

Indicator 5.6.2

Occurrence and Severity of Insect and Disease Pathogens

[1] Foothills Model Forest value

Healthy landscapes.

[2] Objective

To minimize the impact of forest insects and diseases of concern.

[3] Statement of indicator

Occurrence and severity of insect and disease pathogens.

[4] Indicator measure

Measures for this indicator are (a) the number of infested trees that were surveyed and controlled for mountain pine beetle in the Foothills Model Forest area from 2001-2006; and (b) the severity of aspen defoliation in the Foothills Model Forest area during the same period.

Definitions:

- Infested trees: Trees that have live mountain pine beetle present, also known as hit trees.
- Controlled trees: Trees where the live mountain pine beetle within the tree is destroyed.
- Severity of aspen defoliation: The level of loss of green leaves for aspen trees.

[5] Rationale for indicator

a. Significance of indicator to landscape-level management

Forest insects and disease are present in all forest ecosystems and are a natural process within the Foothills Model Forest (FtMF) landbase. A disease is a condition harmful to a tree, caused by fungi, bacteria, viruses, or parasitic flowering plants. A healthy forest includes endemic (static) levels of forest insects and disease as key components of a resilient forest ecosystem. Insects and disease remove weak trees, allowing the remaining healthy components of the forest to flourish with increased availability of light, nutrients, and water.

When forest insects or disease increase to the point of affecting healthy trees, this balance is compromised and the forest as a whole is no longer healthy. Mountain pine

beetle (*Dendroctonus ponderosae*) and aspen defoliators can quickly increase from endemic levels. This creates an unbalanced forest ecosystem that compromises the social, economical and environmental values provided by a healthy, sustainable forest landscape.

b. Meaning of indicator

Within the FtMF, the proportion of lodgepole pine in the forest is significant. Mountain pine beetle numbers can increase greatly from one year to the next, and significant stands of mature lodgepole pine are conducive to this expansion. The level of mountain pine beetle activity on the landscape is a direct indicator of the health of these pine-dominated forests. A higher level of mountain pine beetle activity leads to exponential growth in beetle numbers and a corresponding increased rate of tree death. (For an overview of mountain pine beetle ecology, please refer to the section entitled “General discussion,” below.)

While aspen is not a significant component of the forest within the FtMF landbase, it is by far the most predominant deciduous species. Deciduous stands generally have high biodiversity and are an important contributor to the values provided by a balanced forest ecosystem. Defoliators such as forest tent caterpillar (*Malacosoma* spp.), large aspen tortrix (*Choristoneura conflictana*) and Bruce spanworm (*Operophtera bruceata*) are present on the landscape and are capable of rapid and widespread population growth. Monitoring the level of severity and the hectares affected by defoliators provides a reliable picture of the health of the deciduous component of the forest. Defoliators are the most widespread agents of change in the deciduous forest.

While other forest insects and diseases are also present in the FtMF landbase, levels are generally consistently low and therefore difficult to monitor.

c. Relation of indicator to Foothills Model Forest and to sustainability

The mountain pine beetle is the most destructive insect pest of mature pine in

western North America to date. It can be devastating to forests, and in turn, to communities that depend on forests for their economic, social, and environmental values. Due to pine’s dominance on the landscape, the long-term sustainability of the local forest industry relies heavily on a healthy pine component of the forest. Therefore, mountain pine beetle population levels are a key indicator of forest health.

While not highly economically important, healthy aspen trees do contribute to the local economy and also provide social and environmental values. Unlike mountain pine beetle, the defoliation of aspen will not cause the outright death of the tree, but a sustained attack over several years can cause mortality and an immediate decrease in growth. This growth loss can have impacts on the long-term sustainability of the aspen forest.

[6] Current Status of indicator

Table 1 presents the number of hit trees – trees with live mountain pine beetle present – that were surveyed and controlled in provincial lands within the Foothills Model Forest landbase from 2001 to 2006. Surveyed refers to what is identified on ground; controlled means that the live mountain pine beetle within the tree is destroyed.



Table 1 – Mountain pine beetle survey and control, 2001-2006, as monitored by Alberta Sustainable Resource Development

