OMINECA REGION

SPRUCE BEETLE BENEFICIAL MANAGEMENT PRACTICES

1 Introduction

The purpose of this document is to outline beneficial management practices (BMPs) to mitigate the impact of spruce beetle on the midterm timber supply and to maintain ecosystem functions.

Spruce is an integral part of forested ecosystems throughout Omineca Region's parks, protected areas and special management areas including, but not limited, to wildlife habitat areas, caribou habitat, old growth management areas and wildlife tree retention areas. Given the importance of spruce to the region's forests and to the Omineca mid-term timber supply, any threat is of substantial concern.

Spruce beetle BMPs are determined to be effective means of preventing or reducing spruce beetle population growth. Beneficial management practices outlined in this document are comprised of particulars from the *Bark Beetle Management Guidebook (1995)*, guidance from FLNR wildlife and ecosystem specialists, and are reflective of ongoing discussions with Spruce Beetle Working Groups in Prince George and Mackenzie.

Beneficial management practices are a key piece of the Ministry's ongoing strategy for mitigating impacts of the current spruce beetle outbreak.

2 Background & biology

- The spruce beetle (*Dendroctonus rufipennis*) is native to British Columbia and is regularly seen in forested areas, but higher-than-normal populations of spruce beetles have been detected in the Omineca region.
- FLNR has been actively identifying tree stands that demonstrate an expansion of spruce beetle populations.
- More than 156,000 hectares of forest in the Omineca region are currently infested by spruce beetles, primarily in the southern areas of the Mackenzie Timber Supply Area and the northern portion of the Prince George Natural Resource District, in the Prince George Timber Supply Area.
- The ministry will continue to work with forest licensees and other stakeholders to identify affected areas, evaluate population control methods and determine the most effective ways to limit the current outbreak.
- The B.C. government is closely monitoring the situation to minimize any impacts on ecosystem health, timber supply, the forest industry, and forestry jobs.

3 Detection

Aerial detection of trees affected by spruce beetles can be challenging. An infested host tree does not immediately display crown signs of stress or impending death until 13-15 months after being successfully attacked. Trees can go from healthy green crowns to fallen needles within a few months.

3.1 Spruce beetle susceptibility mapping

Susceptibility maps, generated by FLNR, display stand susceptibility to spruce beetle attack and not current beetle populations. These maps are to focus surveys and subsequent treatment in areas with higher likelihood of epidemic populations. They do not validate immediate harvest.

The hazard rating process can indicate where substantial losses can be expected to occur if spruce beetle populations rise to epidemic levels. This valuable planning tool identifies those stands that are highly susceptible to attack. Hazard rating considers stand age, basal area, stand density, and elevation.

High hazard stands have:

- an average spruce dbh greater than or equal to 41 cm
- a spruce volume exceeding 300 m^3/ha
- more than 65% spruce content in well-drained creek bottoms

In general, the hazard hierarchy for spruce stands are:

1. stands in creek bottoms
2. better stands of spruce on benches, slopes, and high ridges
3. poorer stands on benches, slopes, and high ridges
4. mixtures of spruce and lodgepole pine
5. stands containing all immature spruce

Detailed information on the new system for calculating beetle susceptibility can be found in Appendix C.

3.2 Aerial detection

Spruce beetle incidences are identified by FLNR as part of yearly provincial, high level, fixed wing aerial forest health surveys known as aerial overview surveys (AOS). These flights occur at a time that is optimal to examine a number of forest health indicators.

However, the typically late summer fall timing of these flights limits the ability to effectively mobilize ground surveys prior to snowfall. Therefore detailed FLNR heli-GPS aerial surveys, by helicopter, should be conducted during the prime detection window (after the needles change colour from previous year's infestation) to gather the most accurate and timely information.

FLNR combines knowledge from these flights with susceptibility mapping to generate maps. These maps are used to identify where ground surveys are required not to validate the presence of grey trees (where beetle have come and gone) but more importantly the full extent of currently infested trees.

3.3 Ground detection

3.3.1 Walkthroughs are non-systematic preliminary ground reconnaissance. They determine:

- the size and spatial distribution of the infestation
- access, operability, and integrated resource management issues
- the necessity to obtain further information through probes

3.3.2 Probes are systematic and detailed secondary ground reconnaissance surveys that provide precise estimates of extent and concentration of the spruce beetle attack in currently attacked trees, as well as sufficient information to stratify an area for various management actions. Ground data can also be used to determine if the population is on a one-year or two-year life cycle which will impact the timing of treatments.

