Jasper
National Park

Mountain Pine Beetle Management Plan
Jasper National Park

2016

Parks Canada Parcs Canada

Canada

Parks Canada
Mountain Pine Beetle Management Plan Jasper National Park

Jasper National Park
PO Box 10
Jasper, AB
T0E 1E0

http://www.pc.gc.ca/eng/pn-np/ab/jasper/index.aspx

Contents

List of Figures

APPROVAL PAGE

Recommended by:

_____ Date: JULY 22, 2016

Salman Rasheed
Resource Conservation Manager

Approved by:

_____ Date: July 22, 2016

Alan Fehr
Field Unit Superintendent

EXECUTIVE SUMMARY

The mountain pine beetle, (*Dendroctonus ponderosae* Hopkins) (MPB) is an indigenous forest insect found throughout western North America. Large outbreaks, attributed to global climate change and fire suppression, have resulted in the loss of millions of hectares of pine forests in western Canada and the United States. Jasper National Park (JNP) and neighboring regions to north and west have experienced a marked increase in mountain pine beetle attacked trees in the last four to five years. Mountain pine beetle is spreading from west to east in Jasper National Park, although local outbreaks are function of, for example, stand characteristics and size of parent beetle populations, rather than strictly migration. Population surveys clearly show that mountain pine beetle is already established in Alberta. Mountain pine beetle is viewed as a naturally occurring species within Jasper National Park, however, because of concerns about visitor and resident safety, potential increased risk of wildfire post outbreak and impact to neighboring lands, Parks Canada policy allows for intervention.

Jasper National Park is working with the Government of Alberta (GoA), the Canadian Forest Service (CFS) and the Municipality of Jasper to assist with the development of a Mountain Pine Beetle Management Plan for Jasper National Park. The plan outlines the goals and the measures to be taken to achieve the following outcomes, slow the spread of mountain pine beetle, maintain ecological integrity, ensure the safety of visitors and residents of Jasper and educate visitors on mountain pine beetle occurrence and issues related to national park conservation.

To achieve these goals, Parks Canada will work with our provincial and federal partners and the Municipality of Jasper to undertake a multi-faceted approach. This will include applying prescribed fire to achieve our conservation goals, and using targeted single/multiple and patch tree removal where more efficient and effective. We will also work with the Municipality of Jasper to facilitate community protection through such programs as FireSmart. Finally, Parks Canada will engage both visitors to and residents of Jasper to communicate the story of mountain pine beetle and the efforts made by Parks Canada to maintain ecological integrity and ensure visitor and resident safety.

1.0 INTRODUCTION

1.1 BACKGROUND

The mountain pine beetle (*Dendroctonus ponderosae* Hopkins) (MPB) is indigenous to North America, historically occurring in relatively low numbers in Jasper National Park (JNP). These small insects attack and kill mature pine trees by boring through the bark and mining the phloem – the layer between the bark and wood of the tree. At the same time, they bring with them a blue stain fungus, which helps to kill the tree by disrupting the flow of water and nutrients. When forest and climate conditions are favourable, populations of mountain pine beetle can rise dramatically and affect large areas of mature pine (lodgepole, ponderosa, and western white pine are the main hosts for mountain pine beetle in Western Canada, although all native pines including jack pine, whitebark and limber pine are susceptible) (Safranyik and Carroll 2006).

Decades of fire suppression and a warming climate have created perfect conditions for mountain pine beetle population growth. The current range expansion east of the Rockies is outside the historic range of mountain pine beetle population distribution (Safranyik and Carroll 2006), and predications based on climate modelling suggest that mountain pine beetle will expand its range both in latitude and elevation (Carroll et al., 2006). There are two principal types of mountain pine beetle dispersal, short-range, within-stand dispersal (up to 30 m), and long-range above the canopy dispersal (up to hundreds of kilometres) (Safranyik and Carroll 2006). Techniques to limit mountain pine beetle dispersal are primarily directed at limiting short-range dispersal. For mountain pine beetle, epidemics form as localized infestations coalesce over the landscape. Yearly changes in population and damage levels during outbreaks are a function of i) size of the parent beetle population; ii) stand characteristics such as species composition, density, age and diameter distribution; iii) the spatial distribution of stands of different susceptibility; iv) weather events and v) intraspecific competition. (Safranyik and Carroll 2006).

Historically, fires would have burned through Jasper National Park's valley bottoms as often as every fifteen years, creating a landscape with fewer trees (Tande 1979, Schindler et al., 2000, Achuff et al., 2001). Today, after more than 70 years of fire suppression, most forests in Jasper National Park now contain large, dense, continuous stands of old lodgepole pine that are available to mountain pine beetle (Achuff et al., 2001).

To restore natural disturbance process and limit the overabundance of mature pine forest, Parks Canada's management tool of choice continues to be applying prescribed fire on the landscape. Restoring fire to the landscape is an efficient way to remove mountain pine beetle habitat, restore forest ecological integrity and protect values at risk. Prescribed fire also restores and enhances wildlife habitat and reduces the risk of advancing wildfire, at the same time mimicking natural disturbance processes. The Jasper National Park Fire Management Plan (PCA, 2007a) and the Jasper National Park Mountain Pine Beetle Management Strategy (PCA 2005) both detail the use of prescribed fire to improve forest health and protect values to

risk. As well, prescribed and wildfire has the additional benefit of not promoting bark beetle outbreaks and may decrease populations over time, and is a recommended management approach (Tabacaru et al., 2015). Jasper National Park has been advancing efforts to monitor and limit the spread of mountain pine beetle through working with our partners and implementing a prescribed burn program (Polster 1987, Parks Canada Agency 2005, 2007a, 2010).

1.2 CURRENT SITUATION – REGIONAL

To the west of Jasper, in British Columbia, mountain pine beetle continues to be very active (Figure 1). Occurrence in the Robson Valley Timber Supply Area increased to 36,764 ha, with active outbreaks in Hugh Allan Creek and Mount Robson Provincial Park accounting for 40% of the severe mortality mapped in the province (BC MoFL and NRO, 2014). In Mount Robson Provincial Park, located directly west of Jasper National Park, some south facing slopes near Yellowhead Pass exhibit greater than 70 % mountain pine beetle mortality (BC MoFL and NRO, 2014).