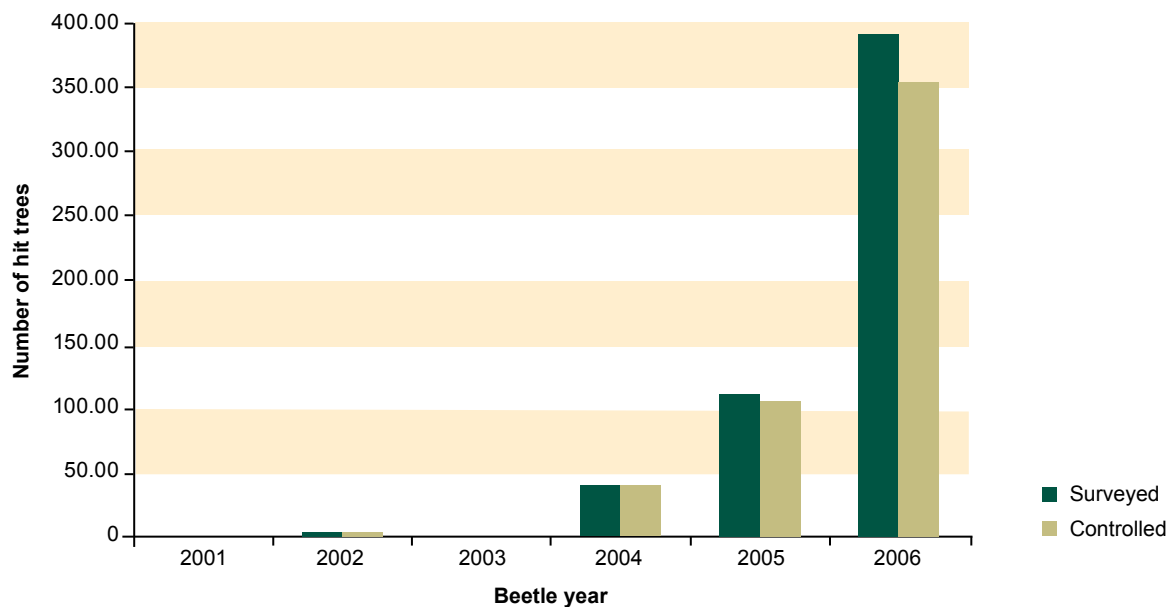


Table 2 describes the area (hectares) of aspen defoliation severity level (light, moderate, severe) by year for provincial land within the Foothills Model Forest landbase.

Table 2 – Severity of aspen defoliation, 2001-2006, as monitored by Alberta Sustainable Resource Development

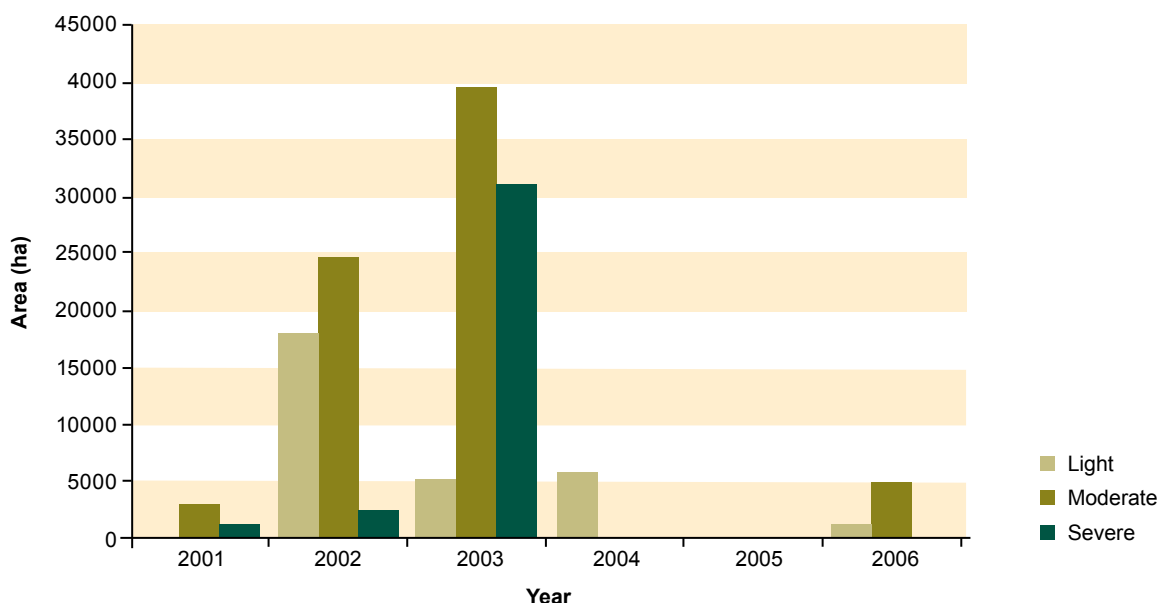


Table 3 describes aerial and ground surveys completed in the Smokey and Miette/Athabasca valleys in Jasper National Park from 1999 to 2007. All trees discovered and surveyed as “green” for mountain pine beetle were controlled – in other words, the beetles in those trees were killed.

“Green” indicates a current live attack brood of mountain pine beetle, and “red” means there is a non-current attack on the tree; i.e., a live brood is not present. Red trees have usually been killed by mountain pine beetles. Please note that in the Miette and Athabasca Valleys, mountain pine beetle surveys began in 2003 and were not conducted before its discovery.

Table 3 – Jasper National Park of Canada: Aerial and ground mountain pine beetle surveys

Year	Smokey Valley		Miette / Athabasca Valleys	
	Green	Red	Green	Red
1999	26	19	Not surveyed	Not surveyed
2000	23	15	Not surveyed	Not surveyed
2001	14	12	Not surveyed	Not surveyed
2002	9	17	Not surveyed	Not surveyed
2003	Unknown	32	126	108
2004	Unknown	19	282	139
2005	Unknown	24	265	54
2006	Unknown	10	192	8
2007	Unknown	200	58	77

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Figures 1 through 7 provide a picture of the effects of the mountain pine beetle and aspen defoliation in the Foothills Model Forest area from 2001 through 2007. The rapid expansion of the pine beetle infestation is particularly striking.

