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Cascades Ecoregion Fires

Introduction

The concentration of this paper is fire occurrence in the Cascades Ecoregion. The Cascades Ecoregion is in the Pacific Northwest and its range extends into Washington, Oregon and California. The northern boundary of the ecoregion is Snoqualmie Pass, which is east of Seattle in Washington State and the southern boundary is slightly north of the Oregon and California border but includes Mount Shasta in California. For this study, the area in California was excluded and the focus is Washington and Oregon (See Figure 1). Initial examination of fire occurrence in the Cascade Ecoregion within Oregon and Washington produced multiple questions.

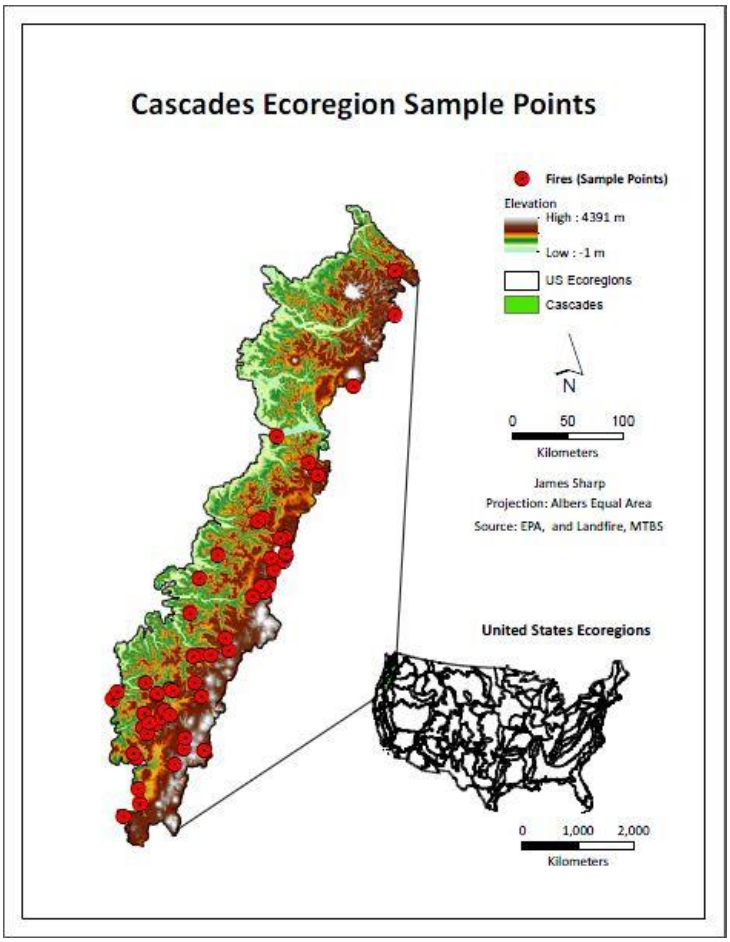

Figure 1: Map of Cascades Ecoregion with fire points

The focal question is: Why are there more fires in the Oregon portion of the Cascades ecoregion than the Washington portion of the Cascades Ecoregion? The fire occurrence data covers the years 1987 to 2011. The fire occurrence data indicates that there were fifty-two fires in the Oregon portion of the ecoregion and only three fires in the Washington portion of the ecoregion. Oregon having forty-nine more fires than Washington does, over the same period in the common ecoregion, indicated a large abnormality in the ecoregion that is state oriented. Determining the factors that could be responsible for the variance in fire occurrence led to the evaluation of conditions in both states.

Methods

Initial data acquisition consisted of the United States Ecoregion map and the point data of the fire occurrences. ESRI ArcMap is utilized in all map creation for this project. The Cascades Ecoregion was extracted from the main file and a one kilometer buffer was placed around the boundary to ensure accurate edge data. The fire points were overlaid on the ecoregion for initial analysis. Once the question of why the variance in fire occurrence per state was established a list of variables that might be responsible was organized (See Table 1). A flow chart of the potential workflow as it relates to the methodology of the project data organization and examination was created (See Figure 3). The data needed to create the variables was acquisitioned from various reputable sources as seen in Table 1.

