UNIVERSITY OF NORTHERN BRITISH COLUMBIA

Impact of Fire Hazards on the Severity of Mountain Pine Beetle Outbreak

A GIS-analysis over Quesnel Forest District

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Abstract

British Columbia has recently been affected by a comprehensive Mountain pine beetle (*Dendroctonus ponderosae* Hopkins) outbreak. This beetle is a native species for North America and has through their attacks on pine trees changed entire landscapes. Fire suppression has been identified as one of the major cause to the massive outbreak. In this GIS based analysis is the importance of fire during the 1919 to 2004 period on the severity of Mountain pine beetle outbreak 2004 in Quesnel Forest District, British Columbia, Canada examined. The results show a higher risk of outbreaks in the total area of the forest district than in burned areas within the study boundary. This result can be used to get a better understanding of how forest management affects the risk of beetle attacks.

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Introduction

Almost one third of all the animals in the world are beetles (Wilson, 1987). That is an enormous number and some of these beetles are tree predators. Some of the beetle species we understand more than others, because they have caused great damage to our forests. One of the beetles that has recently caused damage to forests of British Columbia, Canada is the Mountain pine beetle (MPB) (*Dendroctonus ponderosae* Hopkins). MBP has changed entire landscapes and ecosystem by killing pine trees and devastating many of these forests (Amman *et al.* 1990). MPB is a native beetle for North America (Amman, 1977) and the main host tree species are Lodgepole pine (*Pinus contorta*), Ponderosa pine (*Pinus ponderosa*), Sugar pine (*Pinus lambertiana*), and White pine (*Pinus strobus*) (Amman *et al.* 1990). We know that global warming affected the numbers of this beetle in British Columbia, but we now understand that there were other factors affecting the outbreak. Increased fire suppression created an abundance of mature forest (Logan and Powell, 2001), which is the beetles' first choice. Wildfires are a frequent natural disturbance in British Columbia and the absence of it will change the forests (Amman, 1977).

If the statement that fire suppression is one of the main reasons to the MPB outbreak is true, a correlation between fire hazards and the severity of the MPB outbreak should be seen. The importance of fire suppression could vary in different areas. In this study an analysis of the impacts of fire hazards on severity of MPB outbreak in Quesnel Forest District, using ArcGIS, will be done. Such information will help to understand and prevent further outbreaks of the beetle in the future.

Study area

The study area for this project was Quesnel Forest District. Quesnel Forest District was one

of many areas in British Columbia, Canada that were affected by the recent MBP outbreak.

Fire is also a frequent disturbance in the area. The district is 2,075,875 ha big.

Data Sources

The data sets that are used in this study are:

- BC Forest Districts and Regions, from Land and Resource Data warehouse (LRDW)

    1. Datum Name – North American Datum 1983

    2. Projection Name – British Columbia Albers

    3. Scale – 1:20,000

    4. Spatial – Vector

- Prot Historical Fire Polys sp., from Land and Resource Data warehouse (LRDW)

    1. Datum name – North American Datum 1983

    2. Projection Name – British Columbia Albers

    3. Spatial – Vector

- Severity of Mountain Pine Beetle Outbreak 2004

    (fhf_complete_dataset_20050218.zip), from Forest Practices Branch

    1. Datum name – North American Datum 1983

    2. Projection name – British Columbia Albers

    3. Spatial – Vector

Method

The first thing that was done was to download the data sets from Land and Resource Data warehouse and Forest Practices Branch. Then the files needed to be unzipped and projected in the same coordinate system; NAD83 UTM, zone 10 north. The next step was to select and export the Quesnel Forest District to an own layer from the BC Forest Districts and Regions layer, then clip the other two layers to the Quesnel Forest District.

Thereafter, areas burned anytime between 1919 and 2004 was selected and exported to a new layer (figure 1). The Severity of Mountain pine beetle outbreak was divided into five different layers after severity classes, percent of red attack (table 1).

