

QuickNotes

Science summaries from fRI Research

Introducing: Using innovative techniques to understand how mountain pine beetle is shifting ecosystem composition and configuration in Jasper National Park.

Dr. Eric Higgs, James Tricker, Dr. Jeanine Rhemtulla

The accumulative effects of fire exclusion policies and a warming climate have resulted in significant mountain pine beetle (MPB) outbreaks throughout their historical range in recent decades. Of particular concern is the expansion of MPB into novel habitats, such as northern Alberta, where the broad-scale ecological changes occurring in pine forests are having significant socio-economic impacts. The University of Victoria, in collaboration with Jasper National Park (JNP), is undertaking new research to gain a better understanding of these ecological changes by investigating the implications of the MPB outbreak on the historical range of variability (HRV) of ecosystems in the Athabasca River valley (Figure 1). Studying HRV provides knowledge of ecosystem processes and species adaptations to change, and can be used as a reference for establishing the range of desired future conditions. The intent of this research is to evaluate concerns that MPB outbreaks in novel habitats may push ecosystems beyond their HRV. These changes may increase the potential for ecological regime shifts in the park, which could substantially alter the flow of ecosystem services and have important implications for human livelihoods and community well-being.

Underpinning this research project are the oblique image collections of the Mountain Legacy Project (see <http://mountainlegacy.ca/>), which comprise a vast set of systematic historical survey photographs and repeat imagery.

Federal-Provincial MPB Research Partnership

Mountain Pine Beetle remains a severe threat to Alberta's pine forests despite the province making positive progress in controlling its spread within the province and reducing the risk to the rest of Canada.

Natural Resources Canada and Alberta Agriculture and Forestry have provided funding to a suite of projects with the goals of limiting the spread of Mountain Pine Beetle and mitigating damages where it has already invaded.



Natural Resources Canada Ressources naturelles Canada

Canada



Alberta
Agriculture and Forestry

We will employ innovative techniques to classify and georeference land cover information held in the oblique photographs. This approach will enable historical land cover data to be derived from Dominion Land Survey photographs captured in JNP in 1915, which can provide a snapshot of the composition and configuration of ecosystems in the park under the historical fire regime. This reference baseline can then be used in conjunction with more recent land cover data (derived from oblique, aerial and satellite imagery) to quantify the changes that have occurred on the landscape in JNP due to fire exclusion and the recent MPB outbreak.



Landscape change around the Jasper townsite in Jasper National Park. Images are a mosaic of four photographs taken from Old Fort Point in 1915 (top), 1998 (middle), and 2019 (bottom). The 1915 image depicts an open landscape recovering from a major wildfire that occurred in 1889. 83 years later, the 1998 image captures the dramatic increase in coniferous stands on the landscape. Finally, the 2019 image captures the extensive “dead red” on the landscape – pine trees that were killed by the recent MPB outbreak.

Objectives

Our four primary objectives for this research project are listed below, and will be undertaken to test the hypothesis: MPB outbreaks in novel habitats are pushing ecosystems beyond their HRV, increasing the potential for regime shifts.

1. Test the accuracy of a new approach to classifying and georeferencing land cover data from repeat oblique photographs against comparable data produced from satellite and aerial orthoimagery.
2. Apply the above approach to the historical survey photographs to develop a 1915 land cover map for a portion of JNP (the “three valley confluence” near the town of Jasper).
3. Derive additional land cover data from 1949 aerial photographs, 2002/03 Landsat 5 TM satellite imagery, and 2020 high-resolution aerial imagery.
4. Quantify the changes to land cover types (i.e., configuration and composition) in the JNP study area since 1915 in order to evaluate the impact of the MPB outbreak on HRV and assess the potential for changes in ecological processes that may lead to regime shifts

Expected Outcomes

Land cover data derived from four data points, spanning 105 years, will be used to evaluate changes to landscape pattern since fire suppression began in the park circa 1913. We will calculate the proportion of the study area occupied by each cover type for the four data points (these data will be summarized in bar graphs or pie charts for easy interpretation). We will also use measures of spatial configuration, specifically patch-based metrics such as patch number, area and perimeter, to quantify changes to the spatial arrangement of cover types within the study area.

Implications for Land Management

These data will be presented statistically in tables, and interpreted with the use of graphs, in order to facilitate comparison on the significance of the changes that have occurred to ecosystem composition and configuration over the last century (that includes the impacts of the MPB outbreak). We will use these findings to present the impacts of the MPB outbreak on HRV in the study area, and identify specific areas that may be experiencing rapid change and approaching an ecological threshold that can result in a regime shift to an alternative dynamic configuration.

Expected Social, Economic, and Ecological Value

The value of this analysis is to increase the temporal depth of ecological monitoring in the park and allow managers and restoration practitioners to develop a better understanding of how and where the MPB outbreak may be altering ecological processes that could result in key thresholds to be exceeded and cause regime shifts. This research is intended to support managers in a variety of operational decisions including restoration activities (i.e., prescribed burns), fire-smart actions, community relations with the town of Jasper, and visitor education programs.

Expected Completion Date

The research project will run for two years, with a completion date of September 2023.