Licensees or FLNR contractors perform walkthroughs and/or full scale probes in areas identified as priorities using methods outlined in the *Spruce Beetle Ground Survey Guidelines* established for the Omineca Region.

Data gathered from probes may be necessary to clarify management alternatives and provide sufficient information to stratify the area for various treatment actions. A treatment decision, as part of total chance planning for the area, is then developed based on the nature and intensity of the infestation and pertinent stand factors, such as spruce component, susceptibility and operability context.

3.3.3 Cruising is conducted to assess the merchantability and value prior to harvesting. Although spruce beetle presence can be determined from a cruise the latter cannot replace walkthroughs and/or full scale probes as they are 1) not detailed enough, 2) not designed to record beetle severity and multiple-year attacks, and 3) are seldom conducted by sufficiently experienced beetle classifiers. Therefore, probing should not be conducted in conjunction with cruising, nor should cruising precede a walkthrough or probe.

4 Beetle management units

A beetle management unit (BMU) is a planning and reporting unit for operational beetle management to facilitate the implementation of beetle management activities. BMU boundaries are customarily congruent with the boundaries of Landscape Units. Resource management objectives should be consistent throughout the unit.

Suppression: Objective is to reduce populations and maintain them at a relatively low level. Target is to treat >80% of known infestation centers in the first and subsequent years. All harvest and treatment is directed at spruce beetle infested trees (sanitation)

Holding: Objective is to maintain the infestation to a relatively static level by treating ~50-79% of known infestations in each year. That is, the level of harvest and/or treatment is equal to the rate of infestation expansion. Harvesting should be concentrated in infested trees with live spruce beetle.

Salvage: Objective is to salvage for value recovery as the highest priority. Holding the infestation static may fail due to influx of populations from heavily infested BMUs in proximity. Emphasis is more to retrieve values at risk and maximize Crown revenues by directing harvest towards dead stands prior to significant degrade.

Monitoring: Objective is to only record the change in attack level with no beetle management being attempted. Periodic field checks should be completed to determine if beetle attack has occurred, or if a known endemic population is growing.

5 Spruce beetle suppression options

Various control strategies are used in concert to suppress spruce beetle populations. These strategies focus on sanitation versus salvage. Choice of management strategies for spruce beetle depends upon:

- the size and pattern of the infestation
- severity of attack in each of the last three year
- vigour and survival of the new broods
- the stand hazard
- integrated resource management issues/constraints
- existing and future access
- harvesting operability
- resources available for detection and treatment

5.1 Trap trees

Trap trees can be ten times more effective than standing healthy unbaited spruce at attracting spruce beetle.

5.1a Conventional trap trees are deployed to:

- contain emerging beetles in cutblocks prior to sanitation logging
- protect adjacent healthy timber or reserves
- "mop-up" beetles emerging from adjacent lightly infested stands or stumps and slash following sanitation logging

Conventional trap trees should be routinely felled every year in areas identified primarily as spruce beetle harvesting in order to continually reduce the spruce beetle population. Trap trees can be deployed as patches, decks, strips and or pre-felled landings and rights-of way. Once the traps become infested, they must be removed or otherwise treated before the brood matures to attack new hosts. Refer to *Use of trap trees for spruce beetle management in BC 1979-1984*, *Pest Management Report #5* and Section 41 of *FRPA Forest Planning and Practices Regulation* for more information.

5.1b Lethal trap trees are not available at this time and unlikely to be available prior to 2017 or 2018. Two research trials are ongoing to identify and test suitable lethal trap tree agents.

5.2 Sanitation harvest

Sanitation harvesting for spruce beetle suppression maximizes the extraction of infested spruce stands with adult and young beetles in order to reduce the existing population and to prevent their spread. The highest priority should be given to stands with high levels of new attack, high hazard, and a high risk of spread. Smaller infestations can be addressed using a Blanket Salvage Permit. Recent guidance from Tim Sheldon, Deputy Minister, was provided to inform licensees and districts of the recommended application of this tenure tool.

Trees infested the previous year by beetles on a 2-year life cycle can be pre-felled the following summer to significantly reduce beetle emergence for hibernation (when the beetles travel to the root collar for winter) prior to winter logging.