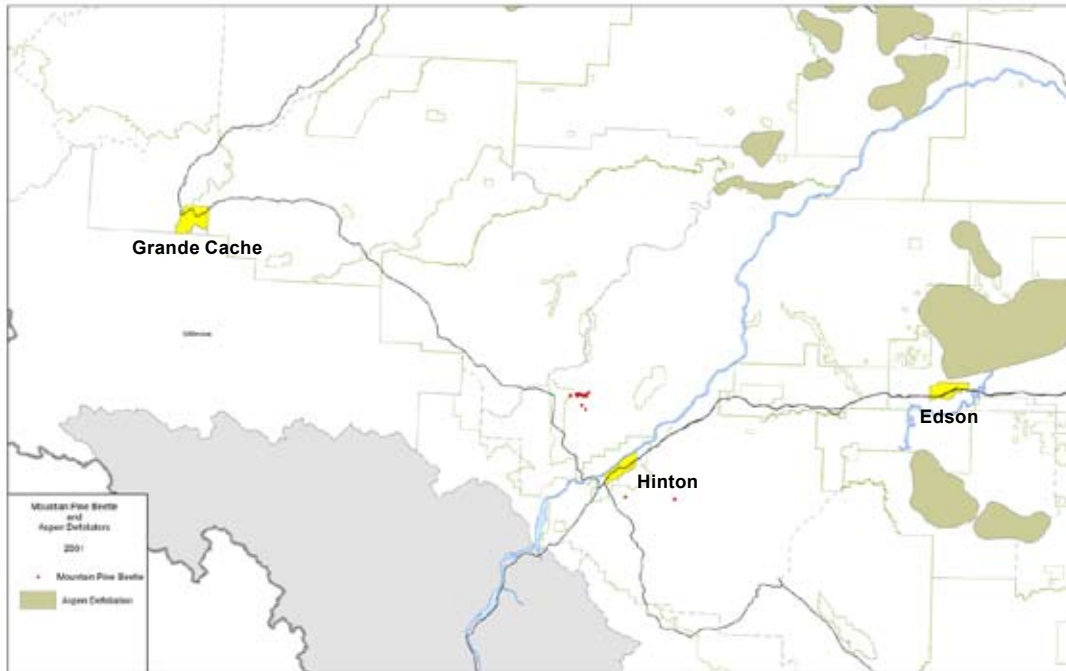


Figure 1 - Mountain pine beetle and aspen defoliation in the Foothills Model Forest area in 2001

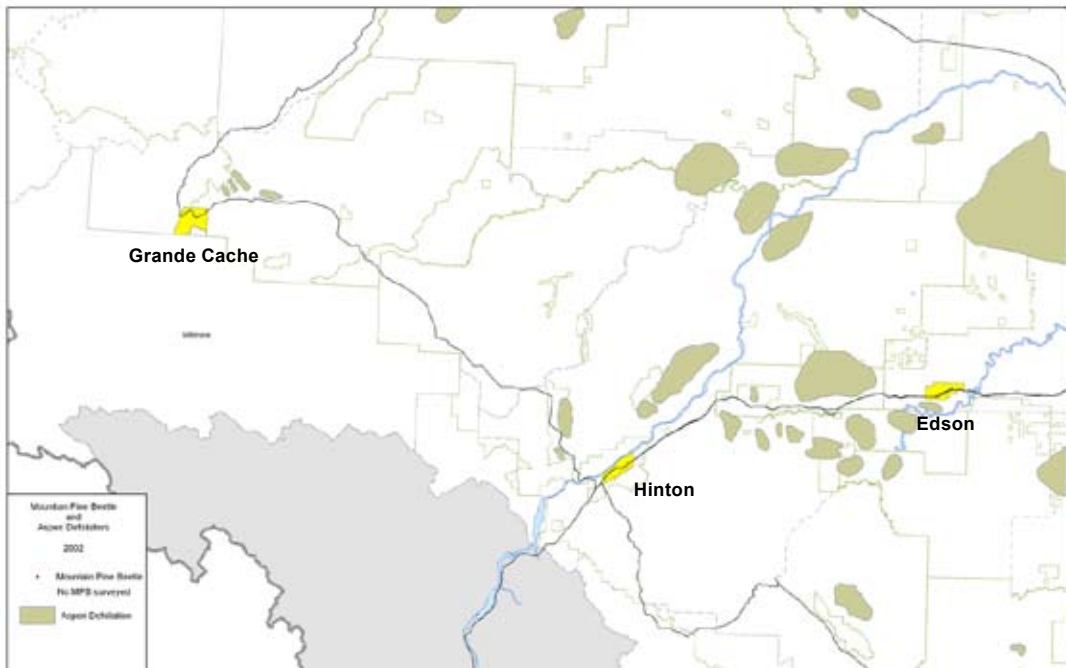


Figure 2 - Mountain pine beetle and aspen defoliation in the Foothills Model Forest area in 2002

