# BULKLEY TIMBER SUPPLY AREA

# FOREST HEALTH PLAN

**Current to April 1st, 2001**

Prepared by

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Bulkley/Cassiar Forest District

# Table of Contents

# Table of Figures

# INTRODUCTION

The forests of the Bulkley Timber Supply Area (TSA) provide many products and uses to residents of the area. The objective of this plan is to maintain existing and future forests in a healthy and productive state. The plan does this by providing a compendium of management strategies that aim to lessen the impact of individual pests on the forest. The one exception to this is the series of strategies around Balsam Bark Beetle (BBB). At this point in time, controlling the BBB is limited to harvesting infected or previously infected timber. Tactics for controlling BBB will be incorporated into future versions of this plan.

The Bulkley Forest Health Plan is intended to provide direction to licensees—which in the context of this plan includes the Small Business Enterprise Program—in the preparation of operational plans under the *Forest Practices Code of British Columbia* Act.

*Table* 1-1 lists the most prevalent forest health factors of concern in the Bulkley TSA, and provides a framework for required forest health assessments. Licensees are encouraged to address—as a minimum—the Major Pests listed in *Table* 1-1. Such assessments will be over the licensee's entire allocated chart areas in the case of mature pests, and obligation areas for immature pests. The October 1996 letter by ADM Operations will guide funding for treatments of pest activities.

The strategies and objectives in this plan are consistent with the objectives of the *Bulkley Land and Resource Management Plan*, and individual *Landscape Unit Plans*. Strategies are grouped by individual pest and follow the principles of Integrated Pest Management, with each section containing the following:

- A brief description of the pest and its associated damage to the forest.
- Simplified Pest and Management activities in a calendar format.
- Methodology to establish Hazard and Risk ratings.
- A list of Pest Impact Treatment Threshold values at the landscape and/or stand level.
- Lists of preferred treatment options and prevention strategies to lessen future pest impact as well as an outline of responsibility.
- Monitoring and reporting procedures.

Through the co-operative effort of all parties, the Bulkley TSA Forest Health Plan will assist forest managers in maintaining the productivity of the area's forests.

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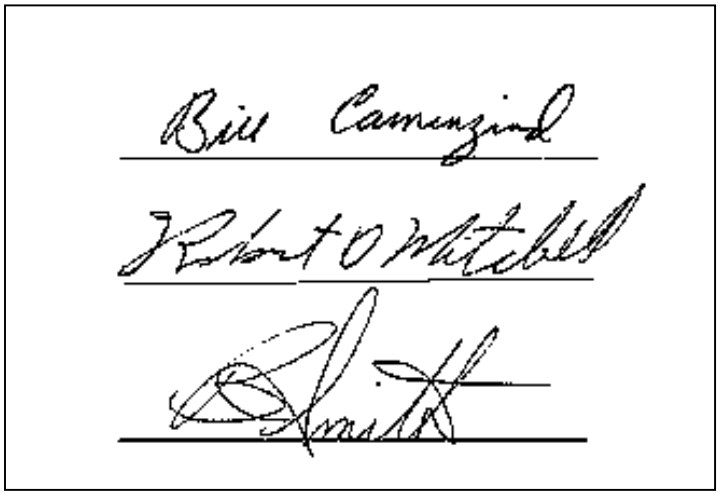

## *TABLE OF FOREST HEALTH FACTORS OF CONCERN IN THE BULKLEY T.S.A.*

*Table 0-1 Table of Forest Health Factors of concern in the Bulkley T.S.A.*

| Pest | **Pest Code**[1] | Severity[2] |
|---|---|---|
| Mountain Pine Beetle | **IBM** | Major, Lethal |
| Spruce Bark Beetle | **IBS** | Major, Lethal |
| BALSAM BARK BEETLE | **IBB** | Major, Lethal |
| *Stalactiform* Rust | **DSS** | Major, Lethal |
| *Comandra* Rust | **DSC** | Major, Lethal |
| Spruce Root Rot | **DRT** | Major, Lethal |
| Root Collar Weevil | **IWW** | Major, Lethal |
| Spruce Leader Weevil | **IWS** | Major, Non-Lethal |
| 2 Yr. Spruce Budworm | **IDB** | Major, Non-Lethal |
| *Rhizina* Root Rot | **DRR** | Minor, Lethal |
| Black Army Cutworm | **IDA** | Minor, Lethal |
| *Atropellis* Canker | **DSA** | Minor, Non-Lethal |
| Western Gall Rust | **DSG** | Minor, Non-Lethal |
| Pine Terminal Weevil | **IWP** | Minor, Non-Lethal |
| Pine Mistletoe | **DMP** | Minor, Non-Lethal |
| Hemlock Mistletoe | **DMH** | Minor, Non-Lethal |
| Mammal Damage | **A"n"**[1] | Minor, Non-Lethal |
| Foliage Diseases/Rusts | **DF** | Minor, Non-Lethal |
| Mechanical Damage | **T"n"**[1] | Depends on Extent |

[1] See Current list of Damage Agents and Condition Codes available from the District Office.

[2] See Detection and Reporting Section of the Forest Health Plan for an explanation of Severity Classes.

*RESPONSIBILITIES FOR BARK BEETLE MANAGEMENT*

File: 18818-00

October 30, 1996

To: Regional Manager, All Forest Regions

From: Janna Kumi
ADM, Operations Division

**Re: Responsibilities for bark beetle management**

Attached please find a document that is intended to provide guidance to District Managers in defining the area under a Forest Development Plan and associated activities in relation to the management of bark beetles by licensees. This document has been developed by Silviculture Practices Branch staff after considerable discussion and review with regional and district forest health specialists.

Please forward this guideline to all District Managers in your region for their information and use.

Thank you for your cooperation in this matter.

Original
signed by Janna Kumi

Janna Kumi
ADM, Operations Division

Enclosure: Guidelines for bark beetle management responsibilities under the *Forest Practices Code of British Columbia Act*.

# GUIDELINES FOR BARK BEETLE MANAGEMENT RESPONSIBILITIES UNDER THE *FOREST PRACTICES CODE OF BRITISH COLUMBIA ACT*

## INTRODUCTION:

Management actions are necessary to reduce or minimize damage caused by bark beetles. These actions include some or all of the following, depending on the management strategy selected for any particular area: aerial and ground surveys; hazard rating; control treatments such as use of pheromones, conventional and lethal trap trees, treatment with MSMA, falling and burning of infested trees, and single tree removal; and, removal of blowdown and general hazard reduction (including selection logging and "beetle-proofing").

The timing and applicability of each of these actions within a management area are discussed in the Bark Beetle Management Guidebook, however, responsibility as to who or which agency is responsible for carrying out the action is not specified.

In the past, various forest regions and districts have made agreements with licensees as to which actions each would be responsible for in particular areas. While most of these agreements have been similar, some inconsistencies have occurred. Further, the *Forest Practices Code of British Columbia Act* and related regulations now require inclusion of activities such as these within approved Forest Development Plans.

## PURPOSE:

The purpose of this document is to provide guidance to district managers in determining responsibilities of the Ministry of Forests, the forest industry, or others for various beetle management activities within identified management areas as specified by the District Manager under Section 13(2) of the Operational Planning Regulation of the *Forest Practices Code of British Columbia Act*.

Further, this document is intended to provide some guidance as to the area to be included in a development plan for the purposes of beetle management. District managers have full authority and responsibility to accept or modify this guide to meet overall management objectives.

## JUSTIFICATION AND AUTHORITY:

The determination of licensee responsibilities are identified under Section 12(g) & (i) and 28(1)d of the *Forest Act*, Section 17(3)c of the *Forest Practices Code of British Columbia Act*, and Sections 13(1) & (2), 15(6)e and 29(1) & (2) of the *Forest Practices Code of British Columbia Act*, Operational Planning Regulations.

## APPLICATION:

The District Manager has the authority to determine the area to be included within a Forest Development Plan. This area may vary depending on the activity being considered and the management objectives for the area. Licensee and ministry responsibilities for bark beetle management activities should be jointly agreed upon prior to submission of a Forest Development Plan. Acknowledgement of the responsibilities should be incorporated into the development plan and a beetle management plan should be included as an approved appendix to the development plan.

The above responsibilities are applicable volume based tenures (including woodlot licenses). Area-based tenure holders are responsible for all activities within the boundaries of their tenure.

## MINISTRY OF FORESTS RESPONSIBILITIES:

The Ministry of Forests should assume full responsibility for ensuring that aerial overview surveys and sketch mapping, at scales of 1: 100,000 or less, are conducted over all forested lands within the district on an annual basis. Results of these surveys should be made available to licensees, parks agencies, or other management agencies for information and to facilitate planning. These surveys will also provide the district manager with an overall risk assessment of bark beetles and other notable damaging agents within the district.

The Ministry of Forests may also assume responsibilities for activities noted under "Licensee Responsibilities" (below) in unallocated planning cells and/or in other areas not specifically under management by other agencies.

## LICENSEE RESPONSIBILITIES:

The following responsibilities are proposed for volume based tenures, including woodlot licenses but excluding pulp wood agreements, Christmas tree permits, and other specialty tenures. For the purposes of this document, the Small Business Forest Enterprise Program (SBFEP) is considered to be a licensee.

*Table 0-2 Licensee Responsibilities*

| AREA | ACTIVITY |
|---|---|
| a) within 1 km around all approved and existing roads and cutblocks within the 5 year development plan area. | • risk and hazard rating<br>• detailed flying<br>• colour photos<br>• ground surveys |
| b) within 400m around approved or existing cutblocks and on each side of approved or existing roads within the areas identified in the first 2 years of the 5 year development plan area. | • pheromone placement<br>• MSMA<br>• fall and burn<br>• conventional trap trees<br>• lethal trap trees<br>• single tree harvesting<br>• blowdown recovery/hazard reduction |

## CHAPTER 1 DETECTION AND REPORTING OF PEST OCCURRENCE:

Detection of forest health factors or pests should be an ongoing operation. Everyone in the field should be aware of the signs of pest damage and know how to report them. That could lead to the danger of over-reporting, but that's better than reporting nothing at all. It should be recognized that pest impacts are everywhere, generally at a low, endemic level. Remember that "One dead Tree does not Make a Catastrophe". It is only when the level of damage exceeds a certain threshold that we become concerned. Specific thresholds will differ depending on location, pest, etc. and are outlined in the individual pest sections.

### *CLASSIFICATION OF PESTS AND SEVERITY CLASS:*

Pests come in all shapes and sizes, and have various affects on their host trees. It would not be practical to record each and every pest occurrence. For the purposes of this Forest Health Plan, pests of concern are classified into a severity class specifying one each of the following two main categories: Lethal vs. Non-lethal, and Major vs. Minor. Although the magnitude of the pest impact and the size of the host tree (seedling vs. mature for example) can change the bearing the pest has on its host, the designations listed in *Table* 1-1 are generalities based on past pest history. The classifications are subject to change should more information become available.

The classifications of lethal and non-lethal pests are self-explanatory. A major pest is defined as one whose impact on the host tree causes, or has the potential to cause mortality or significant economic loss in value. Minor pests are generally non-lethal, are slow to spread, or are relatively rare in the Bulkley. *Table* 1-1 outlines the pests of concern in the Bulkley and their classification. A complete list of pests and their Pest ID Code is available from the District Office.