5.3 Pheromones

Synthetic pheromones mimic the chemical signals beetles emanate when initially attacking a susceptible spruce tree. Pheromones can be effective at drawing in large number of beetles; this is beneficial to suppression efforts only when the attracted populations are subsequently exterminated as noted in Section 41 of *FRPA Forest Planning and Practices Regulation.* It should be noted that pheromone suppliers do not keep large quantities on hand because of shelf life. As such they require sufficient notification to manufacture the products.

The use of semiochemical tree baits in 50 m x 50 m grid patterns in spruce beetle infested stands is a temporary holding tactic until sanitation harvesting is completed. Grid baiting should be installed by no later than mid-May before the beetle flight (May) on cutting permits scheduled for harvesting in the following fall/winter. The recommended density of baiting is four baits per hectare.

Baiting costs are recognized as a "Forest Management Administration" cost to the Interior Appraisal Manual.

When to consider using pheromones:

- pheromone-baited Lindgren traps adjacent to log sort yards and mill sites to see if any new adults are escaping from infested logs in the yard
- smaller, distinct blocks having a light scattered attack with no heavily infested patches
- stands where sanitation harvest is clearly scheduled to occur at the soonest opportunity after the beetle flights and before emergence for hibernation

5.4 Fall and burn/ fall and peel

Handfalling, bucking, or debarking and burning of actively infested spruce trees are valid and effective control strategies for small inoperable or isolated infestations. Although this option is the only one currently available for treating infestations in inoperable areas, it is unlikely to be implemented frequently due to the expense, and worker safety concerns.

5.5 Salvage harvest

Salvage harvesting is primarily conducted to recover damaged timber before it loses wood product value ("shelf life"). These trees no longer have any living broods and therefore, this tactic does not reduce spruce beetle populations. It is, however, the first step in returning the site to increased forest production and recovering spruce trees killed by spruce beetle before the wood becomes unsuitable for primary manufacturing as timber. Salvage is <u>not</u> the foremost priority in Omineca at this time. The shelf life of dead spruce for sawlogs is less than lodgepole pine, estimated to be approximately 5 years.

6 Prevention

Preventing the increase of spruce beetle numbers before they become epidemic. Prompt salvage of spruce blowdown must be an ongoing practice in highly susceptible spruce ecosystems.

6.1 Scaling

Log scalers and weighpersons play a key role in identifying infestations in load deliveries and sample loads as well as identifying and determining beetle infested storage and inventory capacity.

6.2 Hauling and milling restrictions

Spruce originating from the Omineca should be treated as infested unless otherwise verified.

Restrictions on hauling and milling of spruce beetle infested logs are occasionally necessary. If hauling occurs at the beginning and end of the spruce beetle flight, night hauling may need to be utilized, and logs milled within before daytime temperatures reach 16^{o}C. Restrictions, if required, would apply during the beetle flight period from Mid-May to Mid-August.

6.3 Utilization

In spruce beetle sanitation-logged areas long butts, tops greater than 10 cm in diameter, decked logs, and stumps may contain spruce beetle. Maturing beetles will emerge to attack new hosts unless the infested material is burned, removed and milled, or otherwise treated.

- stumps should be cut as low as possible
- a 10 cm diameter top utilization should be used and all tops be scattered on the block or piled and burned on landings
- long butts (if permitted) should be piled and burned on suitable landings or elsewhere
- all recently killed host material such as larger broken tops, spilled logging loads, and recent edge blowdown should be removed before they are attacked

6.4 Reduce windthrow events

Windthrown spruce during endemic and epidemic spruce beetle populations should be managed to prevent beetle population growth.

Given spruce's susceptibility to windthrow (in large part due to its relatively shallow rooting and large sail-like crown), care must be taken to mitigate the risk of future windthrow from spruce beetle infested stem removal from an area. Use small patch (<1 hectare) removal wherever possible. For active infestations larger than 1 hectare, ensure prevailing wind direction, topographic features and edge feathering are considered and incorporated into block design and layout.

7 Spruce beetle management options in special management areas

Suppression options vary considerably between these constrained areas given their unique nature, designation, composition and function. Any cutting or harvesting in constrained areas should be considered as part of a total chance plan for the area. Spruce beetle suppression strategies utilized in a particular special management area must meet the objectives of the order in place for that specific unit.

7.1 Operational options in special management areas

Special management areas include: Old Growth Management Areas, Landscape Biodiversity Areas, Critical Fish Areas, Fisheries Sensitive Watersheds, Wildlife Habitat Areas, and Ungulate Winter Range.