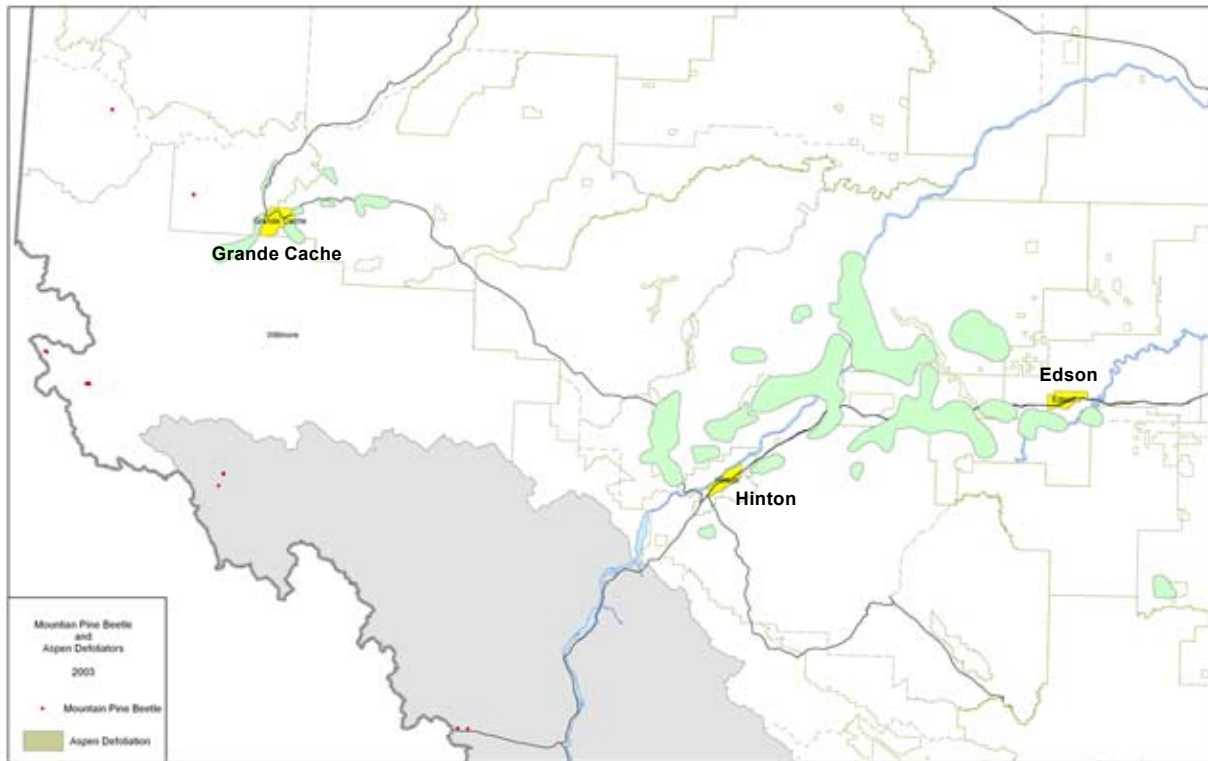


Figure 3 - Mountain pine beetle and aspen defoliation in the Foothills Model Forest area in 2003