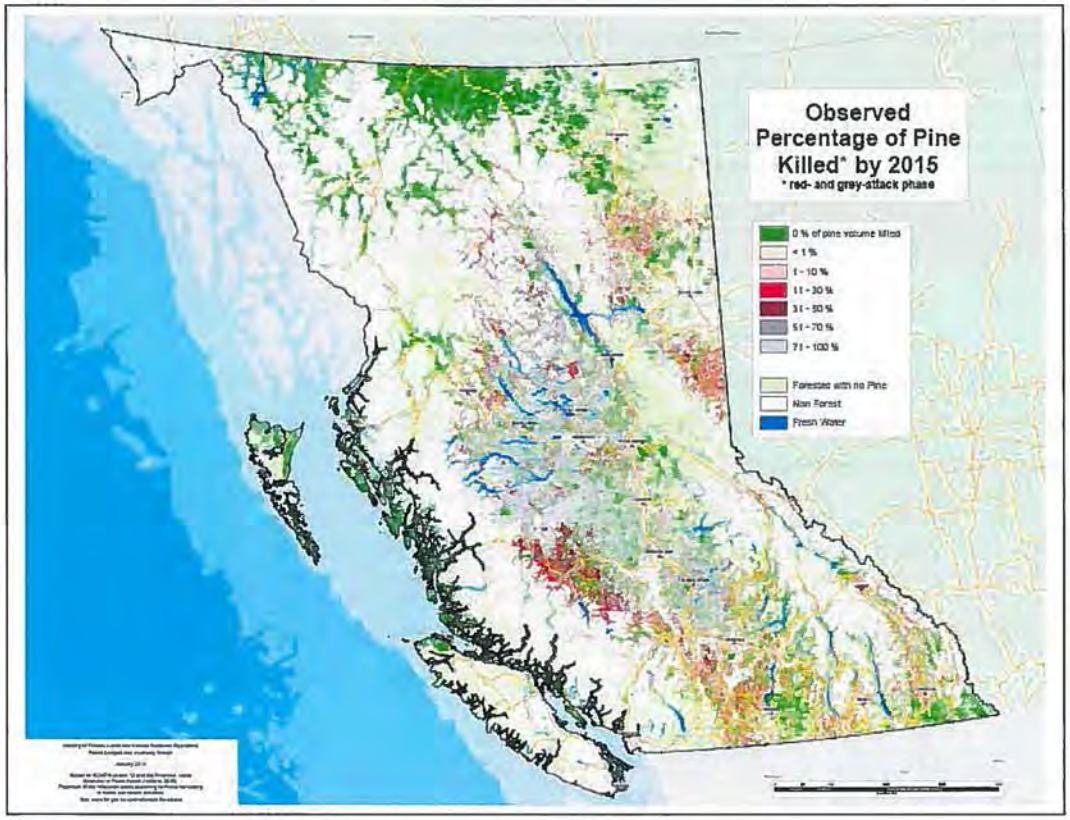

Figure 1. Observed percentage of pine killed in British Columbia in 2015. Robson Valley area adjacent to Jasper National Park circled in blue (https://www.for.gov.bc.ca/hre/bcmpb/year13.htm).

East of Jasper, in most sites in the Peace River region, there continues to be high beetle activity over the past few years (Figure 2). In fact, population forecast surveys conducted by the Government of Alberta clearly show that mountain pine beetle is already well established in Alberta, with an indigenous population

in the Hinton region and several regions showing extremely high success indicative of an increasing populations (Figure 2). In response to the population expansion and spread of mountain pine beetle into Alberta's pine forests, the Government of Alberta released the Mountain Pine Beetle Action Plan (ABSRD, 2007a) and the Mountain Pine Beetle Management Strategy (ABSRD 2007b).

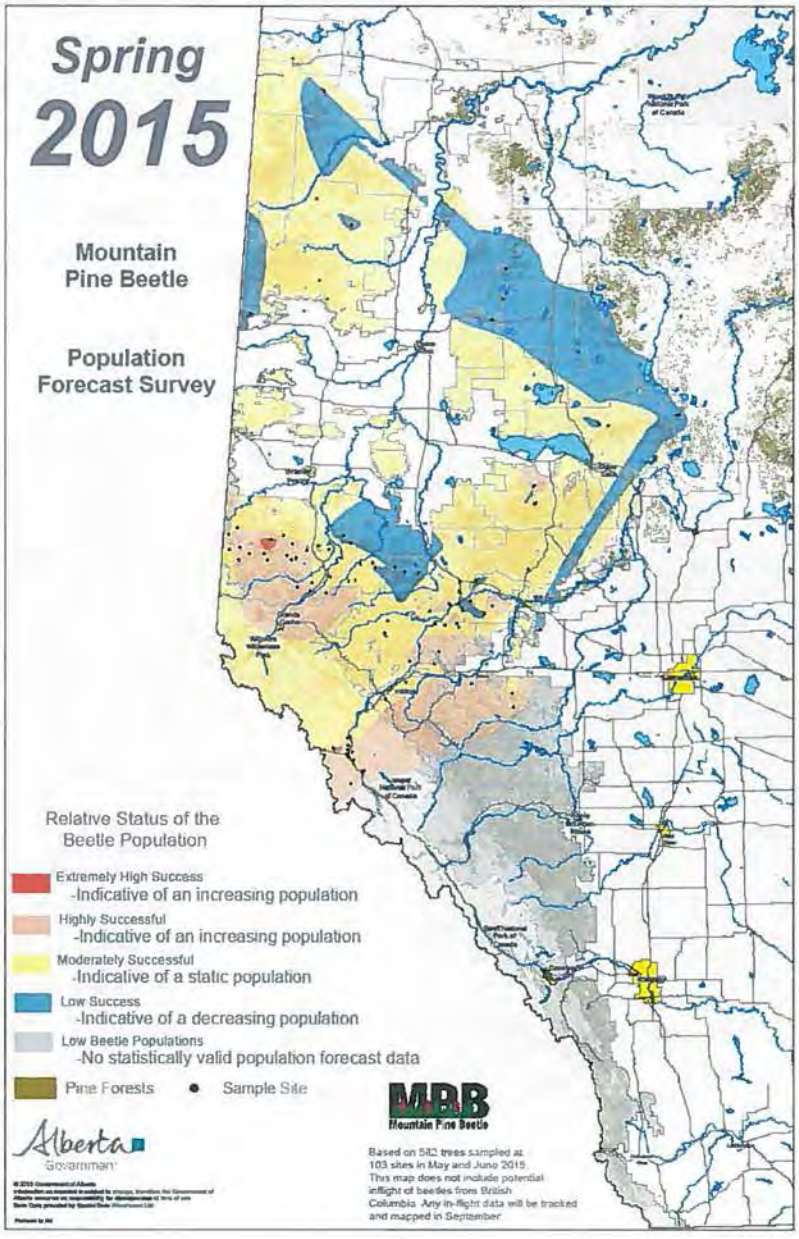

Figure 2. Mountain Pine Beetle Population Forecast Survey Map – Spring 2015 (Government of Alberta- Alberta Agriculture and Forestry - http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/formain15830/$file/MPB-PopulationForecastSurveyMapSpring2015.pdf?OpenElement).