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*Table 1-1 Pests of Concern in the Bulkley T.S.A.*

## *PESTS OF CONCERN IN THE BULKLEY TSA:*

| Pest | *Latin Name* | Pest Code[3] | Severity Class | | Comments or Exceptions |
|---|---|---|---|---|---|
| | | | Major or Minor? | Lethal? | |
| Mountain Pine Beetle | *Dendroctonus ponderosae* | **IBM** | Major | Lethal | |
| Spruce Bark Beetle | *Dendroctonus rufipennis* | **IBS** | Major | Lethal | |
| Balsam Bark Beetle | *Dryocoetes confusus* | **IBB** | Major | Lethal | |
| *Stalactiform* Rust | *Cronartium coleospriodes* | **DSS** | Major | Lethal | |
| *Comandra* Rust | *Cronartium comandrae* | **DSC** | Major | Lethal | |
| Spruce Root Rot | *Inonotus tomentosus* | **DRT** | Major | Lethal | |
| Root Collar Weevil | *Hylobius warreni* | **IWW** | Major | Lethal | Minor and generally Non-Lethal on trees > 20 cm. At root collar |
| Spruce Leader Weevil | *Pissodes strobi* | **IWS** | Major | Non-Lethal | Also known as White Pine Weevil. Only new attack classed as Major; older attack as Minor. |
| 2 Yr. Spruce Budworm | *Choristoneura biennis* | **IDB** | Major | Non-Lethal | Potentially Lethal on immature |
| *Rhizina* Root Rot | *Rhizina undulata* | **DRR** | Minor | Lethal | Considered Major – Lethal on recently broadcast burn sites in ICH |
| Western Gall Rust | *Endocronatium harknessii* | **DSG** | Minor | Non-Lethal | Occasionally Lethal |
| Pine Terminal Weevil | *Pissodes terminalis* | **IWP** | Minor | Non-Lethal | |
| Pine Mistletoe | *Arceuthrobium americanum* | **DMP** | Minor | Non-Lethal | Potentially Lethal on immature |
| Hemlock Mistletoe | *Arceuthrobium tsugense* | **DMH** | Minor | Non-Lethal | Potentially Lethal on immature |
| Mammal Damage | *Various* | **A"n"**[1] | Minor | Non-Lethal | Potentially Lethal on seedlings |
| Foliage Diseases/Rusts | Various | **DF** | Minor | Non-Lethal | Potentially Lethal at high levels |
| *Atropellis* Canker | *Atropellis piniphila* | **DSA** | Minor | Non-Lethal | Potentially Lethal |
| Black Army Cutworm | *Actebia fennica* | **IDA** | Minor | Lethal | Periodically Major – Will be monitored |
| Mechanical Damage | *Various* | **T"n"**[1] | Depends on extent and host | Non-Lethal (Usually) | See TWDGB[4] or Advanced Regeneration Acceptability Criteria |

[3] See Current list of Damage Agents and Condition Codes from District Office

[4] Forest Practices Code of BC Tree Wounding and Decay Guidebook.

## *SURVEYING PEST OCCURRENCE:*

The observation and reporting of pest occurrence should be an ongoing part of any silviculture survey or treatment. Pests or evidence of their impact is most commonly encountered during regular silviculture surveys or other low intensity examinations. Standards for forest health reporting within silviculture surveys are listed below. Pest impacts above minimum thresholds may warrant a separate or further, specific forest health survey. Procedures for these surveys are contained in the *Forest Practices Code of BC* Forest Health Surveys Guidebook.

## *STANDARDS FOR FOREST HEALTH REPORTING WITHIN SILVICULTURE SURVEYS IN THE BULKLEY TSA:*

- In the Bulkley, the pests listed on *Table* 1-3 - *Pests of Concern in the Bulkley TSA* will be tallied as part of the forest health section of the silviculture survey cards. All other pests are to be mentioned in the comment section only, ***unless*** they are significant enough to cause a tree to become unacceptable. In such cases the pest is to be tallied as part of the forest health section of the survey.

- During silviculture surveys, only pests located ***inside*** the plot will be tallied. All pests outside of the plot are to be mentioned in the comment section only. This is due to the statistical nature of silviculture surveys. The only exception to this is Dwarf Mistletoe. Any overstorey host trees infested with Dwarf Mistletoe within 10 m. of the plot edge should be noted in the comments.
  See the *Free Growing Damage Standards* for an explanation.

- If the surveyor believes that the level of pests—***including potentially damaging pests outside of the plot or block***—warrants a more detailed forest health survey, this recommendation will be made as soon as possible to the contract co-ordinator or forest health forester.

- At times it may be more practical to carry out a forest health survey immediately, in conjunction with the silviculture survey. A quick method is as follows:

  While moving from plot to plot, the surveyor looks out for pest damage within a fixed distance of the direction of travel. A 2 to 3 m. width is most often used. All host and infected trees within the strip are tallied, and thus a percentage of infected trees can be easily determined. The intensity of the survey can be determined by calculating the area surveyed (width * distance) as a percentage of the stratum area. It is possible to include trees within the plots as well, but the area of the plots must be added to the area surveyed and these calculations must be separate from those found on the silviculture survey cards.

- Should potentially <u>well spaced</u> trees be affected by a pest (and thus not counted), this fact should be highlighted on the plot card or mentioned in comments.

- Individual trees with multiple pests present should have ***all*** pests of concern recorded in the plot card forest health section. Since the survey is a statistical estimate, we need to know all pests present in the stand. However, if a tree is deemed unacceptable for pest reasons, only the most serious pest will be the one tallied as the causal agent. Multiple pests on the same tree will be highlighted in the comment section.

## Standards for Forest Health reporting within Silviculture Surveys in the Bulkley TSA (Continued):

- Percentage incidence is listed on the silviculture summary card in three different ways: as a percentage of total trees, percentage of conifers, or percentage of host trees. Percentage of living host trees affected is the most important and will be the one stated in written comments or within ISIS. The percentage can be calculated using the pest information summary on the silviculture survey summary card. A more accurate method is to tally ***all*** affected trees as well as ***all*** host trees and determine the percentage of affected. Note however that total trees are not tallied by species on the silviculture survey card, only well spaced trees are. Therefore, to use the actual number count method, the surveyor will have to make a separate record of total trees by host.

- The silviculture survey plot card allows for the tallying of dead trees. If dead trees are tallied, then the total incidence calculations ***must*** include dead trees in the total tree count so as not to over estimate the pest incidence. If dead trees are included in the pest incidence estimate, this fact should be highlighted, either in comments or as a footnote. It is recommended that dead trees only be tallied if they are recently dead, and the cause of death is obvious. If the surveyor has to speculate as to the cause of a tree's death, it should not be recorded.

- The most recent *Free Growing Damage Standards for British Columbia* will be used for assessing unacceptable tree damage during free growing surveys (see appendices).

- Acceptability of advanced regeneration will be as per the criteria outlined in the *Establishment to Free Growing Guidebook* (see appendices). In the case of advanced subalpine or *amabalis* fir in the Bulkley TSA, the *PRFR Regional Operating Standard #1 – Acceptability Criteria for Balsam Advanced Regeneration* shall be used.

## *DESCRIBING PEST OCCURRENCE:*

Simply stating the presence of pest activity is not sufficient in itself. What is important is an identification of the pest, where it is (on the tree, stand and area), and how much there is. There are many different terms used to describe pest occurrence, such as:

- Incidence (Rate or presence of occurrence, or how much there is),
- Severity (How bad it is on the host),
- Extent (Magnitude on an area).
- Intensity (Strength or Concentration), and
- Prevalence (How common),

The Bulkley Forest Health Plan will concentrate on the following main terms:
Reference to these terms will be considered mandatory when reporting and describing pest occurrence.

### INCIDENCE –

An indication of the presence of a given pest.
Rather than a simple Yes or No, the description should include an objective measure of the number of pests, trees or area involved. Wherever possible, statistical confidence limits should be applied to any count of pest incidence.

## SEVERITY –

An objective estimate; or measure of the pest's impact on the tree or stand.
For most immature pests, the Pest Acceptability Guidelines (See Appendices) simplify severity into acceptable or not acceptable. On the stand level, subjective estimates (light, medium, etc) without definitions are not encouraged unless severity classes have been assigned (see specific pest lists).

## EXTENT –

A geographical measure or estimate of the area affected by the pest. A map is ideal, but an objective description (e.g. "*SW corner of Block*") is the minimum expected.

### *RECORDING PEST OCCURRENCE:*

- Pest observations on existing forest cover openings will be recorded in ISIS in the comment section. All major and minor pests (See *Table* 1-3) will be noted. Further, any major pests will also be flagged in ISIS as a *Forest Health Observation,* or *ForHobs*[5]. This action should be limited to pests that will affect the regenerated or juvenile stand. For example it is unnecessary to highlight in ISIS a bark beetle incidence on a stand which will soon be harvested. On the other hand, the presence of *tomentosus* root rot in the mature stand should be highlighted as it may affect regenerated spruce seedlings.

- If the incidence of pests is over the minimum thresholds listed in the individual pest sections, the pest incidence will be flagged as an "**Issue**" in the comment section of ISIS. The minimum threshold, if not specifically described, is defined as any pest incidence level on the treatment threshold matrix where treatment options other than "**A – No Action/Monitor**" are listed.

  Such situations should also be brought to the attention of the survey contract coordinator, and/or the district forest health forester.

- Observations on areas not presently within a forest cover opening shall be recorded in the Forest Health Log, which consists of maps and ledger and is located in the district office. Only major pests need to be recorded. Any pest incidence over the minimum threshold should be brought to the attention of the district forest health forester.

### *EXAMPLES OF DESCRIBING AND RECORDING PEST OCCURRENCE:*

The following are some examples of pest occurrence descriptions, with preferred reporting format, and comments on recording the information:

1) "There is a moderate incidence of *Stalactiform* Rust (DSS) in Block 12"
*Preferred*: 25 ± 3% of the Pine trees in stratum II of Block 12 have unacceptable DSS infections.

   - Since Block 12 would have an opening file, the information would be included in the comment section of *ISIS*, and would also be listed as *a Forest Health Observation*, and as an *Issue.* The District Forest Health Forester would be informed of this finding.

[5] Internal procedures for ForHobs in ISIS will be developed for District Staff.

**Examples of Describing and Recording Pest Occurrence** (Continued):

2) "BBB noticed in Wide River"
*Preferred*: BBB attack in the Wide River Drainage is estimated to be 5% Red, and 10% Grey attack. The attack is scattered evenly over the Drainage, but is more prevalent on the North side.

- Since there is no specific opening involved, this information would be recorded in the *Forest Health Ledger*, but would not be brought to the attention of the District Forest Health Forester unless part of a general or targeted overview.

3) "5% Pine Mistletoe in Block 15"
*Preferred*: 5 ± 2% of the pine trees sampled in block 15 had Mistletoe attack. Attack is limited to the SW corner of stratum 3.

- Since Block 15 has an opening file, the information would be recorded in the comment section, but would not be a *Forest Health Observation* or an *Issue*.

*TRAINING:*

Pest identification and reporting procedures will continue to be included in the work standards schedule of silviculture surveys and stand tending activities.

Silviculture surveyors and workers are expected to be familiar with the pests of concern outlined in *Table* 1-3.

The district forest health forester as well as the regional entomologist and pathologist will be available for assistance and will co-ordinate training sessions if necessary.

# MOUNTAIN PINE BEETLE – IBM

| | | | | |
|---|---|---|---|---|
| **Mountain Pine Beetle** | ***Dendroctonus ponderosae*** | **IBM[6]** | **Major** | **Lethal** |

The Mountain Pine Beetle (*Dendroctonus ponderosae* (Hopkins)), or 'MPB'[6] is the most destructive insect pest of mature Lodgepole Pine forests in the Bulkley TSA. Extensive outbreaks of this pest in the 1970's and 80's infested large areas in the Chapman and Coffin Lake areas and resulted in extensive pine mortality and subsequent salvage logging. The mountain pine beetle prefers to feed on older Lodgepole Pine, and preference is given to stressed trees. Mountain pine beetle does not attack downed trees or logging slash.