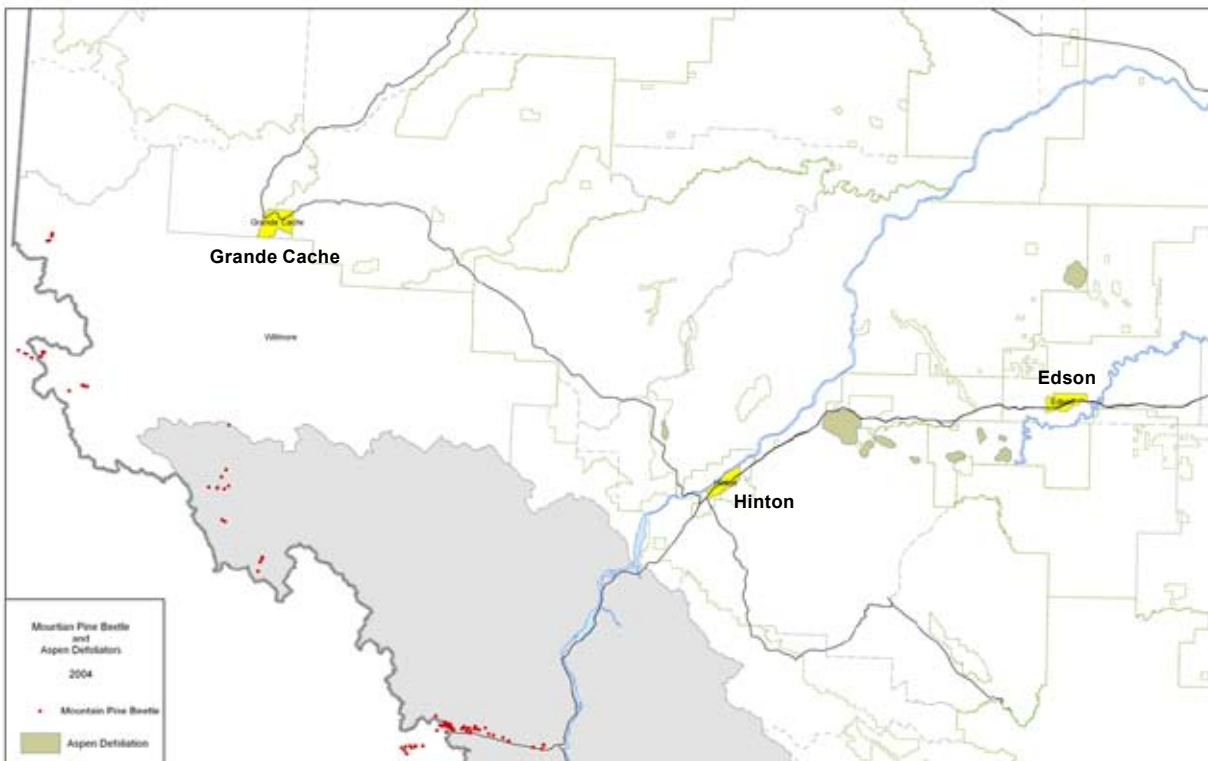


Figure 4 - Mountain pine beetle and aspen defoliation in the Foothills Model Forest area in 2004

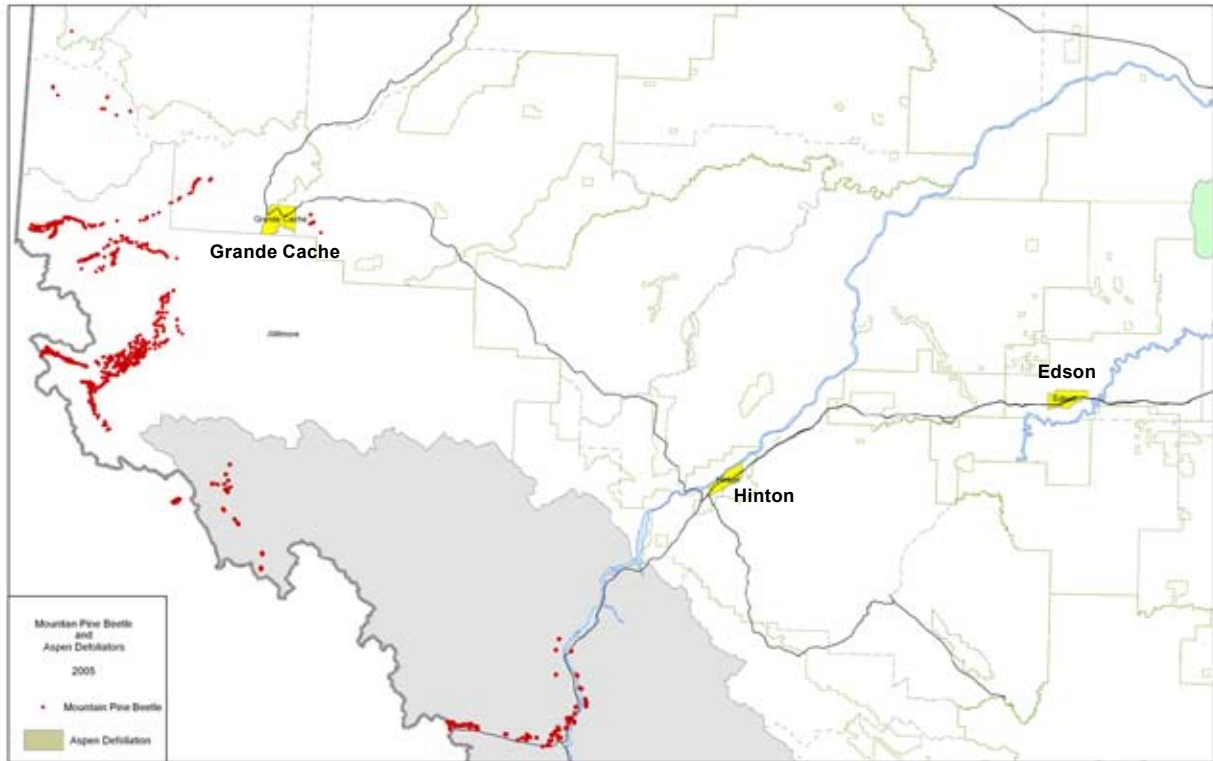


Figure 5 - Mountain pine beetle and aspen defoliation in the Foothills Model Forest area in 2005