1.3 CURRENT SITUATION – JASPER NATIONAL PARK

Mountain pine beetle surveys in 2014 and 2015 indicate that the number of mountain pine beetle infested lodgepole pine in Jasper National Park has increased (Figure 3), with some instances of infection in whitebark pine. The most recently mapped pine mortality in Jasper, covers approximately 21,568 hectares, and occurs primarily along the Highway 16/Miette River Valley corridor between the west park gate and the Snake - Athabasca River's confluence, along Maligne Lake Road, south of the Jasper townsite along the Icefields Parkway to Honeymoon Hill, and most of the Whirlpool River valley. Although mountain pine beetle can come in from many places, the two primary corridors into Jasper National Park are the Yellowhead Pass (west park gate) and the four passes at the headwaters of Whirlpool River. With a favorable winter, further expansion in 2016 is expected.

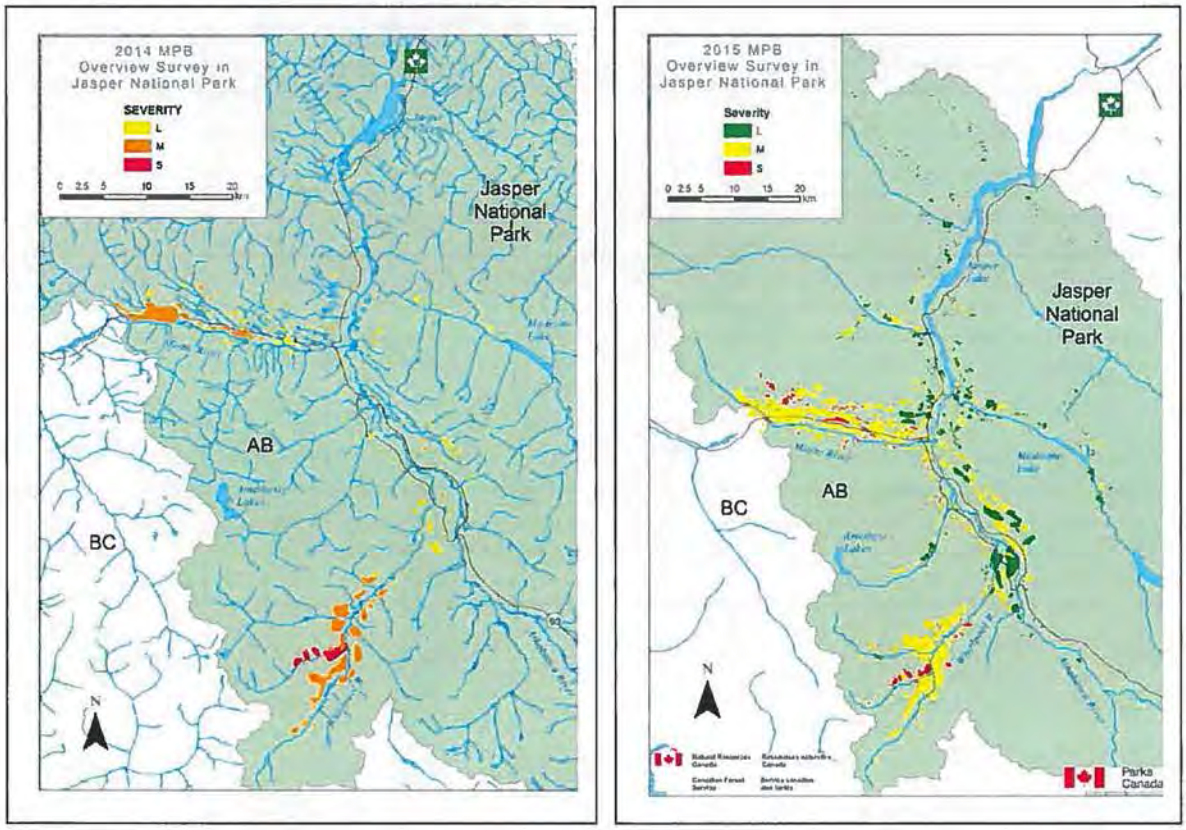

Figure 3. Mountain pine beetle survey results for Jasper National Park for 2014 and 2015, conducted in partnership with Natural Resources Canada, Canadian Forest Service (CFS 2014) (CFS pers.comm.).

In Jasper National Park, two key issues regarding mountain pine beetle have been identified, first, mountain pine beetle range expansion east of the Park may decrease forest health and increase wildfire risk

to values on neighboring lands. Second, mountain pine beetle induced forest mortality within Jasper National Park may increase the wildfire risk to values in the Park, including Jasper townsite and some outlying developments.

2.0 PARKS CANADA'S APPROACH

2.1 POLICY

In Canada's national parks, native insects and diseases are viewed as natural ecological processes that should be allowed to proceed without interference if possible (Parks Canada 1994). However, when native insects pose a threat to communities or provincial lands, as they do in Jasper National Park and also Jasper townsite, intervention is necessary. Active management is recommended when the structure and function of an ecosystem has been altered and manipulation is the only possible alternative available to restore ecological integrity. Intervention is triggered when there may be adverse effects on neighboring lands, major park facilities, public health or safety will be threatened or the objectives of a park management plan cannot be achieved. All active management is to be based on scientific research using techniques that duplicate natural processes as closely as possible, are carefully monitored, and have demonstrated success in an adaptive management framework.

2.2 ISSUE ANALYSIS

Mountain pine beetle expansion in Jasper National Park and associated forest mortality may increase wildfire risk to values on neighbouring lands. As well, mountain pine beetle induced forest mortality within Jasper National Park may increase the wildfire risk to values in the Park including Jasper towniste and major outlying developments.

2.3 GOALS

Jasper National Park's Mountain Pine Beetle management plan has the following goals consistent with previous work in the National Parks (Polster 1987, Dalman 2003, Parks Canada Agency 2005, 2007a, 2010).

- Maintain the ecological integrity of Jasper National Park.
- Slow or limit the spread of mountain pine beetle both through Jasper National Park and into adjacent lands to the extent possible.
- Ensure that threats posed by mountain pine beetle to Jasper townsite and visitors coming to Jasper are mitigated to the extent possible.
- Educate visitors on mountain pine beetle occurrence and issues related to national park conservation and climate change impacts to ecosystem structure and function.

This plan will be reviewed every 5 years, or if the mountain pine beetle situation changes significantly. An operational plan will be updated and reviewed annually.