The Mountain Pine Beetle normally has a one-year life cycle, laying its eggs in mid summer, over-wintering as larvae, pupating in the spring and emerging as adults early in the following summer. In what is called a 2-year cycle–but should more properly be called a *2-summer* cycle– all life stages are delayed (usually because of cool weather) by 4 to 6 weeks. In these cases, the main beetle flight does not take place until that much later than normal. Occasionally, it is possible to have staggered two-year populations in the same area, and also possible to have one-year cycle beetles mixed in with two year.

The Mountain Pine Beetle is similar to other native Bark Beetles (Spruce Bark Beetle, or Western Balsam Bark Beetle) in that larvae feeding in the phloem of the tree introduce a fungus which together with the larval mining causes the tree's translocation to cease, and mortality follows. The foliage of an infested tree will turn red the summer following attack. That foliage normally turns grey and falls off by the next spring.

Management of mountain pine beetle infested timber is presently accomplished by harvesting of infested stands or single trees, and through Fall and Burn. Semiochemical pheromones (chemical attractants) are commonly used to lure beetles into areas prior to harvest or Fall and Burn. These processes are explained further in subsequent sections.

The following *Table* 2-1 summarizes management techniques aimed at the mountain pine beetle. Individual strategies are discussed in the section immediately following the *Table* 2-1.

[6] The Silviculture Code "IBM" can be used to describe the Mountain Pine Beetle, but this document will use the conventional "**MPB**" throughout.

*Table 2-1 Mountain Pine Beetle Management Strategies:*

| No. | IPM Element | Methodology | Rationale | Actions | Responsibility?[7] |
|---|---|---|---|---|---|
| **1** | **Identification** | *Establish Hazard Assessments for Mountain Pine Beetle* | Allows the anticipation of likely pest problem areas and allow us to focus activities on priority areas. | Hazard Rating based on Biological attributes. See *Table* 2-2. | Area Licensees are responsible for their allocated areas. District to co-ordinate and maintain records. |
| **2** | **Identification/ Monitoring** | *Establish Risk Rating based on recent pest activity* | Annual aerial Overviews and operational ground surveys will detect recent MPB activity | See *Table* 2-3 on identifying and marking MPB trees. | District will co-ordinate annual aerial overviews. Licensees are expected to participate. |
| **3** | **Threshold** | *Establish Treatment Thresholds* | Will focus on priority areas and conserve funding. | Thresholds based on LRMP Zonation and local conditions. See *Table* 2-4. | MoF and Licensee (with MoE input) will set the threshold for given areas, and revise them as need be |
| **4** | **Treatment** | *Harvest MPB Infested Timber (Sanitation Harvest)* | Destruction of MPB while harvesting trees. | Prioritise MPB infested areas for harvest, ideally with MPB still inside trees. | Licensee |
| **5** | **Treatment** | *Reduce MPB population through Fall and Burn* | Destroy localised beetle populations. | Fall and Burn is a traditional method of dealing with small isolated beetle patches. | See Introduction of Forest Health Plan. |

[7] Licensee includes **SBFEP** for Responsibility purposes.

Table 2-1 Table of Mountain Pine Beetle Management Strategies(Continued):

| No. | IPM Element | Methodology | Rationale | Actions | Responsibility? |
|---|---|---|---|---|---|
| **6** | **Treatment** | *Reduce local MPB population through lethal Trap Trees* | Lethal Trap trees can destroy localised beetle populations. | See Text for a discussion of Lethal Trap trees | Licensee in allocated area, MoE in Parks. |
| **8a** | **Treatment** | *Minimize MPB spread through pheromone baiting* | Pheromone Baits can stall beetle movement. | Prior to Sanitation Harvesting, Bait areas to hold beetles in place. See GB for Baiting procedures | Licensee |
| **8b** | **Treatment** | *Minimize MPB spread through Mop Up pheromone baiting* | Utilise pheromone baits after logging to contain any stray insects. | Apply pheromones around perimeter of logged area. (see baiting section) | Licensee |
| **9** | **Prevention** | *Beetle Proofing* **(Section Under Development***)* | Manipulating Stand Characteristics to lessen the chance of Beetle infestation. | Thinning a stand may increase its resistance to MPB. | Licensee |
| **10** | **Prevention** | *Clean Logging Practices* | Minimising the amount of residual MPB after logging | Reducing residual MPB left in high stumps, long butts, cull logs, etc. | Licensee and C&E |
| **11** | **Prevention** | *Hauling Ban and Milling Plan* | Restricting the Hauling of infested logs will limit unwanted Beetle spread. Ensure Hot Milling where appropriate. | See *Table* 2-5 Calendar of Events and discussion of timing for specific dates. | Licensee, through Cutting Permit clasues. |
| **12** | **Follow-up** | *Evaluate past practices and monitor past areas* | Evaluate success of current strategies. | Periodic review of MPB program and associated strategies. Continued Risk Assessments. | Licensee/MoF |

*DISCUSSION OF MOUNTAIN PINE BEETLE MANAGEMENT STRATEGIES:*

## INTEGRATED PEST MANAGEMENT ELEMENT – IDENTIFICATION

### Strategy - *Hazard and Risk Assessments*

Developing hazard maps and thus anticipating mountain pine beetle activity is an important first step in managing the pest. The *Forest Practices Code of B.C.* Bark Beetle Guidebook[8] (or other pre-approved source) outlines the attributes needed to develop mountain pine beetle hazard ratings. Stands with a higher rating will potentially be more susceptible to, and sustain more damage from, a mountain pine beetle attack than a stand with a lower rating. Once hazard maps are produced, a risk assessment can be superimposed according to recent evidence of attack. Risk is based on the most recent pine beetle activity within, adjacent to, or within 2 km. of a given stand. In this way, areas of concern can be highlighted for further examination. Hazard maps will follow the criteria outlined in *Table* 2-2.

In the Bulkley, licensees will be required to establish Hazard and Risk maps for their operating areas under the latest Allocation Plan. The hazard ratings will be updated when significant changes to the inventory occur. Risk maps (beetle activity) will be updated annually as information from walkthroughs and probing is reviewed.

*Table 2-2 MPB Hazard Rating Criteria:*

| Hazard Class | Map Colour Legend[9] | Criteria |
|---|---|---|
| Extreme | Orange | Pine Leading Species (>50%)<br>Age Class 7, 8, or 9<br>Site Index >= 16 |
| High | Pink | Pine Leading Species<br>Age Class 7, 8 or 9<br>Site Index <16 |
| **Moderate** | Horizontal Lines | Pine Secondary Species (21-49%)<br>Age Class 7, 8, or 9<br>All Site Indices |
| **Low** | Tan | Pine Leading<br>Age Class 5 or 6<br>All Site Indices |

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[8] Referred to as '**BBGB**' throughout this document.

[9] The Map Legend Colour scheme is being reviewed regionally, and is subject to change.

## INTEGRATED PEST MANAGEMENT ELEMENT - MONITORING AND IDENTIFICATION

Strategy - *To Monitor MPB activity through aerial overviews and ground based surveys.*

The Ministry of Forests in the Bulkley annually co-ordinates an aerial pest overview flight. Licensees are expected to assist MoF staff during this flight(s). Details on the role of District, Licensee and Region have yet to be finalised.

Ground surveys, or beetle probing, is carried out in stands where the threshold infestation level has been exceeded. This walkthrough counts the number of current and recently infested trees and marks them accordingly. This information is then examined and treatment decisions are made. Please refer to the following *Table* 2-3 for tree class codes to be used during probing and overview surveys. Only Red attack, and sometimes Grey attack is noticeable from the air.

*Table 2-3 MPB Tree Class codes*

| Tree Class | Foliage | Beetle activity | Pitch Tubes | Blue Stain | Code | Field Markings |
|---|---|---|---|---|---|---|
| Current Attack | Green | Adults and eggs, and possibly larvae | Can be Present, usually on lower bole | None, or very limited | **C** | Single Paint Ring Optional "C" |
| Red Attack | Yellow to Red foliage, | Beetle larvae present | Dry and Hard | Obvious | **Y1** | Single Paint Ring |
| Red Attack | RED FOLIAGE | No beetle larvae present | Dry and Hard | Obvious | **Y2** | Double Paint Ring |
| Strip Attack | Beetle activity on less than 50% of the tree's circumference. Strip attack code (S) normally combined with other codes, e.g.: **C(S), Y1(S**). | | | | | |
| Pitch Out | Green foliage | no evidence of beetles in tree | Smooth creamy yellow tubes, | None | **P/O** | Painted with "P/O" |
| Healthy | Green, Un-attacked trees. Code **(H)** is seldom used, but is available. | | | | | |
| Grey | Dead, grey or dark red; or no foliage at all | No live beetles, exit holes present | Old and very sparse | Heavy, wood usually checked (split). | **X** | Painted with "X"[10] |

Probers are responsible for examining all Pine trees within a 50 m. radius of a currently infested tree, (C or Y1).

Once the exact number and condition of the attacked trees and Mountain Pine Beetles are known, treatment options can be considered.

[10] Grey trees need only be painted with an "X" if they may be confused with Y2's.

## INTEGRATED PEST MANAGEMENT ELEMENT – THRESHOLD

### Strategy - *Establish Treatment Thresholds*

Mountain Pine Beetle is present in various levels at many areas throughout the district. It is necessary therefore to establish a threshold above which management or control options will be required. These options will range from no control/monitor only, to aggressive intervention. In the Bulkley, these threshold levels and management options have been assigned to applicable areas based on their LRMP Zonation as well as on stand characteristics. Refer to the following *Table* 2-4:

*Table 2-4* *Mountain Pine Beetle Threshold and Treatment Matrix*

| **LRMP Zonation** | **Hazard Local or Adjacent** | **Risk Thresholds (Currents per Ha.)** | | |
|---|---|---|---|---|
| | | **0-10** | **10-20** | **20+** |
| "Protected" ***CR, PR, SMZ- 1 RR***[11] | | **See discussion following Table 2-4 on Pest Control Actions in Protected Zones.** | | |
| | | **Treatment Options:** | | |
| "Special Consideration" ***AgWld RMZ, LC*** | Low to Med. | A | A | B |
| | High | A | B, C | B, C, E |
| | Extreme | A, B | E | B, E |
| "Conventional" ***ETD, IRM, STTL, SMZ 2*** | Low – Med. | A | B, C, D | B to E |
| | High | A, B, D | B to F | C, E, F |
| | Extreme | A, B, D | B to F | C, E, F |

Zonation

| | | | |
|---|---|---|---|
| CR | Core | STTL | Settlement |
| PR | Protected (Parks) | ETD | Enhanced Timber Development |
| LC | Landscape Corridor | IRM | Integrated Resource Mgmt |
| SMZ 1 | Mining | RMZ | Riparian Mgmt Zone (on block) |
| AgWld | Agriculture/Wildlife Zone | RR | On-block Riparian Reserve |
| SMZ 2 | Special Management Zone 2 (Grizzly in Babine, Caribou in Telkwa, etc.) | | |

Treatment Options:

| | |
|---|---|
| A | No Action/Monitor |
| B | Fall and Burn |
| C | Baited or Trap Trees (Harvest) |
| D | Lethal Trap trees (MSMA) |
| E | Fall and Remove |
| F | Harvest as per LUP Constraints |

[11] Felling in a Riparian Reserve is covered under Section 10(3)(b)(A)and (B) of the *Timber Harvesting Practices Regulations*, as well as in Section 4(1)(b)(I) of the *Silviculture Practices Regulations* of the *Forest Practices Code*, and required both DM and DEO approval.