Table 1. Severity classes divided by percent of red attack 2004.

	Acronym	Severity % of red attack
Trace	T	<1
Light	L	1-10
Moderate	M	11-30
Severe	S	31-50
Very severe	V	>50

Both the fire layer and the severity layers were converted to raster. Raster calculator was then used to find the areas that were both burned and infested by MPB (figure 2). Following, the raster layers were converted back to polygons and the area for the two disturbance types were calculated.

Part two of the project was to see if the degree of severity of the MPB attack was lower in burned areas than in unburned (figure 3). The area of each severity class, both burned and unburned, was calculated (table 2). Then the percentage of the infested area in each severity

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class in each severity class was calculated. To have something to compare those results with was the percentage of infested and buried area also calculated.

Results

The result shows that of the total area, 142,805ha, burned in Quesnel Forest District between 1919 and 2004 was 84,486ha infested by MPB in 2004. That gives a risk of 59.16% risk of burned areas to be affected by the MPB compared to 68.87% in the total infested area. The risks of the two severe intensities of outbreak are lower in burned areas than in unburned. The highest severity class, very severe, was 10.31 percentages higher in the total infested area than in areas which had been burned the last 85years. The severe level of the severity class was 5.59 percentages lower in the burned areas, while the moderate is a little bit higher in burned areas than in the total infested area (table 2).

Table 2. Area of Mountain pine beetle infested stands, total, infested and burned, percentage of infested, and percentage infested on burned land in each class.

|	Area Infested Total (ha)	Percentage Infested (%)	Area Infested and burned (ha)	Percentage Infested on burned land (%)
Trace	67866	3.62	7925	9.65
Light	216756	11.56	15769	19.20
Moderate	907907	48.41	41599	50.65
Severe	421574	22.48	13861	16.89
Very severe	261196	13.93	2970	3.62
Total	1875299	-	82124	-

Conclusion

The risk of MPB outbreak in Quesnel Forest District was higher in unburned areas than in the total infested area. Furthermore, the risks of the two severe intensities of the beetle outbreak were lower in burned areas than in unburned, while the moderate was a little bit higher in burned areas than in the total infested area. This means that fire suppression probably was one of the reasons that caused the outbreak and the degree of severity in the forest district.

References

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Logan, J. A., Powell, J. A. 2001. Ghost Forests, Global Warming, and the Mountain Pine Beetle (Coleoptera : Scolytidae). American Entomologist 47: 160-173.
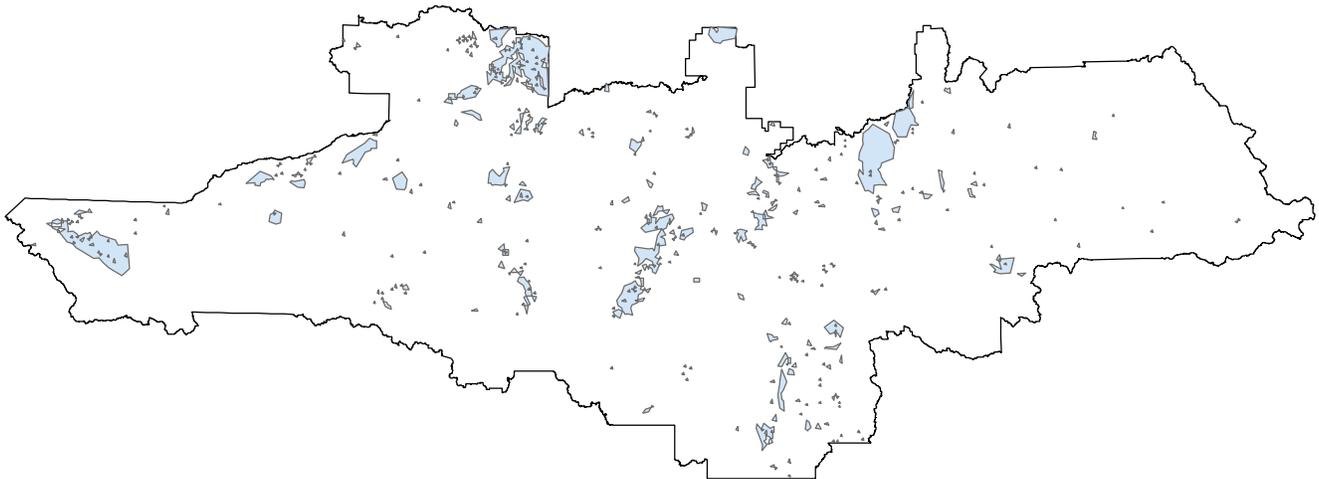
Areas burned 1919-2004
in Quesnel Forest District