2.4 OBJECTIVES

Our goals will be achieved through the following objectives;

- Given the magnitude of the issue, work in cooperation with our provincial and federal partners to ensure a coordinated approach (Action 2.5.1)
- Maintain situational awareness of the distribution and spread of mountain pine beetle within Jasper National Park (Action 2.5.2)
- Remove available mountain pine beetle habitat along the eastern boundary of Jasper National Park adjacent to provincial lands using prescribed fire (Action 2.5.3)
- Maintain the structure and function of Jasper National Park's ecosystems as reported by the ecological integrity monitoring program, including species at risk, such as whitebark pine (specific actions for whitebark pine conservation can be found the Jasper National Park Species at Risk Multispecies Action Plan (in preparation)
- Protect Jasper townsite from the effects of mountain pine beetle, specifically through community facility protection and control activities west of the municipality (Action 2.5.3, Action 2.5.4 and Action 2.5.5).
- Educate and connect with Canadians about the role of National Parks, natural processes and active management. (Action 2.5.6)

2.5 MANAGEMENT ACTIONS

Parks Canada will pursue a suite of approaches to achieve the stated objectives. Measures of success will be provided by the ongoing dialogue with Canadian Forest Service and Government of Alberta, planned surveillance activities, Area Burned Condition Class measure (a monitoring measure part of the Jasper National Park's Ecological Integrity Monitoring Program), a working relationship with the Municipality of Jasper and delivery of a mountain pine beetle outreach and education program.

2.5.1 COOPERATION

- ***ACTION**: Parks Canada will work cooperatively with the Government of Alberta and Canadian Forest Service through the use of a strategic steering committee.*

2.5.2 SURVEILLANCE

- ***ACTION**: Parks Canada will continue working with Canadian Forest Service to estimate population distribution and abundance through aerial surveys.*

Parks Canada, in partnership with the Canadian Forest Service, has been conducting aerial surveys to identify mountain pine beetle attack since the mid 1990's. This survey was undertaken again in August of 2016 and will continue to be scheduled in the late summer, into the future.

- ***ACTION**: Parks Canada will continue working with the Government of Alberta to determine population infection levels through 'r'-value and Green: Red tree ratios.*

In the spring and summer of 2015, Jasper National Park began working with the Government of Alberta's Ministry of Agriculture and Forestry to determine mountain pine beetle 'r'-values and Green: Red tree ratios for Jasper National Park. The 'r'-value is a measure of beetle reproduction and overwinter survival and provides an indication of the population numbers that are expected to emerge as adults attack new pine trees during the summer flight. This measure does not however take into account the attack of beetles due to long range dispersal. These surveys are conducted annually from May 15 to June 15 on provincial lands. As these surveys provide insight into population growth or decline, it is important to continue to conduct them in Jasper National Park over the life of this plan.

Following annual aerial surveys, a fall population survey is conducted, with the assistance of Alberta Agriculture and Forestry, to measure the ratio of newly attacked trees ("green attacks") to older attacked trees ("red attacks"). This ratio indicates the success of beetle populations and can indicate if migration is occurring. The methodology used is identical to that used on provincial lands. In the future, both the 'r' value and the Red to Green Ratio surveys will be used to determine the locations where Parks Canada should focus operations.

2.5.3 PRESCRIBED FIRE

- ***ACTION**: Parks Canada will reduce available mountain pine beetle habitat within the Athabasca Valley.*

Parks Canada will replace the existing mature pine forest near the east park boundary with immature forest. In support of a number of ecological and fire management objectives, including indirect control of mountain pine beetle in Jasper National Park, Parks Canada completed three prescribed fires in the Athabasca Valley, in the spring of 2015 and 2016. The north sub-unit of Jackladder III prescribed fire was a 102 hectare valley bottom burn in the vicinity of the Jasper Airfield. The second prescribed fire undertaken was in the Vine Creek area on the north side of the Athabasca Valley. This 500 hectare unit is of strategic importance to the Jasper National Park mountain pine beetle program. With the completion of this unit, the Athabasca Valley has less available mountain pine beetle habitat, including about 3 km up Vine Creek, across Jasper Lake and 40 km up the Rocky River Valley (Figure 4). In the spring of 2016, the second half of the Jackladder III prescribed fire unit was ignited. This 120 ha unit consisted of 50% grass and 50% lodgepole pine. One of the objectives of this burn was to eliminate the entire pine component. This prescribed fire, in conjunction with the Henry House II prescribed fire (2007) and the Hawk Mountain prescribed fire (2006), has reduced an estimated 1,000 hectares of pine in the mid-Athabasca Valley 10 km north of the Municipality of Jasper (Figure 4).