**Pest Control Actions within Protected Zones:**

Protected Zones are defined as Parks, Core Ecosystems, Special Management Zone 1 areas, and Riparian Reserve Zones. Wildlife Tree Patches will be considered Protected Zones unless arrangements are made for replacement patches which are pre-approved by the District Office.

Pest control actions that destroy or modify trees *(Harvesting, Fall &Burn, Lethal or traditional Trap Trees)* within these protected zones will only be considered if the following requirements are met:

- There is a High to Extreme Hazard adjacent to or within 800 m. of the zone, and a Moderate to High Risk within the Zone, and,
- Use of the actions will likely be successful in reducing the spread of pests to timber values outside of the zone, and,
- An ongoing pest control program is in place outside of the zone.

A high Risk inside the Protected Zone does not necessarily justify control actions if there is already a high pest occurrence outside the zone. In such cases, control measures inside the zone would not lessen the pest occurrence outside the zone and therefore are not warranted. However, actions outside the zone would still be appropriate.

There may be situations where pests from outside threaten values within the Protected Zone, and actions may be necessary to protect these values. Such a situation would be assessed on an individual basis.

Any actions carried out within the Protected Zone would require consultation and agreement with the DM, and—where appropriate—with the DEO or Parks.

## INTEGRATED PEST MANAGEMENT PLAN ELEMENT – PREVENTION

Strategy - *Harvesting of MPB Infested or Threatened Timber.*

The MPB Harvesting Strategy in the Bulkley Forest Health Plan is threefold:

1. Harvesting of infested Pine trees, (*sanitation harvesting*),
2. Harvesting of Pine trees killed by MPB, but with no beetle present in the stand (*salvage harvesting*), and
3. Harvesting of Pine areas threatened by MPB infestation (*pre-emptive harvesting*)

Harvesting alone will not control a severe mountain pine beetle outbreak, but it is an effective way of destroying local beetle populations as well as recovering timber.

Harvesting of MPB infested trees with an aim to destroy as many insects as possible is called sanitation logging, and is only effective when the beetles are present in the tree. The timing of mountain pine beetle harvesting is therefore important to ensure destruction of the beetles. Refer to Calendar of Events for a general overview.

The best time for sanitation harvest is after the beetle flight is over, (usually late August, but later if weather is cool and wet) to mid or late March, as this is when beetles are present in the tree, and ground conditions are generally conducive to harvesting. There may be significant number of beetles over-wintering in the lower meter of a tree. For this reason, winter harvested areas with high stumps should be still considered infested, and mop-up baiting may be warranted. Harvesting just before or during the flight window will usually still allow insects to fly, and may aggravate the situation by transporting them in the cut logs to new areas. Hot milling (milling within 24 hours after transport) is recommended in such cases. Holding insect infested trees (either in log yard inventory or in decks in the woods) over the flight period (May to June) is not recommended as beetles may emerge and infest new areas.

The harvesting of mountain pine beetle areas after the majority of beetles have left is known as Salvage Harvesting. Its primary purpose is to recover timber damaged or killed by the mountain pine beetle, and not to destroy the local beetle population. Timing of harvest is less critical in such an operation.

Pre-emptive harvesting of high-risk stands should be given priority when planning future harvest areas. However, such harvesting must not take place at the expense of sanitation harvesting.

Small Scale Salvage Program options are available for all aspects of beetle harvesting, but are most applicable to smaller areas of sanitation harvest. Contact the District Office for information.

## INTEGRATED PEST MANAGEMENT ELEMENT – TREATMENT

Strategy - *To utilise Fall and Burn Treatments to lower the population of MPB in specific areas:*

Fall and Burn is a recognised, traditional way of destroying small, localised beetle infestations. Specific procedures for fall and burn are well known and are contained in ministry as well as licensee contract standards. Future versions of this plan will list such standards.

## INTEGRATED PEST MANAGEMENT ELEMENT – TREATMENT

Strategy - *To have in place procedures to use lethal (MSMA) Trap Trees to contain and lower the population of MPB in specific areas:*

Lethal Trap trees are a technique to kill MPB larvae while still in the tree without felling the tree. Candidate trees are baited to attract beetles. Within 2 weeks of the initial flight, those same trees—if attacked—are injected with the insecticide MSMA (Mono Sodium Methane Arsenate). This systemic chemical translocates through the tree, killing any beetles therein. The tree does not survive the treatment

Lethal trap trees need not be harvested or even felled, as any beetles in them are killed. Lethal trap trees are most often used in areas where lack of access precludes harvesting, and may be an option in areas where harvesting is not allowed, such as Protected Areas or Parks.

The Pesticide Control Branch of the Ministry of Environment closely regulates the use of MSMA. A permit is necessary in order to apply it. The District is currently reviewing the possibility of a district-wide MSMA permit.

## INTEGRATED PEST MANAGEMENT ELEMENT – TREATMENT

Strategy - *To minimize the unwanted spread of Mountain Pine Beetles through Pheromone Baiting*

Pheromone baits may be used to attract mountain pine beetles and keep them contained in the general area prior to sanitation harvesting. The baits are deployed in April to May (before the ambient temperature reaches 20$^{o}$ C) and are placed on large, healthy, uninfested pine trees. Beetles are attracted to these pheromones, and attack the baited trees rather than flying farther afield.

Baits can also be used to attract any leftover beetles after an area has been logged. This procedure is known as Mop-Up Baiting.

**Mop-up baiting or trap trees should be used if there is a stand with a high to extreme hazard rating within 500 m. Mop-up baiting or trap trees is also recommended if the original stand had a high to extreme pre-harvest hazard rating, but this must be weighed against the hazard in the surrounding forest and access constraints.**

**Mop-up baiting or trap trees may not be necessary if there is an active pre-harvest baiting program in place in the surrounding areas.**

**Where Mop-up baiting or trap trees is planned, initial harvesting must plan on leaving some standing pine trees to act as future trap trees.**

District procedures on baiting are currently being developed, and will be added to subsequent revisions of the Forest Health Plan.

## INTEGRATED PEST MANAGEMENT ELEMENT – PREVENTION

### Strategy – *Beetle Proofing*

Beetle Proofing involves the thinning of a stand in order to improve it resistance to MPB attack. The process is currently not used operationally in the Bulkley, but some projects have been completed and are being reviewed. The District will continue to consider experimental projects.

### Strategy – *Minimise MPB habitat through Clean Logging Practices*

Mountain Pine Beetle brood prefers larger standing trees, and will not normally attack smaller trees, stumps, or pieces of slash. However, such material originating from infested trees may contain living adults that may fly and contribute to the spread of the beetle.
Very high stumps of infested trees are a possible source of adult beetles. Situations such as cull logs, logs inadvertently left on site, "long butts" and so on originating from infested trees are other possible sources. Harvesting operations must ensure that all such material is either removed from the site or destroyed. Where this is not possible, or in high to extreme hazard areas, mop-up baiting should be employed in order to attract and hold any residual beetles.

## INTEGRATED PEST MANAGEMENT ELEMENT – TREATMENT

### Strategy - *To minimize the unwanted spread of Mountain Pine Beetles through a Hauling Ban and Milling Plan.*

A ban on hauling infested logs may be warranted if there are susceptible pine stands near the intended log storage yard. It is doubtful that mountain pine beetles would exit from a moving logging truck during a short haul, but that possibility exists. Logs from outside areas that are infested or suspected of being infested should not be hauled into the district for milling during the flight period. If under special circumstances, log hauling has to take place just before or during the flight period, hot milling (see below) will be required.

Hauling Bans will be implemented on a district wide basis. The time period outlined in the Calendar of Events is a guideline and circumstances from year to year will determine when the hauling ban will be applied. Specific exemptions may be warranted if there are no beetles in that particular area as there is no need to ban the hauling of uninfested trees.

The district forest health forester or compliance and enforcement co-ordinator should be made aware of any infested logs being hauled through the district to an outside destination.

Licensees harvesting infested logs may be asked to provide assurance through a milling plan that all infested logs will be milled within 24 hours of their arrival (Hot Milling). The beetle situation may be worsened if adult beetles are allowed to exit the logs and re-infest nearby pine trees.

## INTEGRATED PEST MANAGEMENT PLAN ELEMENT - FOLLOW-UP

Strategy - *Evaluate Past Practices and Monitor Pest areas.*

An integral part of the strategy is a monitoring, or feedback loop whereby any actions taken are examined for their effectiveness. Through periodic monitoring, the district forest health forester and the regional entomologist will review the strategies included in the Mountain Pine Beetle Strategy. Issues arising from this monitoring will be incorporated where applicable into subsequent refinements to the plan.

The following schedule outlines when portions of the Mountain Pine Beetle Strategy will be examined and updated if necessary:

- Hazard Mapping – As required due to significant changes in, Forest Cover
- Risk Mapping – Annually,
- Treatment Plans – Annually as required,
- Harvesting Plans – In conjunction with Forest Development, Plans or amendments; generally annually
- Baiting and MSMA Plans – Annually,
- Treatment Thresholds – Biannually if required

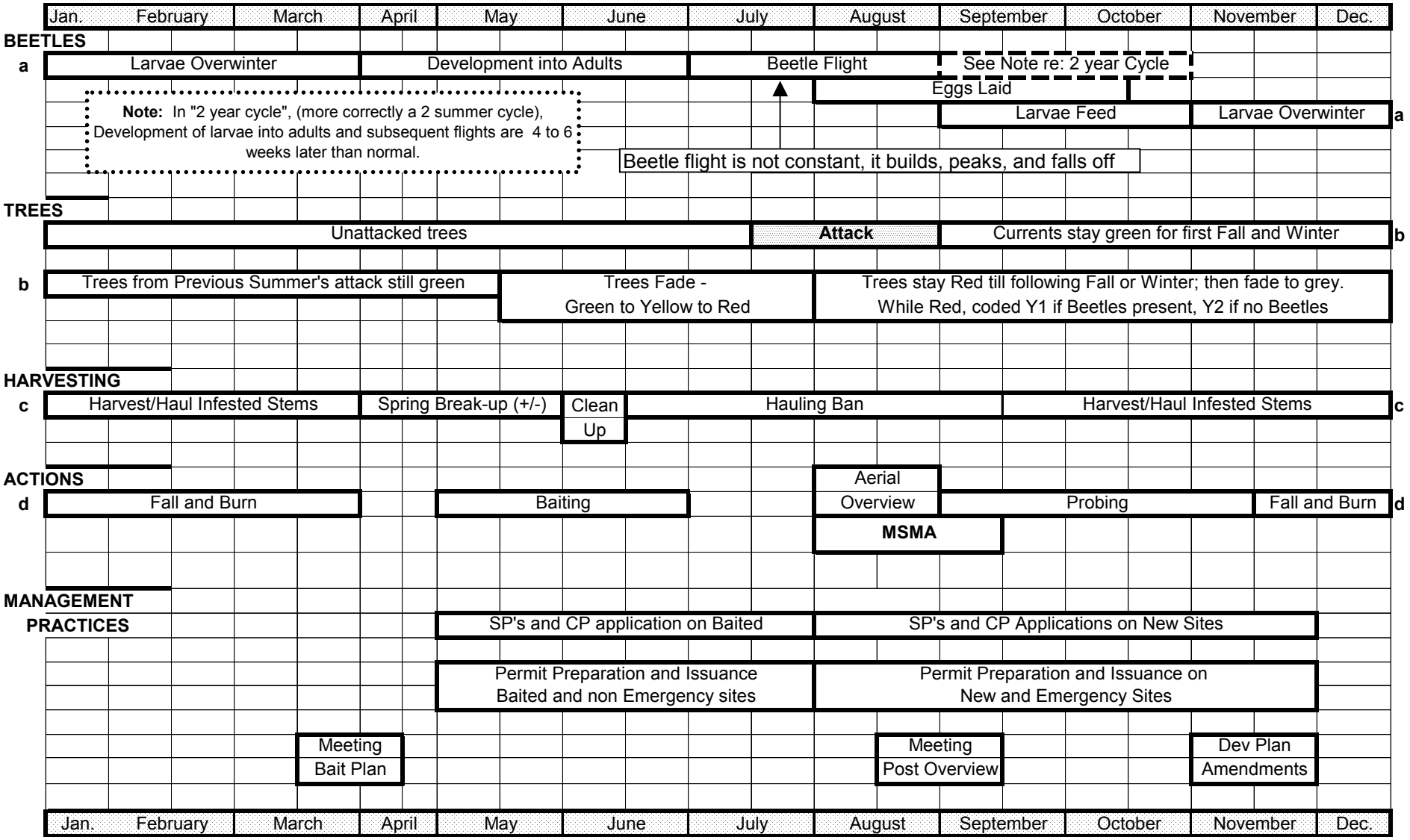



*Table 2-5 Mountain Pine Beetle Calendar of Events:*

Note that letters to the right of text continue to same letter at left of text.