Table 1: Table of variables utilized in the Cascades Ecoregion fire occurrence analysis

Variable	Units	Description and data study
Precipitation	Inches	Precipitation in fire area derived with data from Geospatial Data Gateway (http://datagateway.nrcs.usda.gov) Precipitation 1981-2010 Oregon and Washington
Number	Continuous number	Calculated from Ecoregion data and LANDFIRE (http://www.mtbs.gov)
Proximity to roads	Meters	Distance from fire ignition point to nearest road. Calculated from raster road layers (Geospatial Data Gateway ttp://datagateway.nrcs.usda.gov) and (http://www.mtbs.gov)
Severity	Acres	Burn severity derived from Monitoring Trends in Burn Severity (http://www.mtbs.gov)
Temperature	Degrees Fahrenheit	Temperature in fire area derived with data from Geospatial Data Gateway (http://datagateway.nrcs.usda.gov) Temperature 1981-2010 Oregon and Washington
Streams	Meters	Density of streams in relation to fire ignition points. Calculated from raster stream layers (Geospatial Data Gateway http://datagateway.nrcs.usda.gov) and fire occurrence (http://www.mtbs.gov)
Distance to Wildland Urban Interface (WUI)	Meters	Distance from each fire ignition point to the nearest Wildland Urban Interface(WUI) WUI boundary data from SILVIS (http:silvis.forest.wise.edu)
Aspect	Degrees	Derived with Oregon and Washington Digital Elevation Model data from LANDFIRE (http://www.landfire.gov)
Slope	Degrees	Derived with Oregon and Washington Digital Elevation Model data from LANDFIRE (http://www.landfire.gov)
Elevation	Meters	Derived with Oregon and Washington Digital Elevation Model data from LANDFIRE (http://www.landfire.gov)

Map creation utilizing the variable data requires all of the data be projected to the same projected coordinate system (Albers Equal Area) before data analysis. Once the data was projected variables were converted from vector to raster. After the creation and formatting of the maps to an equally proportional size and an accentuating color scheme the initial visual inspection was performed.

Several of the initial variables proved to be irrelevant to the evaluation and were replaced with alternate variables. The final variable map was re-evaluated visually and several hypotheses formed based on this evaluation (See Figure 2). The values for the data were extracted to the fire point data table to allow comparison within the table and also to allow the creation of graphs for cross evaluation of data. The data was converted to Excel format to allow fluid graph creation and export.

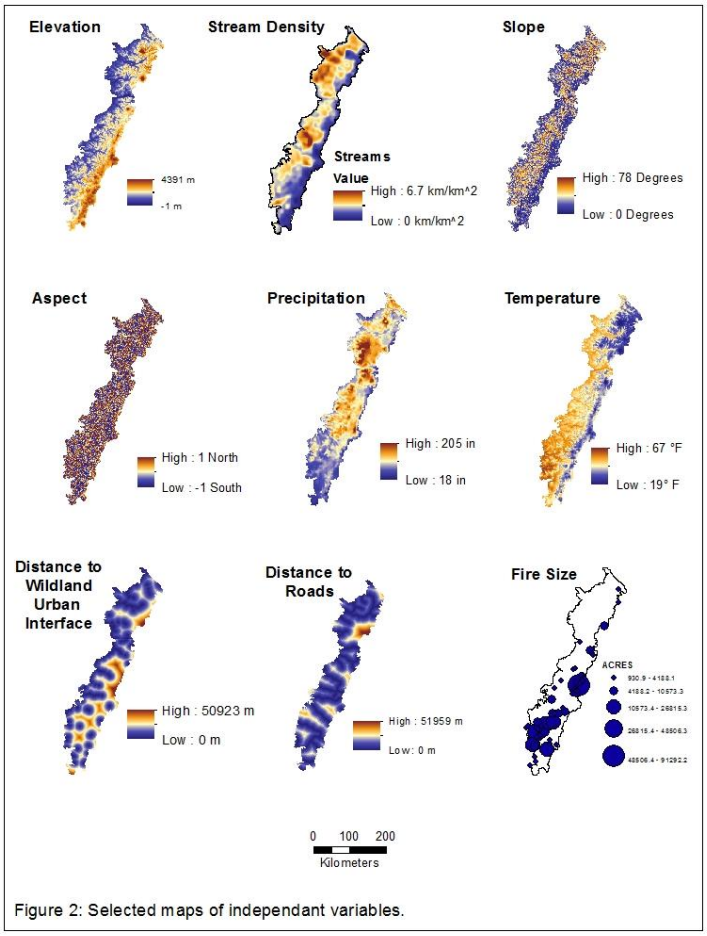

Figure 2: Selected maps of independant variables.

Sorting the data by state for comparison quickly indicated that the imbalance in fire occurrence would hamper the evaluation.