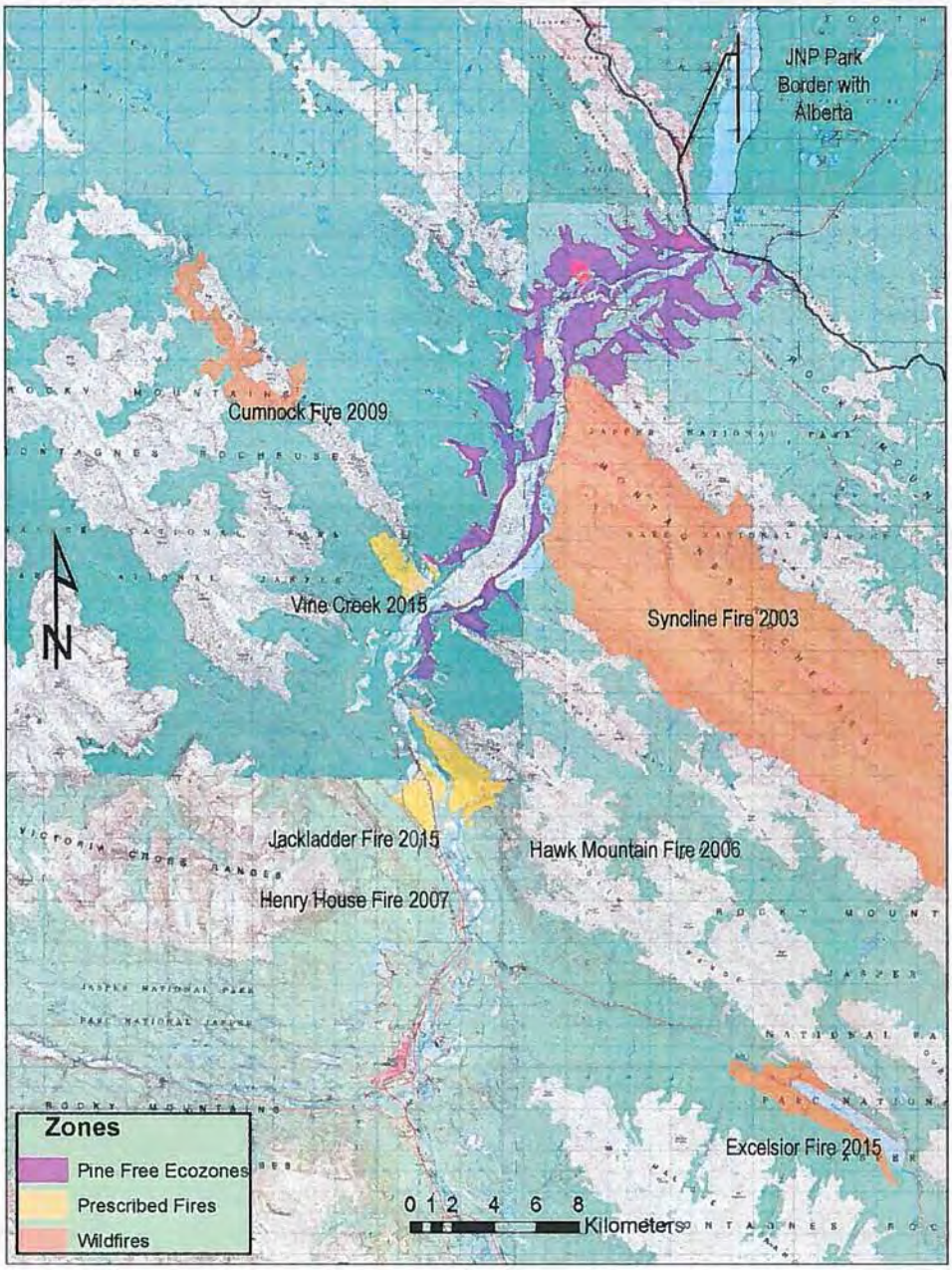

Figure 4. Areas without mature pine mountain pine beetle habitat as a result of prescribed fires (Jackladder, Vine, Henry House, Hawk, Syncline) and wildfire.

- ***ACTION**: Parks Canada will reduce mountain pine beetle habitat in the Athabasca Valley on the eastern Park boundary.*

The Fiddle Prescribed Fire Complex is a series of 5 sub-units designed to bring a natural process back to the landscape and also remove susceptible pine at a pinch point in the valley between the Boule and the Fiddle Ranges. The Fiddle Complex will eliminate another 660 hectares of susceptible pine habitat. Perhaps more importantly, with the completion of this prescribed fire complex, the complexity of future prescribed burn units upwind will be reduced. Work on strategic control lines for this prescribed fire complex began in the winter of 2014-15 (Figure 5), and some of the units could be burned as early as fall 2016.

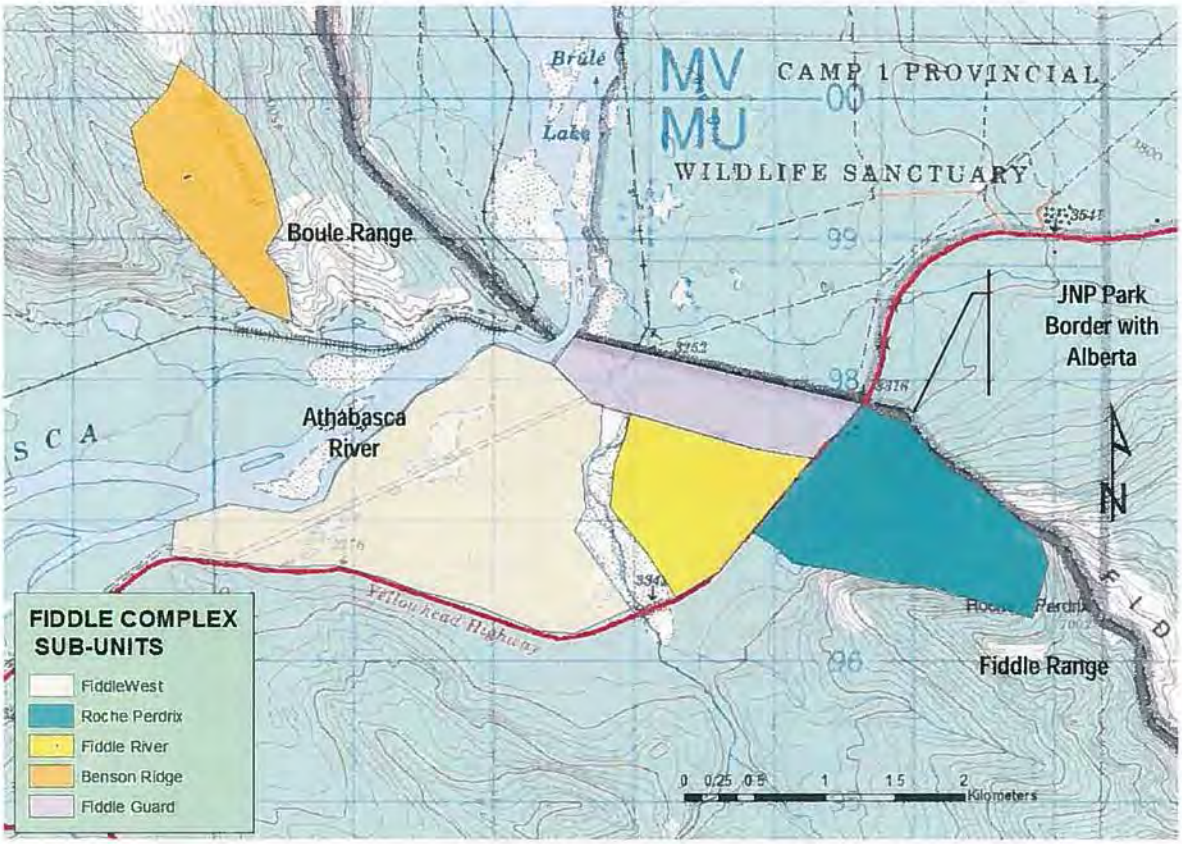

Figure 5. Fiddle Prescribed Fire Complex on the eastern boundary of Jasper National Park

- ***ACTION**: Parks Canada will protect Jasper townsite by reducing mountain pine beetle habitat on the benchlands west of the townsite.*

Parks Canada will ramp up efforts to remove mountain pine beetle habitat immediately west of Jasper townsite by implementing the Bench Lakes Prescribed Fire Complex (Figure 6). The importance of completing these units has increased due to the likelihood of an increased fire hazard associated with beetle-killed trees located directly upwind of the Jasper townsite. The plans and some of the initial guard burning have also been completed for the Bench Lakes Prescribed Fire Complex. This 6 sub-unit prescribed fire complex is located upwind of the Municipality of Jasper. (Figure 6). The main objective of

this burn complex is to augment the FireSmart work which was completed in 2006. Once completed, these prescribed fires will further eliminate an estimated 420 ha of mountain pine beetle habitat. Some control line work was completed for these units during the winter of 2010-11 and is ongoing and some of these units could be burned as early as late Fall 2016.