Chapter Three
Bulkley TSA Forest Health Plan

# SPRUCE BARK BEETLE – IBS

# CHAPTER 3 SPRUCE BARK BEETLE (IBS) STRATEGIES, BULKLEY T.S.A. FOREST HEALTH PLAN

| | | | | |
|---|---|---|---|---|
| **Spruce Bark Beetle** | *Dendroctonus rufipennis* | **IBS**[11] | **Major** | **Lethal** |

The Spruce Bark Beetle (*Dendroctonus rufipennis* (Kirby)) is undoubtedly the most destructive insect pest of mature spruce forests in the Bulkley TSA. Both White and Engleman Spruce are susceptible. Extensive outbreaks of this pest in the 1970's and 80's infested large areas in the Chapman and Coffin Lake areas and resulted in extensive spruce mortality and subsequent salvage logging. The level of beetle activity has been relatively low since that time, but recent observations are showing outbreaks of spruce bark beetle are on the increase.

The Spruce Bark Beetle prefers to feed on downed, green material such as recent blowdown or large logging slash. Only when the local beetle population has overwhelmed this food source will it attack standing spruce trees.

The Spruce Bark Beetle normally has a two-year life cycle, laying its eggs in mid summer, over-wintering once as larvae and again as immature adults to emerge and fly in early summer of the 2nd year. Occasionally, abnormally warm weather can trigger a one-year life cycle, and there have been rare reports of a three-year cycle in higher elevation sites. It is possible to have staggered two-year populations in the same area, and also possible to have one-year cycle beetles mixed in with two year.

Correctly identifying infested trees and insect phases is paramount to properly managing a spruce beetle infestation. Tree symptoms can vary widely, and the explanation contained in the Calendar of Events is a generalisation only. Refer to Appendices *Table* s 3-6, 7 & 8 (**Spruce Beetle Codes** from Bob Hodgskinson, PGFR) for a detailed examination of tree symptoms and insect conditions and their corresponding category codes. Other pests and bark beetles may cause symptoms similar to SBB. The presence of SBB can be confirmed by detecting blue stain fungus. Probers are encouraged to check for blue stain fungus, especially in situations where single tree treatment is planned.

The Spruce Bark Beetle is similar to other native bark beetles (Mountain Pine Beetle, or Western Balsam Bark Beetle) in that larvae feeding in the phloem of the tree introduce a fungus which together with the larval mining causes the tree's translocation to stop, and mortality follows. What is different about the spruce trees so affected is that their foliage does not rapidly turn red, as is the case with infested lodgepole pine or subalpine fir. Instead, spruce crown symptoms do not normally occur until 18 to 24 months after the attack. Fortunately there are other symptoms such as boring dust and woodpecker predation that make observation feasible from the ground. Management of spruce beetle infested timber is presently accomplished by harvesting or through trap trees. These are examined further in subsequent sections.

[11] The Silviculture Code "IBS" can be used to describe the Spruce Bark Beetle, but this document will use the conventional "**SBB**" throughout.

*Table 3-1 SBB Management techniques summary*

The following *Table* summarises management techniques aimed at the Spruce Beetle. Individual strategies are discussed in the section immediately following the *Table* .

| No. | IPM Element | Methodology | Rationale | Actions | Responsibility?[12] |
|---|---|---|---|---|---|
| **1** | **Identification** | *Establish Hazard Assessments for Spruce Beetle* | Allows the anticipation of likely pest problem areas and allow us to focus activities on priority areas. | Hazard Rating based on Biological attributes listed in text.<br><br>Refer to *Table* 3-2. | Area Licensees are responsible for their allocated are. District to co-ordinate. |
| **2** | **Identification** | *Establish Risk Rating based on recent pest activity* | Annual aerial overviews and operational ground surveys will detect recent SBB activity | See Appendices *Table* s 3-6, 7 & 8 for code lists for identifying SBB trees and Insects. | District will co-ordinate annual aerial overviews. Licensees expected to partake. |
| **3** | **Threshold** | *Establish Treatment Thresholds* | Will focus resources on priority areas. | Specific areas based on LRMP Zonation and local conditions will have a level above which treatments will be considered. See *Table* 3-3. | MoF, Licensee and MoE will set threshold for given areas. |
| **4** | **Monitoring** | *To Annually detect recent SBB activity* | Keep current on the location of Beetle activity, and thus keep Risk Rating up to date | See Text for a discussion on Aerial Overviews. | District will co-ordinate annual aerial overviews. . Licensee participation welcome |
| **5** | **Treatment** | *Reduce Localised SBB population through Fall and Burn* | Destruction of localised SBB Brood | See Discussion section | Licensee |

[12] Licensee includes SBFEP

Table 3-1 SBB Management techniques summary (Continued):

| No. | IPM Element | Methodology | Rationale | Actions | Responsibility?[12] |
|---|---|---|---|---|---|
| **6** | **Treatment** | *Harvest SBB Infested Timber (Sanitation Harvest)* | Destruction of Spruce Bark Beetles. | Prioritise SBB infested areas for harvest, ideally with SBB still inside trees. | Licensee |
| **7** | **Treatment** | *Reduce local SBB population through conventional Trap Trees* | Trap trees lure beetles away from standing live trees | See *Table* 3-4 -- Characteristics of Conventional Trap Trees | Licensees on their operating areas. |
| **8** | **Treatment** | *Reduce local SBB population through lethal Trap Trees* | Lethal Trap trees can destroy localised beetle populations. | See Text for a discussion on Lethal Trap trees. | Licensee in allocated area, or MOF elsewhere. |
| **9** | **Treatment** | *Minimize SBB spread through pheromone baiting* | Pheromone Baits can stall the spread of Spruce beetles. | Prior to Sanitation Harvesting, Bait areas to hold beetles in place. See BBGB for Baiting procedures | Licensee |
| **10** | **Prevention** | *Reduce potential SBB breeding sources* | Lessens the chances of SBB build-up in logging slash or windthrow. | Clean logging and prompt removal of downed logs or trees, especially large areas of windthrown spruce trees. | Licensees on their logging shows, District on large scale windthrow areas |
| **11** | **Prevention** | *Hauling Ban and Milling Plan* | Restricting the Hauling of infested logs will limit unwanted Beetle spread. Ensure Hot Milling where appropriate. | See *Table* 3-5 Calendar of Events and discussion of timing for specific dates | Licensee, through FDP commitment. |
| **12** | **Follow-up** | *Evaluate past practices and monitor past areas* | Beetles left in slash, stumps or logs may continue to infest area. | Post Harvest Surveys will be done on high-risk areas. Repeat Trap Trees may be warranted.<br>Annual review of SBB program | Licensee/MoF |

*DISCUSSION OF SPRUCE BEETLE MANAGEMENT STRATEGIES:*

## INTEGRATED PEST MANAGEMENT ELEMENT - IDENTIFICATION

### Strategy - *Hazard and Risk Assessments*

Developing hazard maps and thus anticipating SBB is an important first step in managing the pest. *Table* 3-2 below outlines the attributes needed to develop Spruce Bark Beetle Hazard Ratings. Other rating systems may be used with prior consultation with the district office. Stands with a higher rating are more susceptible to spruce beetle attack than a stand with a lower rating. Once hazard maps are produced, a risk assessment can be superimposed according to recent evidence of attack. Risk is based on the most recent SBB activity in or within 2 km. of a given stand. In this way, areas of concern can be highlighted for further examination.

In the Bulkley, licensees will be required to establish hazard and risk maps for their operating areas under the Forest Development Plan. The hazard rating need not be updated unless there is a significant change in forest cover. Risk ratings will be updated annually as information from walkthroughs and probing is reviewed.

*Table 3-2 SBB Hazard Rating Criteria:*

| Hazard Class | Map Colour Legend[13] | Criteria |
|---|---|---|
| **Extreme** | Bright yellow | Spruce Leading Species (>50%)<br>Age Class 7, 8, or 9<br>Site Index >= 15 |
| **High** | Medium Yellow | Spruce Leading Species<br>Age Class 7, 8 or 9<br>Site Index <15 |
| **Moderate** | Diagonal Up Lines | Spruce Secondary Species (21-49%)<br>Age Class 7, 8, or 9<br>All Site Indices |
| **Low** | Light Yellow | Spruce Leading<br>Age Class 5 or 6<br>All Site Indices |

[13] The Map Legend Colour scheme is being reviewed Regionally, and are subject to change.

## INTEGRATED PEST MANAGEMENT ELEMENT - THRESHOLD

Strategy - *Establish Treatment Thresholds*

Spruce Bark Beetle has recently shown itself to be evident throughout the district at various levels of infestation. It is necessary therefore to establish a threshold above which management or control options will be required. These control options will range from no control/monitor only; to aggressive intervention. In the Bulkley, these threshold levels and management options are assigned to applicable areas based on their LRMP Zonation as well as on stand characteristics.
As thresholds will differ from stand to stand and perhaps from year to year, this procedure should be maintained annually.