N

Km
0   50   100
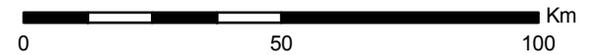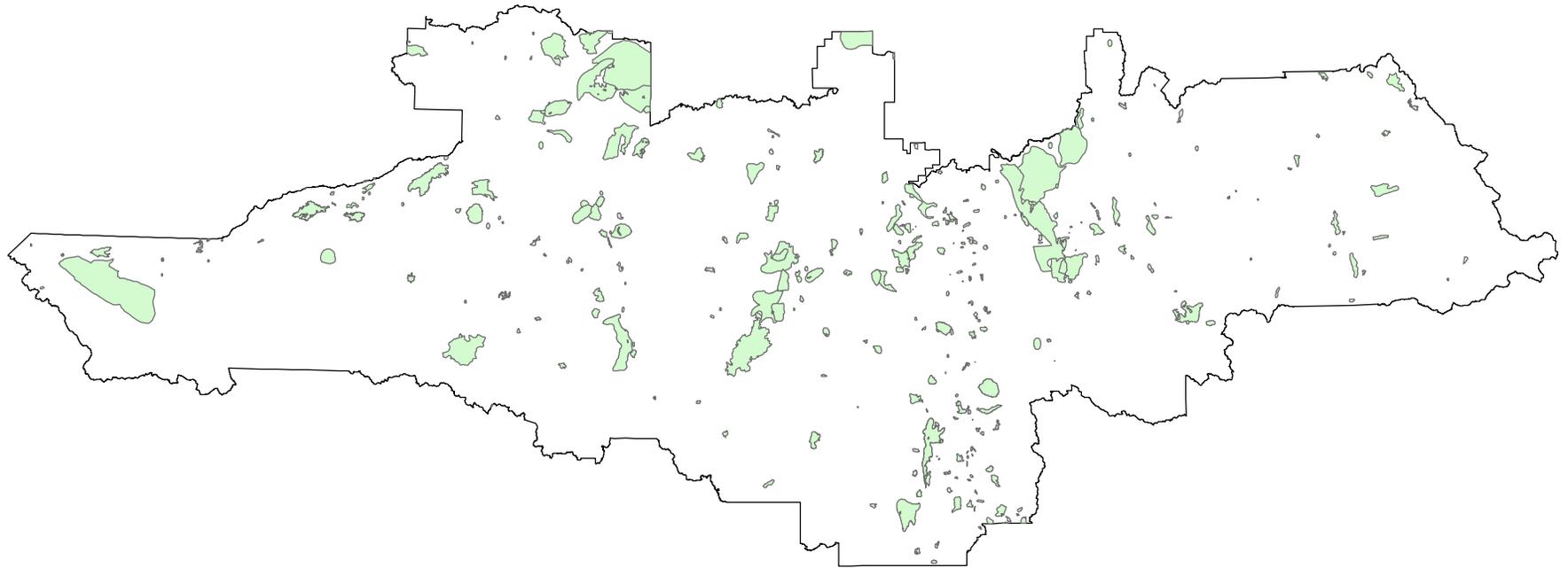
Bured areas 1919-2004
Quesnel Forest District, Border