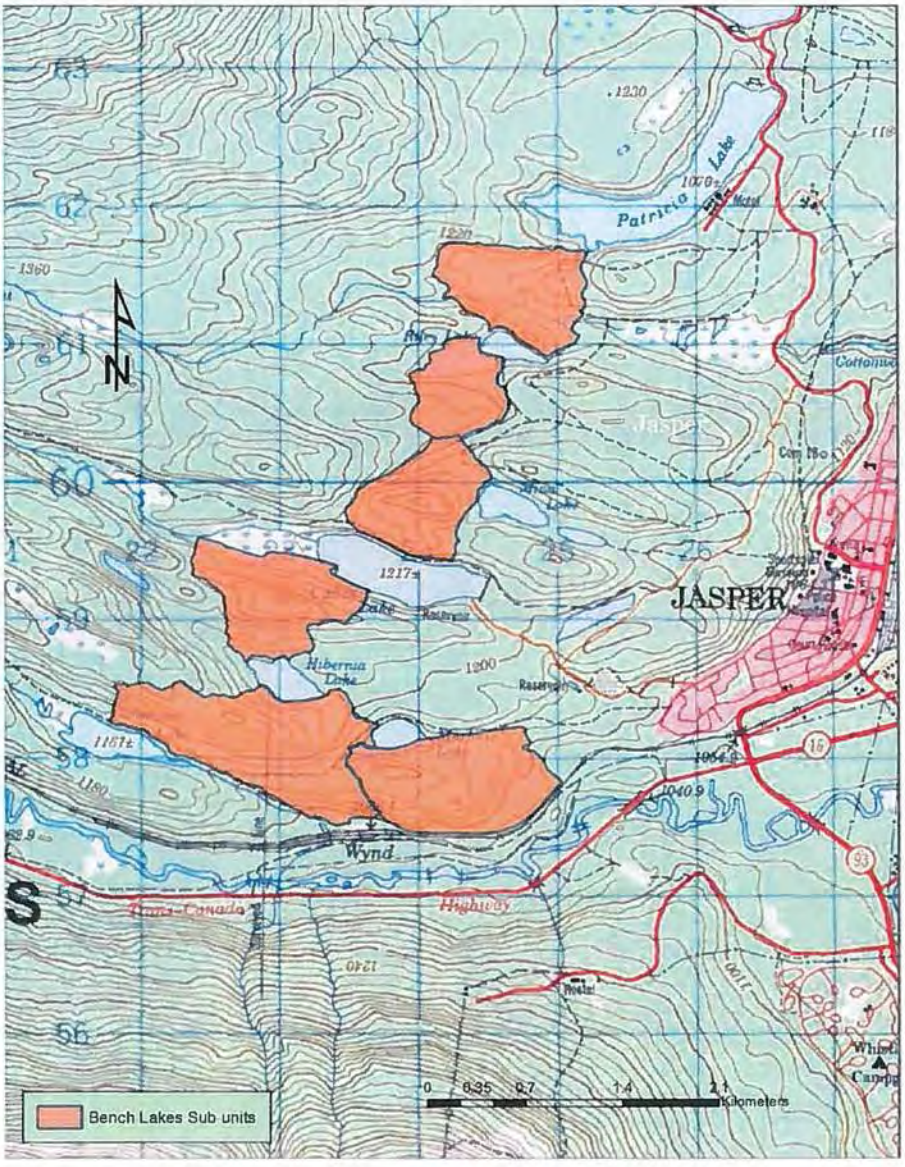

Figure 6. Bench Lakes Prescribed Fire Complex for townsite protection. Prescribed burn units shown in orange.

2.5.4 LEVEL 1 MOUNTAIN PINE BEETLE TREATMENT (Single/Multiple Tree Removal)

- ***ACTION**: Parks Canada will remove single or multiple infected trees from accessible, leading edge zones[1] where prescribed burning would not be feasible.*

Level 1 treatment refers to single or multiple tree removal from small patches with follow-up debarking, burning or grinding to destroy the beetle broods (ABSRD 2007a). Level 1 treatment will focus on pine stands in the Moose Horn Valley, the Fiddle Valley, and southern sections of the Snake Indian Valley and Athabasca Valley (within 15 km of the east boundary) (Figure 7). Jasper National Park will continue to evaluate the feasibility of this work through impact assessment and also determine efficacy through ongoing monitoring and comparison with other jurisdictions.

Selection of trees to be treated will be based on the same criteria used on all lands in the Province of Alberta. Where possible, Parks Canada will use an approach similar to the Alberta Mountain Pine Beetle Decision Support System to prioritize treatment sites within Jasper National Park (ABSRD 2007b).