*Table 3-3 Spruce Beetle Threshold and Treatment Matrix*

| LRMP Zonation | Hazard -Local or Adjacent- | Thresholds: Sanitation Harvest Index (See BBGB) Light | Moderate | High |
|---|---|---|---|---|
| **"Protected" *CR, PR, SMZ- 1 RR*[13]** | | **See discussion following Table 3-3 on Pest Control Actions in Protected Zones.** | | |
| | | **Treatment Options** "( )" indicates less than ideal | | |
| **"Special Consideration" *AgWld, LC RMZ,*** | **Low to Mod.** | **A** | **A** | **(B), C** |
| | **High** | **A** | **(B), C** | **C, E** |
| | **Extreme** | **(B)** | **C, E** | **E** |
| **"Conventional" *ETD, IRM, STTL SMZ- 2*** | **Low – Mod.** | **A** | **A, (B)** | **B, C, D** |
| | **High** | **A, (B), C** | **(B), C** | **(B), C to F** |
| | **Extreme** | **(B), C, E** | **(B), C to F** | **(B), C to F** |

| | | | |
|---|---|---|---|
| **CR** | **Core** | **ETD** | **Enhanced Timber Development Zone** |
| **PR** | **Protected (Parks)** | **IRM** | **Integrated Resource Mgmt** |
| **RR** | **On-block Riparian Reserve** | **STTL** | **Settlement** |
| **SMZ 1** | **Mining Only** | **AgWld** | **Agriculture/Wildlife Zone** |
| **SMZ 2** | **Special Management Zone 2 (*Grizzly in Babine, Caribou in Telkwa, etc.*)** | **LC** | **Landscape Corridor** |

**Treatment Options:**

**A - No Action/Monitor**
**B - Fall and Burn, (*Difficult to do with Spruce, but possible*)**
**C - Baited or Trap Trees (Harvest)**
**D - Lethal Trap trees (MSMA – Where permitted)**
**E - Fall and Remove**
**F - Harvest as per LUP Constraints**

[13] Felling in a Riparian Reserve is covered under Section 10(3)(b)(A) and (B) of the *Timber Harvesting Practices Regulations*, as well as in Section 4(1)(b)(I) of the *Silviculture Practices Regulations* of the *Forest Practices Code*, and required both DM and DEO approval

**Pest Control Actions within Protected Zones:**

Protected Zones are defined as Parks, Core Ecosystems, Special Management Zone 1 areas, and Riparian Reserve Zones. Wildlife Tree Patches will be considered Protected Zones unless arrangements are made for replacement patches which are pre-approved by the District Office.

Pest control actions that destroy or modify trees *(Harvesting, Fall &Burn, Lethal or traditional Trap Trees)* within these protected zones will only be considered if the following requirements are met:

- There is a High to Extreme Hazard adjacent to or within 800 m. of the zone, and a Moderate to High Risk within the Zone. and,
- Use of the actions will likely be successful in reducing the spread of pests to timber values outside of the zone. and,
- An ongoing pest control program is in place outside of the zone.

A high Risk inside the Protected Zone does not necessarily justify control actions if there is already a high pest occurrence outside the zone. In such cases, control measures inside the zone would not lessen the pest occurrence outside the zone and therefore are not warranted. However, actions outside the zone would still be appropriate.

There may be situations where pests from outside threaten values within the Protected Zone, and actions may be necessary to protect these values. Such a situation would be assessed on an individual basis.

Any actions carried out within the Protected Zone would require consultation and agreement with the DM, and—where appropriate—with the DEO or Parks.

## INTEGRATED PEST MANAGEMENT ELEMENT - MONITORING AND IDENTIFICATION

Strategy - *To Monitor SBB activity through aerial overviews and ground based surveys.*

The Ministry of Forests in the Bulkley annually co-ordinates an aerial pest overview flight. Licensees are expected to partake in this program. Details on the role of district, licensee and region have yet to be finalized.

Recent Spruce Beetle infestations can be difficult to locate from the air because of the fact that infested trees often stay green for up to a year after the initial attack. Observers need to be on the look out for older attacks in the vicinity, as well as recent spruce blowdown, which is favoured spruce beetle breeding material. Suspect areas can be examined further on the ground. Licensees will be responsible for such surveys within their allocated areas.

Ground surveys can take the "coarse filter" approach, where a first stage walkthrough is used to determine if more study is warranted. This walkthrough gathers information necessary to develop a Sanitation Harvest Index (See Bark Beetle Guidebook for details). This index is used in conjunction with the Threshold Matrix to determine possible treatment options.

Detailed systematic probes may be necessary. These probes gather individual tree and beetle information as outlined in the guide book as well as in Appendices *Tables* 3-6, 7 & 8 – Spruce Beetle Codes.

Once the exact number and condition of the attacked trees and spruce beetles are known, treatment options can be considered.

## INTEGRATED PEST MANAGEMENT PLAN ELEMENT - TREATMENT

Strategy – *Reduction of localised SBB through Fall and Burn*

Fall and Burn can be used on SBB infested spruce trees. However, since infested trees are usually of large diameter and have many branches, fall and burn is often a labourious and expensive treatment option. Other options should be considered.

Fall and burn standards, if required will be similar to those for mountain pine beetle.

## INTEGRATED PEST MANAGEMENT PLAN ELEMENT - PREVENTION

### Strategy - *Harvesting of SBB Infested or Threatened Timber.*

The SBB Harvesting Strategy in the Bulkley Forest Health Plan is threefold:

1. Harvesting of infested spruce trees, (sanitation logging),

2. Harvesting of spruce trees killed by SBB, but with no beetle present in the stand (salvage harvesting), and

3. Harvesting of spruce areas threatened by SBB infestation.

Harvesting alone will not control a severe spruce beetle outbreak, but it is an effective way of destroying local beetle populations as well as recovering timber.

Harvesting of SBB infested trees with an aim to destroy as many insects as possible is called sanitation logging, and is only effective when the beetles are present in the tree. The timing of spruce beetle harvesting is therefore important to ensure destruction of the beetles. Refer to Calendar of Events for a general overview.

The timing for sanitation harvest takes place from the egg stage in July to that Fall in the case of 1 year cycle beetles, or to the Fall of the second year in the case of 2 year beetles. After this, immature adults may have migrated to the base of the tree, and remain behind in stumps after harvest. Winter harvest areas with high stumps should therefore still be considered infested, and follow-up trap trees should be deployed. Harvesting just before or during the flight window will usually still allow insects to fly, and may aggravate the situation by transporting them in the cut logs to new areas. Hot milling (milling within 24 hours after transport) is recommended in such cases. Holding insect infested trees (either in log yard inventory or in decks in the woods) over the flight period (May to June) is not recommended as beetles may emerge and infest new areas.

The harvesting of spruce beetle areas after the majority of beetles have left is known as Salvage Harvesting. Its primary purpose is to recover timber damaged or killed by the spruce beetle, and not to destroy the local beetle population.

The harvesting of uninfested spruce stands should only be undertaken when there are no opportunities for sanitation harvesting.

## INTEGRATED PEST MANAGEMENT ELEMENT - TREATMENT

Strategy - *To utilize conventional trap trees in order to contain and lower the population of SBB in specific areas.*

The Spruce Beetle prefers downed spruce logs to feed on and breed in. Large healthy spruce trees felled and left on site will attract spruce beetles. These decoy trees will lure spruce beetles away from living, standing trees. The beetles under the bark of the trap trees are then disposed of through harvesting and milling. Trap trees can be used in a light infestation to draw beetles away from living trees, to protect an adjacent healthy stand, or as "mop up" to attract beetles emerging from stumps or slash.

**Mop-up trap trees or baiting should be used if there is a stand with a high to extreme hazard rating within 800 m. Mop-up trap trees or baiting is also recommended if the original stand had a high or extreme pre-harvest hazard rating, but this must be weighed against the hazard in the surrounding forest and access constraints.**
**Mop-up baiting or trap trees may not be necessary if there is an active pre-harvest baiting or trap tree program in place in the surrounding areas.**
**Where Mop-up baiting or trap trees is considered, initial harvesting must plan on leaving some standing spruce trees to act as future trap trees.**

Refer to the following *Table* 3-4 on Spruce Trap Trees Characteristics.

*Table 3-4 Spruce Beetle Trap Trees Characteristics:*

- Trap trees should be large healthy, uninfested spruce, and should be felled inside a spruce beetle infestation or within 400 meters. Although trap trees can attract beetles from up to 800 meters away, 400m. is operationally preferable.
- Approximately 1 trap tree per 10 standing infested trees is recommended. A higher ratio of trap trees to standing may leave little shade for the trap trees, thus lessening their efficiency.
- Ideally trap trees should be felled in late spring prior to the flight but after large snowfalls. Felling trees in the fall or winter is marginally acceptable but not preferred.
- Trap trees can be felled individually, in patches or strips.
- Trees should be felled so that they have the greatest amount of shade. This keeps them cool and slows the drying out process.
- Stumps should be as low as possible and the felled tree should be made to lie close to the ground, yet ideally still allow beetles to attack the underside of the tree.
- Trees should not be bucked or limbed. This assists in shading and keeping the trees cool.
- Trees should be well marked so that the logs may be easily found again, even under a covering of snow.
- Trees should be felled in such a way as to facilitate extraction.
- Trap trees should ideally be harvested before they are hidden by snow or frozen to the ground.
- Trap trees holding or suspected of containing beetles ***must*** be harvested or destroyed prior to the next beetle flight, or the beetle situation may be worsened.

While it is possible to burn or otherwise destroy trap trees on site, it is very labour intensive and expensive. Recovering and milling or de-barking the logs is a much better option.

Like any insect infested trees, trap trees filled with beetles should be harvested and milled when the insects are still in the logs. Harvesting should take place while the trap trees are still accessible, and not too covered in snow or frozen to the ground. Under no circumstances should trap trees be left over two flight windows, otherwise they may aggravate the problem by releasing the insects they collected the year before.

Normal harvesting practices may be modified to take the place of trap trees. Rights-of-way or pre-felled uninfested spruce trees may be left on site over the flight window to act as trap trees and capture beetles. Any such wood should be examined for beetles and treated (milled or debarked) prior to the next winter if infested.

## INTEGRATED PEST MANAGEMENT ELEMENT - TREATMENT

Strategy - *To have in place procedures to use lethal (MSMA) Trap Trees to contain and lower the population of SBB in specific areas:*

Lethal Trap Trees are felled spruce trees which have been injected with a systemic insecticide—most commonly MSMA (Mono Sodium Methane Arsenate). The insecticide kills attacking spruce beetles when they bore into the logs. Lethal trap trees need not be harvested, as their systemic insecticide will kill any beetles therein. Lethal trap trees are most often used in areas where lack of access precludes harvesting.

The use of MSMA requires a pesticide use permit or similar authority from the Ministry of Environment Pesticide Use Branch. Specific procedures for using MSMA are not yet finalized, but will be added to this strategy if and when required.

## INTEGRATED PEST MANAGEMENT ELEMENT - TREATMENT

Strategy - *To minimize the unwanted spread of Spruce Beetles through Pheromone Baiting*

Pheromone baits may be used to attract spruce beetles and keep them contained prior to sanitation harvesting. Baiting procedures are similar to mountain pine beetle baits, in that baits are deployed in April to May and are placed on large, healthy, uninfested spruce trees.

Baiting is not necessary in conjunction with trap trees, as the trap trees alone are sufficient to attract beetles. Downed trap trees typically hold many times more beetles than standing trees even if the standing trees are baited. For this reason, it is recommended that spruce pheromone baits should be limited to circumstances where felling of trap trees is not feasible. See Bark Beetle Guidebook for further discussion.

## INTEGRATED PEST MANAGEMENT PLAN ELEMENT - PREVENTION

Strategy - *Reduce potential Spruce Beetle breeding habitat.*

a) Windthrow -- Spruce Beetles thrive in any downed spruce trees, and therefore windthrown trees are a likely breeding ground. Prompt recognition and mapping of windthrown spruce trees, either by ground observations or during the aerial overview, should be carried out. Follow up ground assessments will identify any insect activity. Large-scale blowdown of spruce trees will almost guarantee spruce beetle infestation, so these areas should be given a high priority for assessment and follow up treatments.
b) Harvesting -- Like windthrow, spruce trees felled during harvest are also likely breeding grounds for spruce beetle. Rights of Way and decked wood, if infested, should be promptly removed from the site and treated. Any uninfested felled wood should be examined for beetles if left onsite over the flight period.
c) Spruce Bark Beetle brood will as a rule, develop in blown-down trees, logs, or large pieces of slash. In addition, living adults left in material after logging may fly and contribute to the spread of the beetle. Clean logging practices must be followed when harvesting in high to extreme hazard spruce beetle stands.

d) As immature adult beetles often over-winter at the base of a tree, winter harvesting (especially in a high snow year) may not capture the majority of the beetle population. In these cases, trap trees should be used to "mop- up" any beetles remaining on site.
e) Harvesting must ensure that all infested or susceptible material is either removed from the site or destroyed. Where this is not possible, or in high to extreme hazard areas, mop-up baiting should be employed in order to attract and hold any remaining beetles. See the earlier section on Mop-up baiting for details.