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Areas burned 1919-2004
and
infested by Mountain pine beetle 2004
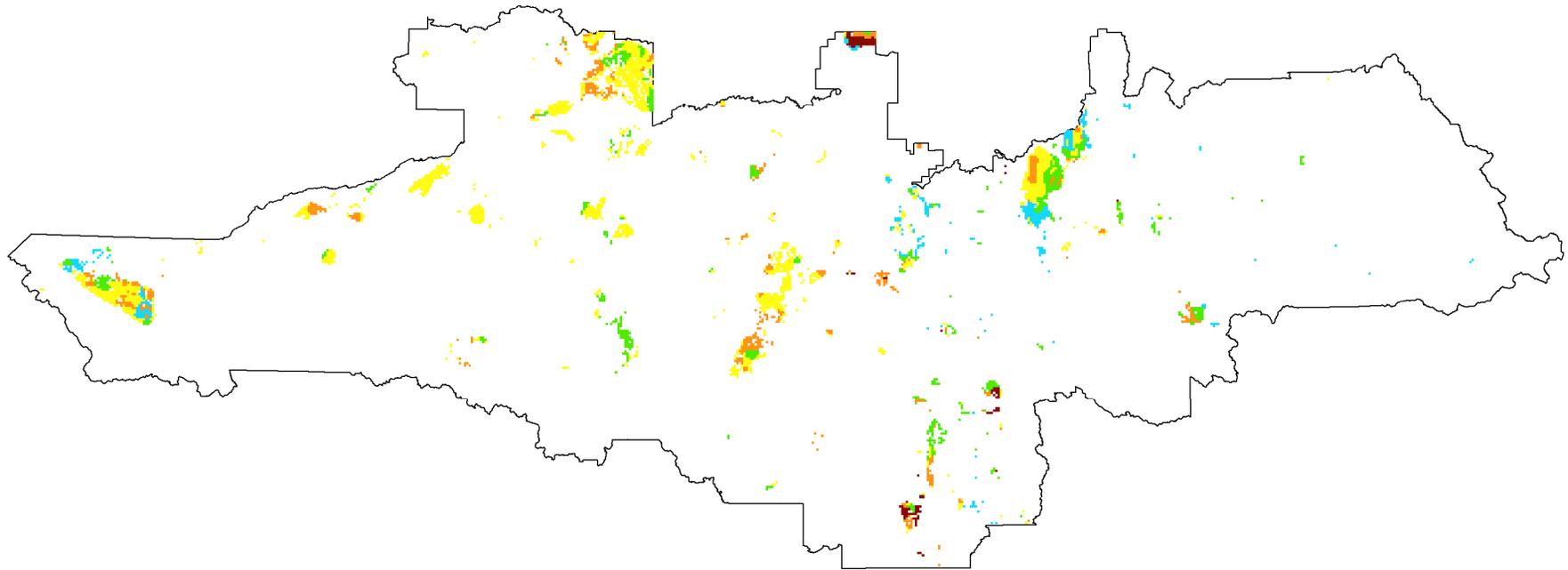# In Quesnel Forest District

N

Areas burned 1919-2004 and infested by Mountain pine beetle 2004

Quesnel Forest District, Border

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0   50   100   150
Km

Areas burned 1919-2004
and
infested by Mountain pine beetle 2004
in Quesnel Forest District

N

Km
0   50   100

- Burned Areas 1919-2004 and Infested by Mountain pine beetle 2004 with severity class V
- Burned Areas 1919-2004 and Infested by Mountain pine beetle 2004 with severity class S
- Burned Areas 1919-2004 and Infested by Mountain pine beetle 2004 with severity class M
- Burned Areas 1919-2004 and Infested by Mountain pine beetle 2004 with severity class L
- Burned Areas 1919-2004 and Infested by Mountain pine beetle 2004 with severity class T
- Quesnel Forest District, Border

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