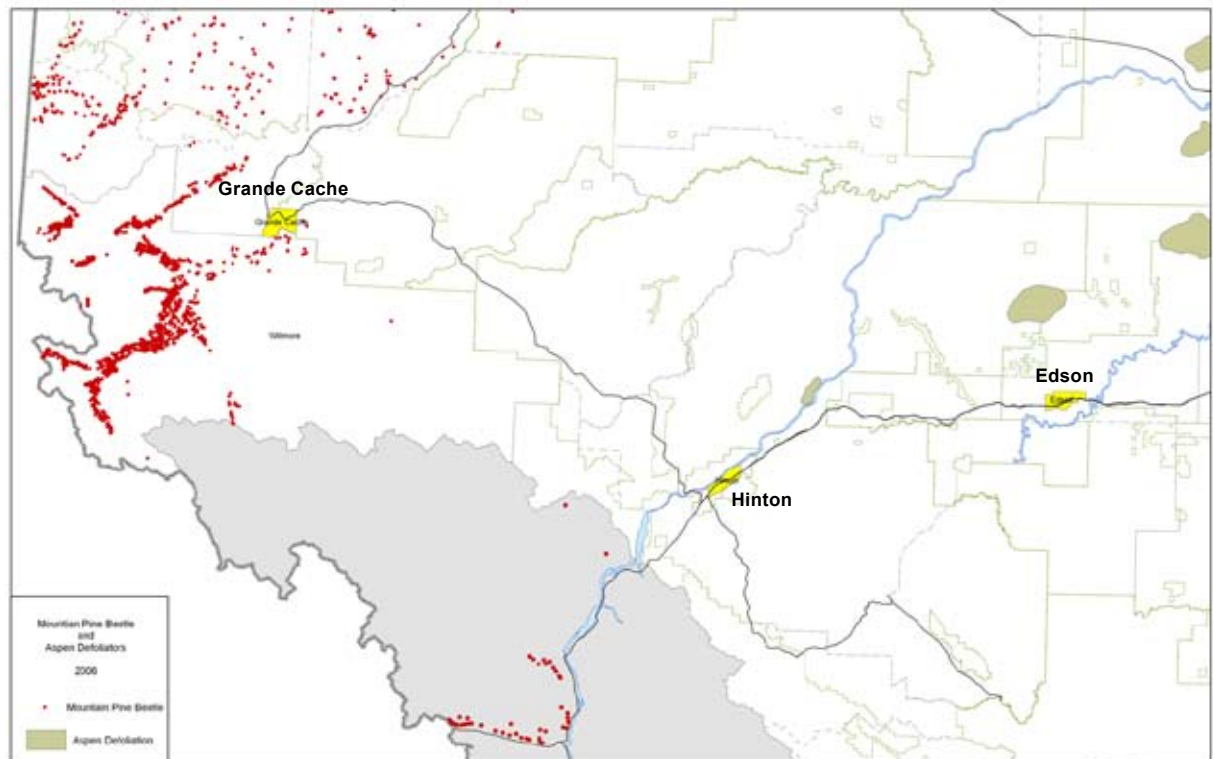


Figure 6 - Mountain pine beetle and aspen defoliation in the Foothills Model Forest area in 2006