## INTEGRATED PEST MANAGEMENT ELEMENT - PREVENTION

Strategy - *To minimize the unwanted spread of Spruce Beetles through a Hauling Ban and Milling Plan.*

A ban on hauling infested spruce logs may be warranted if there are susceptible spruce stands near the intended log storage yard. It is doubtful that spruce beetles would exit from a moving logging truck during a short haul, but that possibility exists. Logs, which are infested or suspected of being infested, should not be hauled into the district from outside areas during the flight period (Refer to Calendar of Events for details). If hauling has to take place just before or during the flight period, hot milling will be required.

Hauling bans will be implemented over the entire TSA, but may be exempted on specific areas. There is little reason to ban the hauling of uninfested spruce trees.

Licensees harvesting infested logs may be asked to provide assurance through a milling plan that all infested logs will be milled within 24 hours of their arrival (Hot Milling). The beetle situation may be worsened if adult beetles are allowed to exit the logs and re-infest nearby spruce trees.

## INTEGRATED PEST MANAGEMENT PLAN ELEMENT - FOLLOW-UP

Strategy - *Evaluate Past Practices and Monitor Past areas.*

An integral part of the strategy is a monitoring, or feedback loop whereby any actions taken are examined for their effectiveness. Through periodic monitoring, the district forest health forester and the regional entomologist will review the strategies included in the Spruce Bark Beetle Strategy. Issues arising from this monitoring will be incorporated where applicable into subsequent refinements to the plan.

The following schedule outlines when portions of the Spruce Bark Beetle Strategy will be examined and updated if necessary:

- Hazard Mapping – When warranted by significant change to Forest Cover.
- Overviews and Risk Mapping – Annually.
- Hauling Ban – Review of specific areas for possible exemption.
- Treatment Plans – Annually as required.
- Harvesting Plans – In conjunction with Forest Development Plans or amendments, generally annually.
- Baiting and MSMA Plans – Annually.
- Treatment Thresholds – Biannually if warranted.

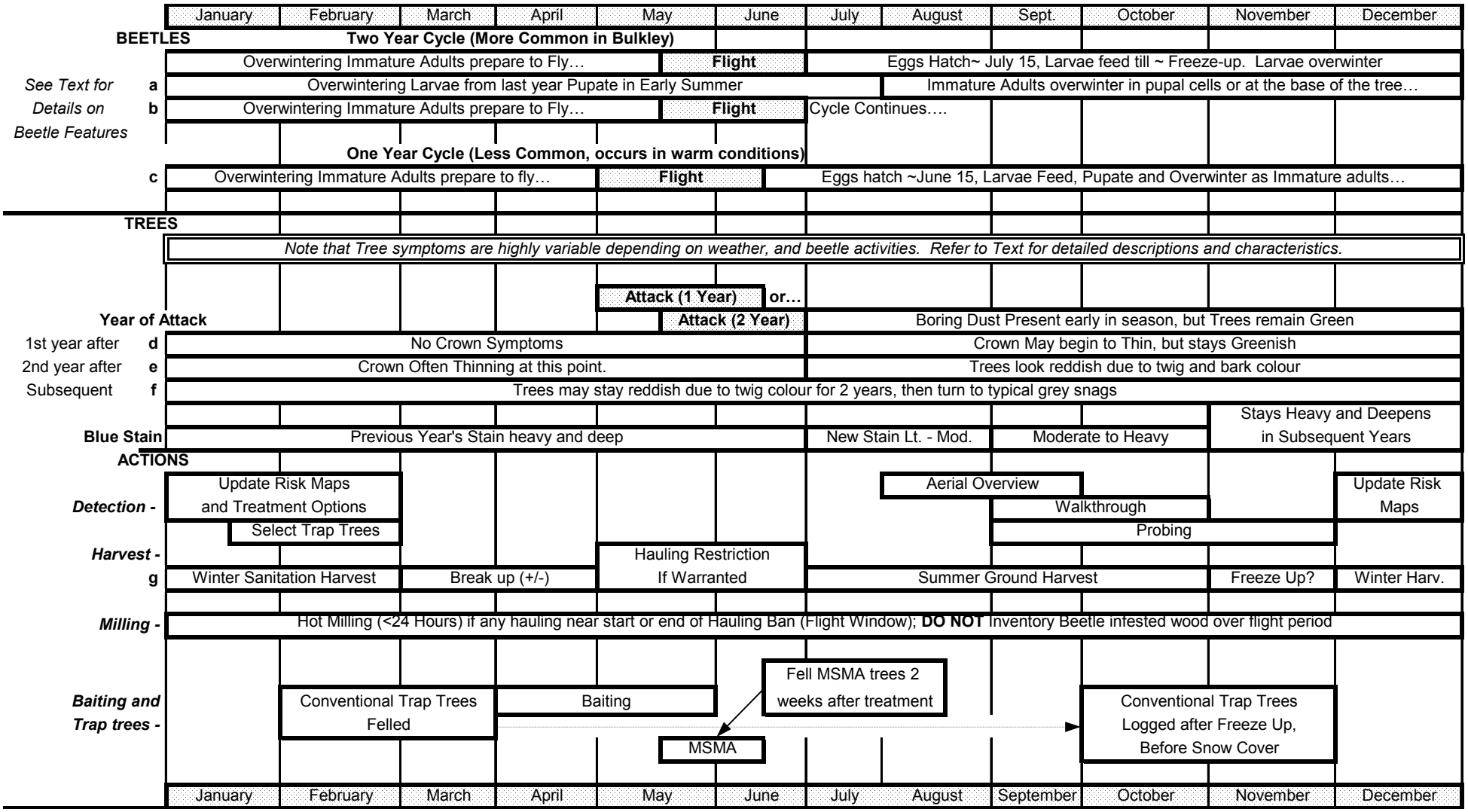



*Table 3-5 Spruce Beetle Calendar of Events:*

Note that letters to the right of text continue to same letter at left of text.

*Appendix 3-1 Table 3-6 Spruce Beetle Codes – (2- And 1-Year Life Cycles)*

**Code 1** Most recent year of full attack (200_)
**Code 2** Most recent year of strip attack (200_)

With spruce beetle on a 2-year life cycle, attacks occur mainly in June but extend into early August. With 1-yr cycle, the attack occur in late May and early June.

All "*external bark"* and "*phloem/sapwood"* indicators refer to successfully attacked portions of the tree. *Full-attacks* are on 50% or more of the tree's circumference; *strip-attacks* are on less than 50%. *Crown Symptoms* mainly refer to full-attacks, heavy strip-attacks and/or multiple attacks.

| | | **External Bark Indicators** | | | | **Phloem / Sapwood Indicators** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beetle life cycle | Time of survey | Pitch tubes | Boring dust | Wood-pecker damage | Exit holes | Parent adults | Larvae | Pupae | Immature adults | Sap wood | Blue staining | Fungi | Secondary insects | Crown Symptoms |
| 2-yr | July – August | sticky | Powdery dark brown | light to moderate | -- | alive | 3-7 mm | -- | -- | still moist | light & shallow | -- | few | none |
| 2-yr | Sept. – Oct. | still pliable | some left between bark scales | moderate | -- | dying | 5-7 mm | -- | -- | drying | moderate & deepening | -- | mostly predators | none |
| 2-yr | Nov. – May | stiffening | Scarce | moderate to heavy | -- | dead | 5-7 mm | -- | -- | very dry | heavy & deepening | some | predators and then secondary beetles | none |
| 1-yr | July – August | still pliable | some left between bark scales | usually light | -- | alive | 6-7 mm | many | some | drying | moderate & deepening | -- | mostly predators | none |
| 1-yr | Sept. – Oct | stiffening | Scarce | light to moderate | vary | dying | -- | few | many | very dry | heavy & deepening | some | mostly predators | none |
| 1-yr | Nov. – May | stiffer | -- | usually moderate | vary | dead | -- | few | many | very dry | heavy & deep | moderate | predators and by spring, ambrosia beetles, ips spp., etc.,.. | none |

*Appendix 3-2 Table 3-7 Spruce Beetle Codes – (2- And 1-Year Life Cycles)*

**Code 3** Second most recent year of full attack (199_)
**Code 4** Second most recent year of strip attack (199_)

With spruce beetle on a 2-year life cycle, attacks occur mainly in June but extend into early August. With 1-yr cycle, the attack occur in late May and early June.
All "*external bark"* and "*phloem/sapwood"* indicators refer to successfully attacked portions of the tree. *Full-attacks* are on 50% or more of the tree's circumference; *strip-attacks* are on less than 50%. *Crown Symptoms* mainly refer to full-attacks, heavy strip-attacks and/or multiple attacks.

| | | **External Bark Indicators** | | | | **Phloem / Sapwood Indicators** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beetle life cycle | Time of survey | Pitch tubes | Boring dust | Wood-pecker damage | Exit holes | Parent adults | Larvae | Pupae | Immature adults | Sap wood | Blue staining | Fungi | Secondary insects | Crown Symptoms |
| 2-yr | July – August | stiffening | -- | Heavy | -- | dead or dying | 5-7 mm | mod. to heavy | mod. to heavy | very dry | mod. & deepening | some | predators and secondary beetles | none |
| 2-yr | Sept. – Oct. | stiffer | -- | Heavy | vary | dead | -- | few | heavy with some in root collar | very dry and some checking | heavy and deepening | moderate | predators and secondary beetles | may be thinning slightly |
| 2-yr | Nov. – May | brittle | -- | Heavy | vary | dead | -- | few | vary with some in root collar | very dry and mod. checking | heavy and deep | heavy | predators and secondary beetles | may be thinning slightly with very minor coloration change |
| 1-yr | July – August | brittle | -- | Heavy | mod. to heavy | dead | -- | -- | few with possibly some in root collar | very dry and some checking | heavy and deepening | moderate | predators and secondary beetles | none |
| 1-yr | Sept. – Oct | brittle | -- | Heavy | mod. to heavy | dead | -- | -- | -- | very dry and some checking | heavy and deeo | heavy | predators and secondary beetles | may be thinning slightly |
| 1-yr | Nov. – May | brittle | -- | Heavy | mod. to heavy | dead | -- | -- | -- | very dry and mod. Checking | heavy and deep | heavy | predators and secondary beetles | may be thinning slightly with very minor coloration change |

*Appendix 3-3 Table 3-8 Spruce Beetle Codes – (2- And 1-Year Life Cycles*

**Code 5** Third most recent year of full attack (199_)
**Code 6** Third most recent year of strip attack (199_)

With spruce beetle on a 2-year life cycle, attacks occur mainly in June but extend into early August. With 1-yr cycle, the attack occur in late May and early June.