Forty-nine random points were established within the Washington portion of the ecoregion and the values of the variables were extracted to these random points for comparison with the Oregon fire data. Several types of graphs were utilized in the evaluation of individual and multiple variables. Summary tables were created within Excel for quick visualization of variable statistics.

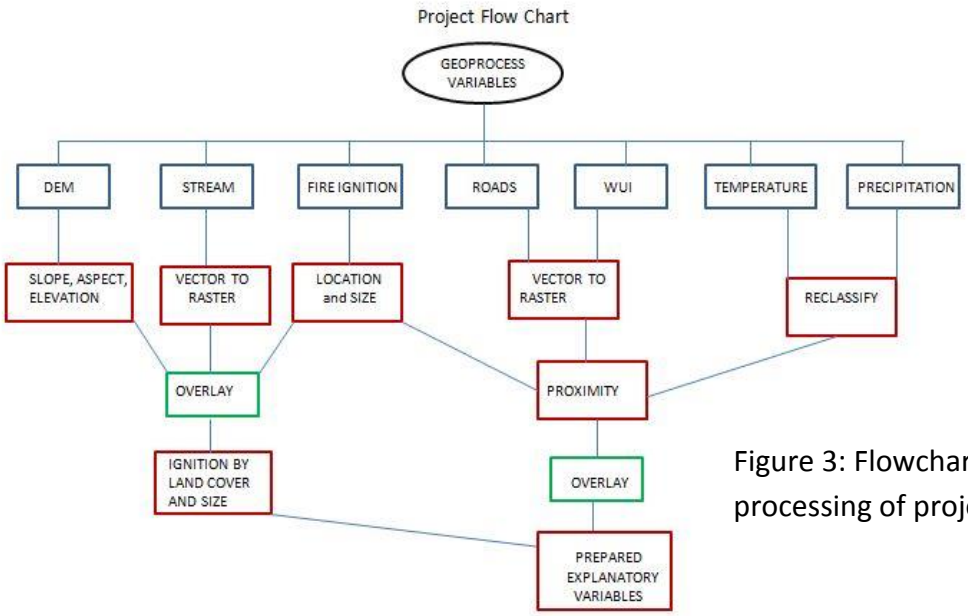

Figure 3: Flowchart of data processing of project variables.

Results

The initial visual inspection of the variable data indicated the area within Oregon containing the majority of the fires had two distinct characteristics. The first characteristic is a slightly lower amount of precipitation and the second is a slightly higher average temperature. The table of the Oregon data showed the same trend of more fires in lower precipitation and higher temperature areas. The graph of the two variables combined specified an inversely proportional relationship between precipitation and temperature. The Washington data associated with randomly generated points indicates the existence of a minimum amount of precipitation within the area being at or above 60 inches per year average. Insertion of a threshold line in graphs from both states indicates the majority of the Oregon fires occurrences were in areas with less than 60 inches of rain per year average (See Figures 4 and 5).

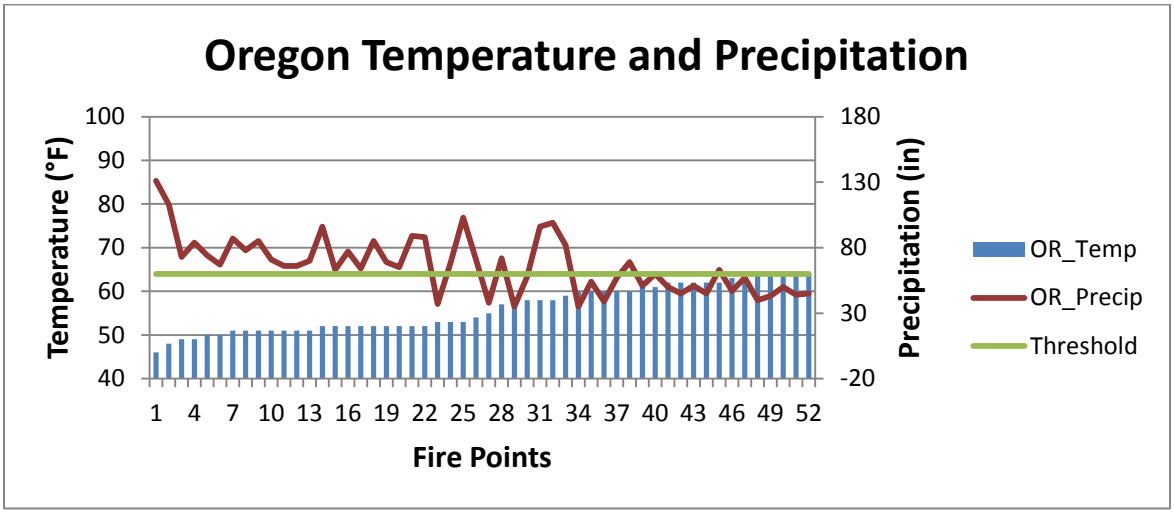

Figure 4: Graph of Oregon fire occurrence precipitation and temperature.