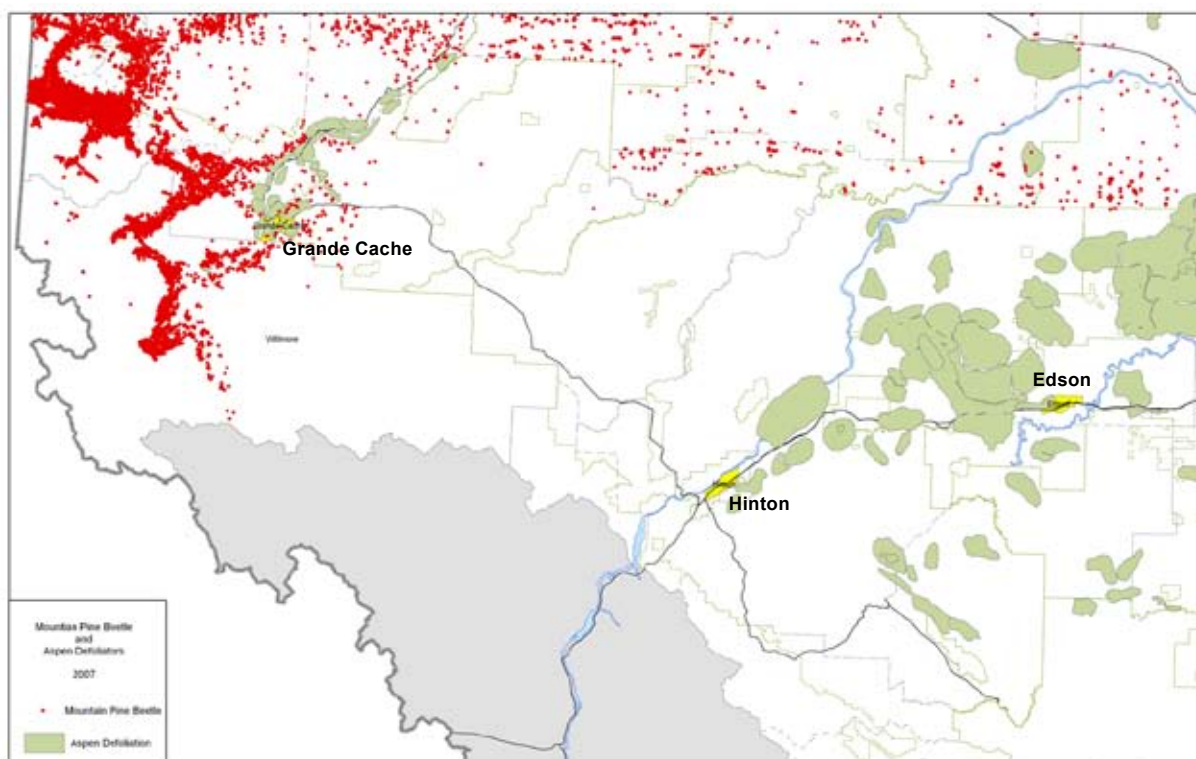


Figure 7: Mountain pine beetle and aspen defoliation in the Foothills Model Forest area in 2007

Please note that Figure 7 does not include Jasper National Park mountain pine beetle locations.

[7] Interpretation

Currently, forest ecosystem conditions and productivity are being conserved and ecosystem resiliency is not being compromised. The indicator (presence of mountain pine beetle and aspen defoliators) shows the forest over the reporting period to be healthy overall. Aspen defoliator populations have increased and decreased over time, which is common for the Foothills Model Forest landbase. The threat of mountain pine beetle to the healthy forest, however, is very real at present and in the near future. The beetle population on the British Columbia side of the mountains adjacent to the FtMF landbase is at a peak level, and the numbers on the Alberta side have increased dramatically due to a large dispersal flight in the summer of 2006. While the population in the Foothills Model Forest landbase is largely limited to Willmore Wilderness Park and to a lesser extent Jasper National Park, the E10 and E8 Forest Management Units are now beginning to be affected.

[8] Rationale for allowable variance (threshold)

For the mountain pine beetle, Alberta Sustainable Resource Development has a goal that all detected beetles on provincial Crown lands within science-based priority areas for control of spread must be controlled.

All areas of aspen defoliation that can be observed from a fixed wing aircraft are mapped and assigned an attack severity. In contrast, at this time defoliators are only monitored and not actively managed.

[9] Analytical considerations

a. Calculation of indicator

The indicator was calculated from numbers derived from historical mountain pine beetle data from Alberta Sustainable Resource Development and Jasper National Park. For pine beetle calculations, the number of infested trees surveyed and the number of infested trees controlled were totalled by year. Aspen defoliation was determined by calculating the area of aspen defoliation

severity by year for provincial lands within the FtMF landbase. Aspen defoliation severity was calculated by mapping the areas of attack according to severity and using a geographic information system (GIS) to calculate.

b. Special considerations

Starting in 2007, the number of trees infested by the mountain pine beetle that are controlled will no longer be a reliable indicator on provincial lands. The population has increased to the point these trees will not be controlled. However, the number of trees surveyed will still be obtainable through estimation of non-priority areas, and through actual ground survey information in priority areas.

From 2000 to 2003, mountain pine beetle activity was reported on a calendar year basis. This reporting led to confusion because events of the mountain pine beetle program overlap two calendar years. In 2004 the Forest Health Section of Alberta Sustainable Resource Development decided to base its reporting on a “beetle year” basis, starting on August 15 of one year and ending August 14 of the following year (for example, Aug. 15, 2005 – Aug. 14, 2006 is known as the 2005 beetle year).

For Jasper National Park, however, beetle activity will continue to be reported using the fiscal calendar. (April 1 to March 31).

[10] Responsibility

Alberta Sustainable Resource Development and Jasper National Park were responsible for providing the data for the calculation of this indicator.

[11] Monitoring

On provincial lands, the mountain pine beetle year begins with the results of the pheromone bait monitoring program in the summer and aerial overview surveys in the fall of one year, and ends with the resulting management program in the following year.

The pheromone baits contain three chemicals: one which replicates lodgepole pine aroma, another which replicates the male attractant (pheromone) released by the female, and one which replicates the attractant (pheromone) released by the first beetles into a new tree to summon other beetles to a mass attack to overpower the tree’s defences.

These baits are used to gather beetles to known locations. Over the course of the beetle year, dispersal (beetles from elsewhere) and containment baits (to keep beetles in known locations) are monitored and taken down, aerial surveys are conducted, ground surveys are completed by concentric and transect methods, and detection walkthrough surveys are done in select areas.

Control measures are taken by two methods: fall and burn (destroys all live beetles) and fall and peel



Mountain pine beetle burrowing through the inner bark of a lodgepole pine tree

(exposure of beetle larvae causing death). As well, rotary-wing-assisted control methods are used in areas where attacked trees are in high density. Dispersal and containment pheromone baits are deployed in the summer before the next flight.

Aspen defoliators are monitored by aerial surveys, flown in late spring to early summer. Aspen defoliation is sketch-mapped and then ground surveys are done to determine which defoliator pest is causing the damage. In Jasper National Park, two aerial surveys in April along with a ground survey will continue to be undertaken. Control measures are taken in situ on attacked trees using the fall and burn method.