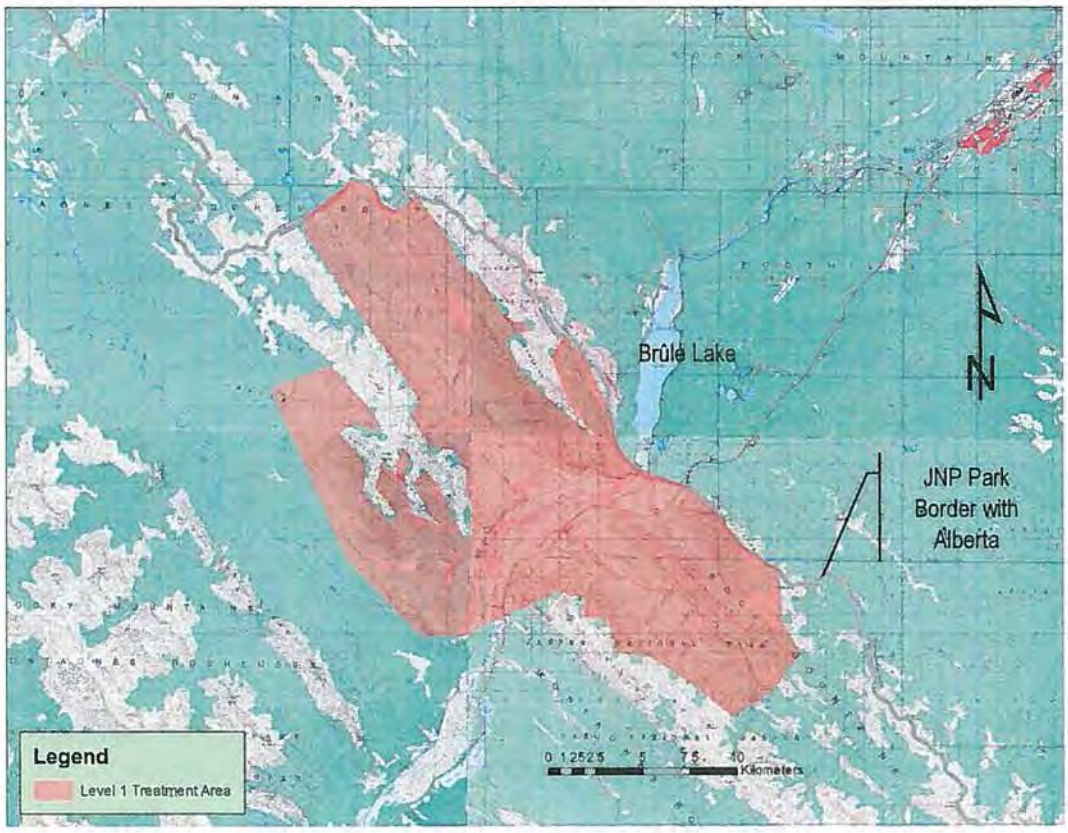

Figure 7. Level 1 (Single/Multiple Tree) treatment area in the Athabasca Valley

[1] The Leading-edge zone are areas where mountain pine beetle populations spread along the eastern slope and eastward into the boreal forest. In this zone, outbreaks, are widely scattered and small and receive Level 1 single tree treatment.

One of the challenges of working in the area and in a national park context will be access. Road access is not available although snow machines and 4x4 quads can be used to facilitate the approach to a number of sites. Helicopters and the construction of remote helipads will likely be required for more remote areas and higher elevation targets.

2.5.5 LEVEL 2 MOUNTAIN PINE BEETLE TREATMENT (Patch removal)

- ***ACTION**: In order to facilitate safer application of prescribed fire, to ensure townsite protection, Parks Canada will remove larger patches of trees and create wider fire guard lines.*

Level 2 treatment is the use of mechanical harvesting equipment to remove infested trees in patches considered too large for single/multiple tree treatment (ABSRD 2007b) and will be used where appropriate in Jasper National Park. Given the national park context, the use of harvesting equipment such as processers and forwarders to remove beetle attacked trees will be considered only for locations where access is feasible, will serve tangible benefits for townsite and visitor protection, and the approach taken will be ecologically-based (e.g., retain the inherent structural and vegetation diversity of forest landscapes and the complex set of ecological relationships that determine the abundance and distribution of plant and animal communities). For example, mechanical harvesting equipment will be considered for the creation of fire guards associated with the proposed prescribed fire operations. Establishing these guards with harvesting equipment will decrease the complexity of the prescribed fires, which in turn will lower the cost of the burn operation and expedite their completion. The prescribed fire operations where mechanical guard construction may be used include the Fiddle Prescribed Fire Complex and the Bench Lakes Prescribed Fire Complex (Figure 5 and 6). As well, mechanical harvesting may be used in areas where the prescribed burning window of opportunity does not open.

Mechanical harvesting equipment will be considered to widen the Minaga, Tekarra Marsh and Cabin lake/Stone Mountain strategic control lines which were established in 2011. (Figure 8). At present, these three strategic control lines are narrow (i.e. 3 – 5 metre wide) linear gaps in the forest. Trees and understory shrubs were mechanically removed or mulched to provide enhanced opportunities for firefighters to implement successful fire control and containment tactics. If these strategic control lines were widened to 30-50 m, they would provide better wildfire protection for the Municipality of Jasper and could be used to access other mountain pine beetle sites. Design of these strategic lines would consider visual impacts from the highway, wildlife movement and potential to be incorporated into future prescribed fire operations.

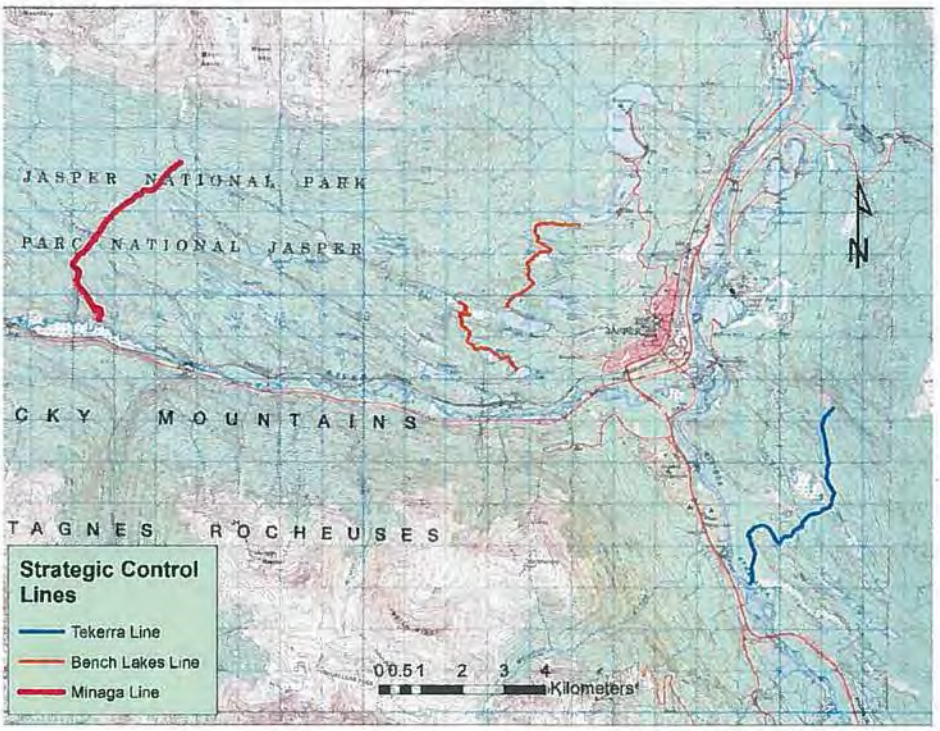

Figure 8. Minaga, Tekarra Marsh and Bench Lakes strategic control lines where mechanical treatment could be used to expand existing narrow control lines.

2.5.6 COMMUNICATION AND EXTENSION

- ***ACTION**: Parks Canada will continue to contribute to visitor, Jasper residents, and adjacent-community understanding and support of the Jasper National Park Mountain Pine Beetle Management Plan.*

Some of the following tactics will be used.

- Work with our neighboring industry and provincial partners to ensure a coordinated communication approach.
- Work with the tourism sector to communicate mountain pine beetle mitigation measures as well as develop innovative ways to engage visitors.
- Design local and urban outreach programs to engage visitors and the public through hands-on learning and experiences.
- When opportunity exists and new information becomes available develop newsletters, factsheets, social media campaigns and stakeholder updates on program activities to keep people aware and informed (PCA 2007b, McFarlane et al. 2015).

