided a natural, generally-accepted method of classifying wind speed into seven categories. The impact of fuel load was classified into low, medium, and high categories (with assigned values of 1, 2, and 3) based on the 40 Scott and Burgan Fire Behavior Fuel Model.

After all the physical data was reclassified, a weighted overlay was run incorporating the physical features listed above, using reclassified values. Aspect and slope values were given weights of 1, fuel load was given a weight of 2, and wind speed was assigned a weight of ½. The fuel load factor was given increased weight to account for the significant impact it has on wildfire development and growth. Wind speed was given a smaller weight to reduce the impact of the 7-level classification scheme.

The final step extracted the weighted overlay data for the fire locations, and an ordinary Kriging analysis was run to create the risk assessment map.

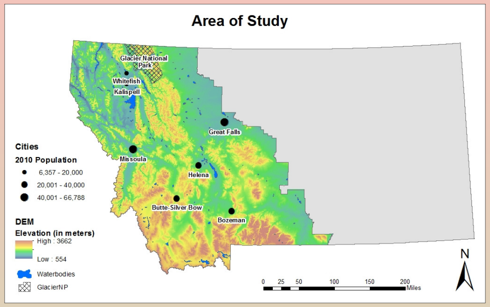

Figure 1. Area of study with points of interest

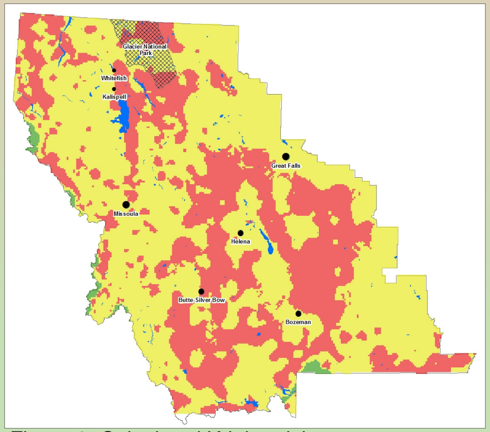

Figure 2. Calculated Kriging risk assessment map

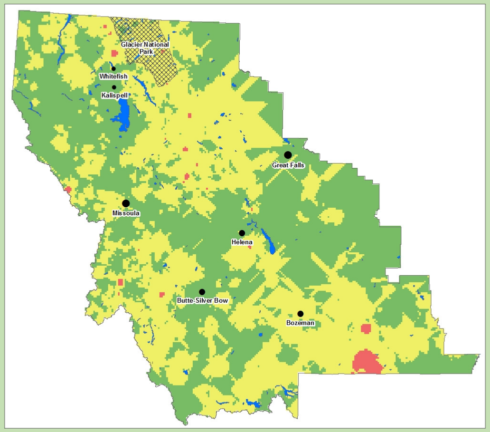

Figure 3. Historical Kriging risk assessment map

Low risk	Medium risk	High risk

Results/Conclusions

The results of the Kriging analysis conducted from the raster calculations (see Figure 2) show that virtually the entire western portion of Montana would be in a medium to high-risk area for wildfires. Areas of particular concern would include portions of Glacier National Park, the cities of Bozeman and Butte-Silver Bow, and the resort areas of Whitefish and Kalispell.

However, when compared to the Kriging analysis of historical fires, it is clear that the raster calculations overstate the risk across nearly the entire study area. Based on the historical data, none of the locations listed above are in high-risk areas, with only a couple of locations (the city of Bozeman and Glacier National Park) meeting the criteria for medium risk.

Reviewing the results, additional evaluation of risk factors and the relative weights of those factors will be necessary to generate a more realistic risk assessment map based on topological features. Due to the consistently exaggerated level of risk throughout the study area, it appears necessary that specific risk factors will need to be adjusted lower in order to produce results that are more in line with historical data.

References

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Cumming, S. G. (2001). Forest Type and Wildfire in the Alberta Boreal Mixedwood: What Do Fires Burn? *Ecological Applications, 11*(1), 97-110. Retrieved March 30, 2016, from http://www.jstor.org/stable/3061059

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Data Sources

Basemap data (state of Montana, counties, cities, and waterways): USGS National Map (http://nationalmap.gov/)

Digital Elevation Model: GTOPO30 DEM from the USGS EROS program (http://earthexplorer.usgs.gov/)

Fuel load data: US Forest Service LANDFIRE, 40 Scott and Burgan Fire Behavior Fuel Model (http://landfire.cr.usgs.gov/)

Historical wildfire data: USGS Federal Fire Occurrence dataset (http://www.wildfire.cr.usgs.gov/firehistory/)

Wind speed data: Montana State Library, Wind Power Distribution of Montana 2002 (http://geoinfo.msl.mt.gov)