In Jasper National Park, aerial surveys using rotary-wing aircraft, are conducted in the late spring and late summer each year. These surveys, done in conjunction with forest insect and disease specialists from the Canadian Forest Service, have been carried out since 1996.

During aerial surveys, low-level flights are flown over areas recognized as potentially susceptible to mountain pine beetle infestation. These areas are earmarked based on the mountain pine beetle risk and susceptibility model, known infestation locations, and proximity to known infestation locations.

During the survey, surveyors look for any evidence of mountain pine beetle activity. This could include both red attacked pine and “faders” (beetle-attacked trees, often in the process of dying, which appear light green and/or yellow, in contrast to the darker green of healthy pine trees).

For treatment of colonized trees in Jasper National Park, a trained ground crew is provided with a map of the management unit in question that details the previous summer’s air survey locations of suspect beetle-attacked trees. As well, a list of maps of beetle attack trees locations, in Universal Transverse Mercator (UTM) format, is provided to the ground crew. Procedures for performing cut and burn operations are as follows:

- Locate suspected red attack trees using global positioning system (GPS) and map references
- Determine if identified trees were killed by mountain pine beetles
- Perform 100m concentric circle survey around red

attack tree to identify green attack trees in area

- Identify green attack trees and perform circle surveys from any green trees found
- Fall red and green attack trees and burn all trees containing mountain pine beetle
- Document attacked trees and record UTM locations

[12] General discussion

Since the previous report inclusive of data from 2000, aspen defoliation levels have not changed to any degree. Mountain pine beetle populations, however, have increased significantly. There has been a steady increase in trees surveyed and controlled from 2001 to 2005, and a spike occurred in 2006.

While the pine forests in the FtMF landbase are generally healthy, they have reached a stage of maturity that has left them in a state that is susceptible to mountain pine beetle attack. Due to this state, significant change in the state of the forest is very possible. A widespread mountain pine beetle outbreak would have a devastating impact on the sustainability of the Foothills Model Forest landbase, given the prominence of mature lodgepole pine in the forest.

As such, the threat of mountain pine beetle is taken very seriously by Jasper National Park and Alberta Sustainable Resource Development. Every effort is being made to control any detected outbreaks found in areas at risk of spread, through harvesting in the working forest to single tree control or prescribed burning within protected areas.

In July/August, mountain pine beetles typically fly from their “birth” tree to a new host tree. The female lays eggs in a vertical gallery and then dies. The eggs hatch into larvae, which then burrow out horizontally, eating inner bark. The larvae overwinter while dormant under the bark, continue their development the following spring and early summer, and emerge as new adults and fly to a new host tree in July/August. Trees typically turn red within a year of being infested. The trees are killed by girdling caused by the larval feeding, as well as by the blue stain fungus which is brought to the host tree by the invading beetle.

Aspen defoliators also have one generation per year. The defoliation (leaf eating) is done by larvae (caterpillars) and is partial or complete depending on

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the species. Defoliation generally occurs in June and the trees will typically reflush with leaves in mid to late July, though not fully. Because leaves are absent during the growing season, the growth of the tree is reduced. Defoliation may occur for many consecutive years, which cause the trees to be stressed. The trees are then susceptible to other diseases which may cause mortality. The defoliation itself is very rarely the cause of mortality, even with consecutive years of leaf removal. The more severe the defoliation, however, the greater the growth loss, stress and susceptibility to other diseases.

Along with mountain pine beetle and aspen defoliators, Alberta Sustainable Resource Development actively monitors spruce budworm and gypsy moth through trapping and aerial detection. Pheromone traps are used to monitor population and dispersal trends of adult spruce budworm moths. Each year, 13 spruce budworm traps are placed throughout the FtMF area. These are collected each fall and the adult moths are counted. The results are used to predict the likelihood of new budworm outbreaks occurring in the following year.

Although spruce budworm is always present within the FtMF, there have been no large infestations over

the last five years. Yearly forest insect and disease surveys are completed in Jasper National Park. These surveys are conducted by both the Canadian Forest Service and Parks Canada personnel.

Gypsy moth is one of the most serious introduced pests of trees in eastern Canada. It has not become established in Alberta. It prefers to feed on the foliage of oak trees; however, it can attack and kill other deciduous tree species in Alberta. Alberta Sustainable Resource Development dispatches pheromone traps annually, in four established sites within this working area. There have been no gypsy moths found in this area from 2001-2006.

Many other forest pests affect the local forests, such as terminal weevils, other bark beetles, and root collar weevils. As well, there are major diseases, such as lodgepole pine dwarf mistletoe, various pine and spruce rusts, and cankers, stem rots, and root rots such as Armillaria root disease. Levels of these insects and diseases are generally low, and there have been no outbreaks detected or brought to our attention that have the potential to compromise ecosystem stability or resiliency.



With the right mix of conditions, such as hot summers and mild winters, mountain pine beetle can attack and destroy large tracts of lodgepole pine forests like these