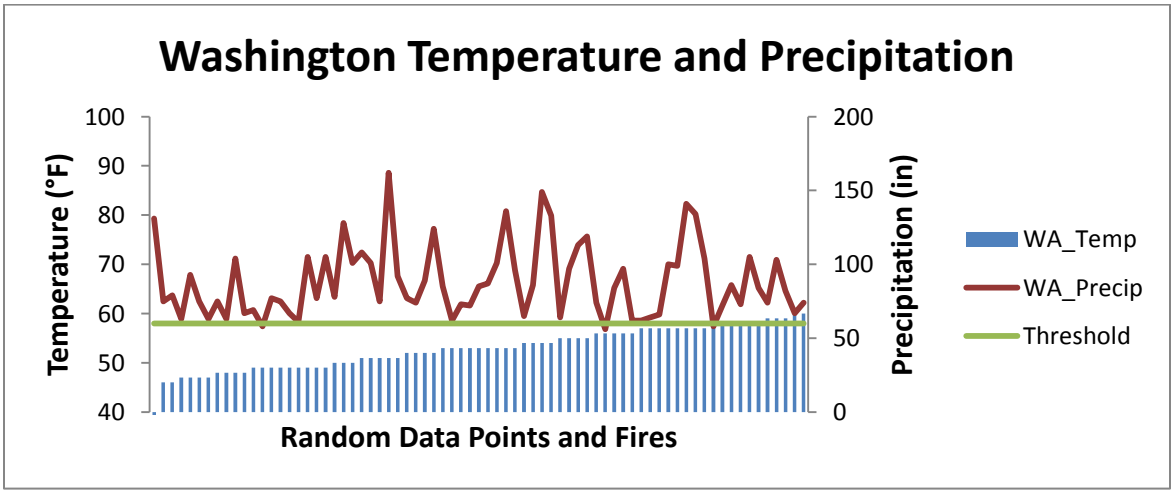

Figure 5: Graph of Washington fire occurrence precipitation and temperature with random point precipitation and temperature data.

The fires that did occur in the Washington portion of the ecoregion were near this 60 inch per year threshold, but slightly above. Evaluation of the remaining variable did not indicate any patterns of any significance when comparing the two states (See Tables 2 and 3).

Table 2: Statistical summary of Oregon fire occurrence variables.

	StrmDist	Temp	Aspect	Elev	Precip	Slope	WUI	RdDist	AspectNS
Min	0.125	46.000	0.000	313.000	35.000	1.968	3206.634	381.838	-1.000
Max	4.775	64.000	355.365	1864.000	131.000	39.841	37484.996	24477.445	0.999
Mean	1.974	55.981	176.967	1235.673	66.635	19.044	18080.778	11576.217	0.069
STD	0.955	5.312	111.713	437.942	21.222	10.941	8589.083	6860.219	0.661

Table 3: Statistical summary of Washington fire occurrence variables.

	StrmDist	Temp	Aspect	Elev	Precip	Slope	RdDist	AspectNS
Min	0.482	47.000	57.700	1151.000	63.000	7.783	14820.273	-0.610
Max	2.688	49.000	217.569	1681.000	75.000	30.819	45990.781	0.880
Mean	1.399	48.000	112.304	1425.667	69.000	20.605	25943.904	0.372
STD	1.149	1.000	91.183	265.528	6.000	11.738	17395.930	0.850

The aspect of a local is thought to have effect on the occurrence of fire but the available data did not produce a recognizable pattern. Slope is thought to be a factor in fire occurrence but again a recognizable pattern in the available data was not detectable. The distance a local is from a stream or road may also contribute to the occurrence of fire but the existing data did not produce a recognizable pattern. Examination of the distance to the Wildland Urban Interface (WUI) did not produce any readily recognizable patterns in the available dataset. The correlation between the precipitation and temperature does not prove causation in fire occurrence. A distinguishable pattern does exist between fire occurrence, precipitation, and temperature. Further examination and comparison of variables may indicate other causations or contributions to fire occurrence.