- When opportunity exists and new information becomes available provide in-person presentations and field tours to the guiding industry to keep them apprised of the latest situation and Parks Canada's actions, thereby becoming multipliers for key mountain pine beetle messages.
- Continue "The Beetles" street theatre, performed three times per week in the summer to educate Canadians and people from around the world on mountain pine beetle and healthy forests.

3.0 MOUNTAIN PINE BEETLE CONTROL IN JASPER TOWNSITE

3.1 CURRENT SITUATION – MUNICIPALITY OF JASPER

The Municipality of Jasper in Jasper National Park occurs in a forested landscape where mountain pine beetle also occurs and has been detected in greater numbers recently. Over the last four years mountain pine beetle attacked trees within the municipality have started to appear. Mountain pine beetle has the potential to adversely affect the Jasper townsite by creating tree hazards and reducing the Municipality's aesthetics for residents and visitors. As well, the townsite could serve as a reservoir for successful beetle reproduction contributing to further spread.

- ***ACTION**: Parks Canada will continue to work with the community of Jasper to ensure facility protection and resident awareness and safety.*

Jasper National Park could assist the community through two specific actions. First, Jasper National Park could provide mountain pine beetle awareness session(s) for Municipality of Jasper field staff to identify and remove mountain pine beetle attacked trees. Second, Jasper National Park could work with the municipality to implement a verbenone program for municipal lands and private properties. Beetles emit an anti-aggregating pheromone to inform incoming beetles that a specific tree is full of beetles. This pheromone is a signal to prevent over populating the tree, which in turn reduces brood success. This pheromone has been synthesized and is available commercially and is called verbenone. Making verbenone available for susceptible pine trees within the townsite limits and installing verbenone pouches on these trees may decrease urban tree mortality.

3.2 FIRESMART

- ***ACTION**: Parks Canada will continue to implement the FireSmart program in and around the community of Jasper.*

FireSmart is a national, community-protection program designed to reduce the threat of wildfire. This program has a direct benefit to mountain pine beetle control as reduction of stand densities reduces mountain pine beetle susceptibility. FireSmarting a community is achieved by reducing stand densities surrounding the townsite and protecting values at risk, reducing structure flammability and fire spread potential. Once these objectives have been met, a regular maintenance program must be undertaken to guard against the deterioration of the initial FireSmart efforts.

To date, more than 1,000 hectares of forest surrounding the Municipality of Jasper have had a fuel modification treatment. Reducing stand density creates conditions unfavorable to mountain pine beetle attack and also creates more vigorous, resistant trees (Whitehead et al. 2001). Parks Canada has been maintaining 8 to 10 hectares of the fire guard, upwind of the townsite on the Pyramid bench, on a regular basis since 2004. These operations will continue into the future.

4.0 REFERENCES

Achuff, P., Westhaver, A., and Mitchell, M. 2001. Fire/Vegetation Groups, Fire cycles and Fire Behaviour Prediction (FBP) Fuel Types and Annual Burn Areas in Jasper National Park. Internal Parks Canada Document. Jasper National Park, Environment Canada. 15 pp.

Alberta Sustainable Resource Development. 2007a. Mountain Pine Beetle Action Plan. ISBN No. 978-0-7785-6541-3, Pub No. T/152.

Alberta Sustainable Resource Development. 2007b. Mountain Pine Beetle Management Strategy. ISBN No. 978-0-7785-6545-1, Pub No. T/154.

British Columbia Ministry of Forests, Lands and Natural Resource Operations, Resources Practices Branch. 2014. Pest Management Report Number 15.

Canadian Forest Service. 2014. The 2014 Forest Health Conditions in the Rocky Mountain National Parks. Canadian Forest Service, Northern Forestry Centre, Edmonton, Alberta.

Carroll, AL, Régnière, J., Logan, JA., Taylor, SW., Bentz, BJ. and Powell, JA. 2006. Impacts of climate change on range expansion by the mountain pine beetle. Victoria, BC. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre.

Dalman, D. 2003. Mountain pine beetle management in Canada's mountain National Parks, in Mountain Pine Beetle Symposium: Challenges and Solutions. October 30-31, 2003, Kelowna, British Columbia. TL Shore, JE Brooks, and JE Stone (editors). Natural Resources Canada. Canadian Forest Service, Pacific Forestry Centre, Information Report BC-X-399, Victoria, BC 298. p.

McFarlane, BL., Watson, DOT. And JR Parkins. 2015. Views of the public and land managers on mountain pine beetle activity and management in Western Alberta. Nat. Resour. Can., Can. For. Serv., North. For. Centre, Edmonton, AB. Information Report NOR-X-423.

Parks Canada. 1994. Parks Canada Guiding Principles and Operational Policies. Department of Canadian Heritage.

Parks Canada Agency. 2005. Mountain pine beetle management strategy for Jasper National Park. Parks Canada Agency.

Parks Canada Agency. 2007a. Fire management plan Jasper National Park. Parks Canada Agency

Parks Canada Agency 2007b. Mountain pine beetles in National Parks: Visitor Experience, Attitudes & Knowledge. Final Report. Report prepared by Ipsos Reid, Vancouver, BC.

Parks Canada Agency. 2010. Jasper National Park of Canada. Management Plan. Parks Canada Agency.

Polster, A. 1987. Mountain Pine Beetle Strategy for Jasper National Park. Report prepared for D. Carnell. Parks Canada, Western Region, Resource Management Planning.

Safranyik, L. and Carroll, AL, 2006. The biology and epidemiology of the mountain pine beetle in lodgepole pine forests. In L. Safranyik and WR. Wilson (Eds), The mountain pine beetle: A synthesis of biology, management, and impacts on lodgepole pine (pp. 3-66). Victoria, BC. Canadian Forest Service, Pacific Forestry Centre.

Schindler, DW., Huvane, J. and Zutter, C. 2000. A paleolimnological investigation of the late Holocene forest fire history of the Athabasca Valley, Jasper National Park, Alberta. Unpublished report to Parks Canada. Hull, QC.

Tande, GF. 1979. Fire history and vegetation patterns of coniferous forests in Jasper National Park. Can Journal of Botany. 57:1912-1931.

Tabacaru, C. A., Park, J., and Erbilgin, N. 2015, Prescribed fire does not promote outbreaks of a primary bark beetle at low-density populations. Journal of Applied Ecology. doi: 10.1111/1365-2664.12546

Whitehead, R., Martin, P. and A. Powelson. 2001. Reducing Stand and Landscape Susceptibility to Mountain Pine Beetle. BC Ministry of Forests, Victoria BC. https://www.for.gov.bc.ca/hfp/publications/00170/MPB_SDM.pdf