Beetle management in areas spatially identified to manage for 'other forest values', or classified as a special management zone, is designed to balance the needs to suppress beetle populations that pose a significant risk with the need to maintain the special values. These BMPs address suppression treatments in "no-harvest" areas as well as areas that permit harvesting with restrictions, such as Fisheries Sensitive Watersheds. These BMPs do not supersede existing guidance as per Government Action Regulations (GARs) and associated General Wildlife Measures (GWMs) and Objectives, or FPPR Section 7 Notices for species at risk or ungulates.

In this section, "No-harvest" suppression methods refer to beetle control methods where no trees are removed from the stand. In comparison with sanitation harvesting, bark beetle suppression using trap trees has less ecological impact on old forest values and reduces collateral loss of green and dead trees.

7.2 Trap trees in special management areas

- Place trap tree sites outside of special management areas.
- Place trap tree sites along existing roads or skid trails.
- Avoid falling trap trees within riparian areas.
- Non-target volume removal of trees greater than 27.5 cm dbh for access and damage must be limited to 10% or less of the trap tree volume felled within a special management area.
- Use small, well distributed trap tree sites wherever possible. It is usually preferable to use more small well distributed sites than fewer large sites.
- Select, fall and remove trap trees carefully to minimize damage to residual trees.

8 Setting priorities

Timelines and resources compel the need to prioritise efforts in terms of probability and impact. Each incidence of spruce beetle attack needs to be assessed in terms of extent, intensity and vigour, and therefore the risk that it presents. Variables to be considered in determining risk include:

- current size of the population
- population trend – is it increasing, decreasing or stagnant?
- is attack of new hosts successful or not? (trees 'pitching out' the new adults?)
- spruce component in the stand and its susceptibility (as % of basal area)
- spruce component in adjacent stand(s) – potential for spread.

A recommended hazard/risk assessment procedure can be found in Appendix C.

The Sanitation and Salvage Harvesting Priority Rating, as determined using the tool developed by FLNR Regional Forest Entomologist, in concert with the spruce beetle probe card (FS 1111) or the compass and traverse sheet (FS 375) will be highly useful for this application.

For additional information on spruce beetle suppression, please contact your local FLNR office.

APPENDIX A: TIMELINES
This table provides a time horizon by which to plan beneficial management practices.

- Beetle flight begins when beetles have matured and canopy temperatures reach 16^{o} C or higher.
- Trap trees are most effective when felled as close as possible to the begining of the flight window.
- All harvested/felled wood with active beetle, including infested trap trees, are moved to a mill yard, processed and/or disposed of prior to the next flight to minimize the spread of the beetle.

Stage/Month	S	O	N	D	J	F	M	A	M	J	J	A
Detection flights												
Ground walk through and probing												
Trap tree removal or burning												
Log deck removal												
Possible beetle flight window												
Trap tree falling												
Hauling restrictions												

APPENDIX B: SPRUCE BEETLE HARVEST INDEX

Sanitation harvest index = (A + B + C) x D
A = % most recent attack in stand
B = % 1-year-old attack in stand/1.5
C = % 2-year-old attack in stand/2.0
D = total % of healthy and attacked spruce in stand

Sanitation harvest index	Recommendation
0-599	Leave (monitor, trap trees, baits, etc.)
600-999	Probe to obtain more precise information
1000+	Operational cruise prior to sanitation harvest

APPENDIX C: SPRUCE BEETLE HAZARD AND RISK RATING

Hazard rating of stand susceptibility considers factors of: site quality, stand age, proportion of susceptible basal area, and stand location, density, and growth rate.

To determine stand hazard, the following formula is applied:

$10 \times (Q \times A \times P \times L \times S_2) \times 0.5$

Where the formula factors are:

Q = Site quality (good = 1.14; medium = 0.60; poor = 0.27)

A = Age (> 120 = 1.21; 100-120 = 0.74, <100 = 0.07)

P = Proportion of susceptible basal area

= (basal area of spruce $\geq$ 17.5 cm)/(basal area of all species $\geq$ 12.5 cm) x 100

L = Location

= (24.4 x absolute longitude) - (121.9 x latitude) - (elevation (m)) + 4408.1)

S_2 = Stand density and growth rate (see the following link to calculate):

Hazard ratings can be used to set priorities for surveys and treatments and may be used during the preparation of site plans as a tool in preventative management. Stands with high hazard and risk values have a high priority for management.

https://www.for.gov.bc.ca/ftp/hfp/external/!publish/barkbeetles/New%20Susceptibility%20Ratings/Documentation/SB_Hazard_Rating_Documentation_version1.2.doc