All "*external bark"* and "*phloem/sapwood"* indicators refer to successfully attacked portions of the tree. *Full-attacks* are on 50% or more of the tree's circumference; *strip-attacks* are on less than 50%. *Crown Symptoms* mainly refer to full-attacks, heavy strip-attacks and/or multiple attacks.

| | | **External Bark Indicators** | | | | **Phloem / Sapwood Indicators** | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beetle life cycle | Time of survey | Pitch tubes | Boring dust | Wood-pecker damage | Exit holes | Parent adults | Larvae | Pupae | Immature adults | Sap wood | Blue staining | Fungi | Secondary insects |
| 2-yr | July – August | brittle and yellow | -- | heavy* | heavy | dead | -- | -- | -- | very dry with heavy checking | very heavy and deep | vary | ambrosia beetle and woodborer holes |
| 2-yr | Sep. – May | brittle and yellow | -- | heavy* | heavy | dead | -- | -- | -- | very dry with heavy checking | very heavy and deep | vary | ambrosia beetle and woodborer holes |
| 1-yr | July – August | brittle and yellow | -- | heavy* | heavy | dead | -- | -- | -- | very dry with heavy checking | very heavy and deep | vary | ambrosia beetle and woodborer holes |
| 1-yr | Sep. – May | brittle and yellow | -- | heavy* | heavy | dead | -- | -- | -- | very dry with heavy checking | very heavy and deep | vary | ambrosia beetle and woodborer holes |

* Usually exceeds 80% of attacked portion of bole.

# BALSAM BARK BEETLE (IBB)

# CHAPTER 4 BALSAM BARK BEETLE (IBB[14]) STRATEGIES, BULKLEY T.S.A. FOREST HEALTH PLAN

| | | | | |
|---|---|---|---|---|
| **Balsam Bark Beetle** | *Dryocoetes confusus* | **IBB** | **Major** | **Lethal** |

The Balsam Bark Beetle[14] (*Dryocoetes confusus* (Swaine)) also "BBB" or "WBBB" is the most destructive pest of mature Balsam trees in the TSA. Its life cycle and mode of attack are somewhat similar to other bark beetles, except that the individual beetle normally has a 2-year life cycle and the adult female can lay up to 3 sets of eggs. Like the other bark beetles, larval mining together with an introduced fungus[15] in the phloem of the tree cause the tree's translocation to cease, and mortality follows. This fungus lacks the blue coloured stain associated with other bark beetles.

The BBB must overwinter first as larvae, and then as callow (immature) adults. The adult beetle can lay up to 3 sets of eggs, one in the first summer, and two in the second. There are normally multiple and overlapping broods. Thus under normal conditions, a total of 4 summers and 3 winters will have passed from the original flight to the flight of the last set of brood. Please refer to the Calendar of Events for an illustration.

The beetles fly in early to mid summer and lay their first set of eggs. The adults then overwinter under the bark along with the developing 1st year brood. In the second summer the adults elongate their galleries, and lay another brood, and often emerge to fly again and lay a third set of eggs in the same or neighbouring trees. The adults die soon after. Those 2nd and 3rd eggs develop into larvae and over-winter along with the first set of larvae, which have now developed into callow adults. The next (or third) summer would see the first brood emerge as adults, and the 2nd and 3rd brood over-winter as callow adults. These would emerge and fly in the middle of the 4th summer.

Balsam Bark Beetle prefers to attack Subalpine fir, and rarely attacks Amabalis fir. The beetle typically targets larger trees, generally only attacking smaller ones once the larger ones are completely inundated. This is termed "Spill-Over Attack". BBB can also breed in downed material, although it prefers standing trees. Most attack on the main bole occurs between 2 and 15 metres above ground, although they can attack almost the entire tree. This can make ground detection of current attack difficult. Pitch streaming down the bole is thought to be a sign of BBB attack. The attack should only be deemed successful if frass is noted in the pitch. Fine, pepper like frass near the base of the tree can also be used to confirm a successful attack. Please refer to *Table*s 4-2 and 4-5 for illustrations of balsam attack codes.

Needles of infested trees turn brick red the summer after the attack, but can remain on the tree and red for up to 5 years, with 3 years being the average. Detection and identification of the appropriate life cycle stage, although complicated, is necessary to understanding the dynamics of the beetle.

[14] The Silviculture Code "IBB" can be used to describe the Balsam Bark Beetle, but this document will use the conventional "**BBB**" or "**WBBB**" throughout.

[15] Recently reclassified as *Ophiostoma dryocoetidis*, from *Ceratocystis dryocoetidis*

Strategies for managing balsam bark beetles are more stand based than tree based. Individual tree treatments such as fall and Burn, MSMA, and even single tree harvesting are difficult, expensive and of limited value due to the extensive nature of most BBB infestations. Stand management strategies are limited at present to sanitation and salvage harvesting. Trap trees with follow-up sanitation harvest are another possibility that warrants further study.

Stands under attack by BBB can be classified into one of 5 impact classes as illustrated in Figure 4-1. The impact % are based on aerial and/or ground observations of Green, Red and Grey attack levels. The harvest priority on a district basis follows the same numbering system as the impact class.

The Impact classes and suggested priority of harvest is as follows (Priority 1 is highest.)

*Table 4-1 BBB Impact Classes and Harvest Priority:*

| Impact Class/ Priority | Criteria | Objectives |
|---|---|---|
| 1 | Green and Red attack >35% | Recovery of Sawlogs (**Sanitation**) |
| 2 | Red and Grey attack >35% | Recovery of Dry Sawlogs |
| 3 | Green and Red attack >20% | Stand at Risk to more loss |
| 4 | Green and Red attack < 20% and High Hazard | Pre-emptive Harvesting |
| 5 | Grey Attack >35% | **Salvage** Pulp Volume |

Note that when a stand falls into more than 1 category or class, the stand should be assigned the higher priority.

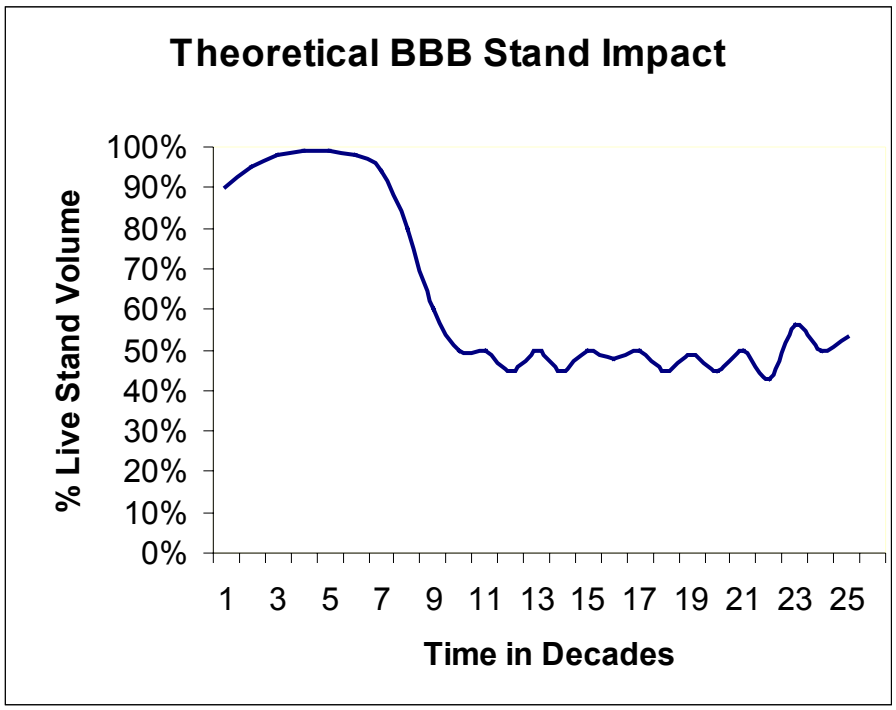


*Figure 4-1 Theoretical BBB Stand Impact:*

*Table 4-2 Balsam and BBB Tree Class Codes.*

| |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
| **Attack Class** | **N - Normal 1 unconfirmed 1a - confirmed** | **2 Red attack** | **3 Grey attack** | **4** | **5** | **6** | **7** |
| **Note: N = Normal (no attack), 1 = unconfirmed attack (pitch only), and 1a = confirmed attack (frass visible)[1]** | | | | | | | |
| *Foliage* | Green | Red | Grey | None | None | None | None |
| *Bark* | ALL BARK PRESENT | All bark intact | All bark intact | At least 75% bark present | 25 to 75% bark present | <25% bark present | Traces of bark |
| *Branches* | All present | Fine branchlets present | Fine branchlets present | No fine branchlets | Branches up to 3cm missing | Few branches | no or few branches |
| **Other Descriptors**: | Healthy tree; live crown, may be currently attacked (can have decay indicators) | Classified as "Red attack" if red needles considered to be visible from the air; if not, called "Grey" | TOP INTACT OR FRESHLY BROKEN, BARK INTACT. | Top may be missing but bark must be relatively intact. | Top may be missing but differs from TC 6 by % bark & deterioration of sapwood. | Top broken @>20cm diameter; visible sap rot. | Broken top at >20cm, stump 5-10 m; sapwood severely decayed. |

1. Mass attacks by WBBB are identified by prolific fine, pepper-like frass on the bole, the ground and on lichens both on and around the tree. Beetle entrance/exit holes are approximately 1.5 mm across
Most attack on the main bole occurs between 2 and 15 metres above ground. This can make ground detection of current attack difficult. Pitch streaming down the bole is thought to be a sign of BBB attack. The attack should only be deemed successful if frass is noted in the pitch.

*Table 4-3 Balsam Bark Beetle Management Strategies:*

| # | IPM Element | Methodology | Rationale | Actions | Responsibility?[16] |
|---|---|---|---|---|---|
| **1** | **Identification** | *Establish Hazard Assessments for Balsam Bark Beetle* | Allows the anticipation of likely pest problem areas and allow us to focus activities on priority areas. | Hazard Rating based on Biological attributes. Current hazard assessment criteria are listed in *Table* 4-3. | Area Licensees are responsible for their allocated are. District to co-ordinate. |
| **2** | **Identification And Monitoring** | *Establish Risk Rating based on annual pest activity* | Annual Aerial Overviews and operational ground surveys will detect recent BBB activity and mark their location on a map. | Individual trees are assigned tree class codes (*Table* 4-2). See also *Table* 4-5 for an alternate Code list. Stands are assigned Impact classes based on the distribution of tree classes (Figure 4-1) | District will co-ordinate annual aerial overviews. Licensee responsible for ground surveys. |
| **3** | **Threshold** | *Establish Treatment Thresholds* | Will focus harvesting efforts on priority areas. | Thresholds are based on Impact class as in Strategy 4. | Licensee will set threshold for given areas. |
| **4** | **Treatment** | *Harvest BBB Infested Timber (Sanitation Harvest)* | Destruction of Balsam Bark Beetle and recovery of green volume | Prioritise BBB infested areas for harvest, based on Stand Impact Classes 1 to 4. | Licensee |
| **5** | **Treatment** | *Salvage Harvesting* | Recovery of Sawlog and Pulplog volumes. | Salvage according to priority based on Stand Class. See text). | Licensee |
| **6** | **Treatment** | *Reduce local BBB population through conventional Trap Trees* | It is theorised that Trap trees lure beetles away from standing live trees | Not yet fully operational at this point in time. Some Research Test areas will be baited. | Licensees, with District and Regional assistance. |
| **7** | **Treatment** | *Minimise BBB spread through pheromone baiting* | Pheromone Baits may stall the spread of BBB. | Prior to Sanitation Harvesting, Bait areas to hold beetles in place. See BBGB for Baiting procedures | Licensee |
| **8** | **Prevention** | *Reduce potential BBB breeding sources* | Lessens the chances of BBB build-up in logging slash or windthrow. | Clean logging and prompt removal of downed logs or trees, especially large areas of windthrown Balsam trees. | Licensees on their logging shows, and large scale windthrow areas |
| **9** | **Prevention** | *Hauling Ban and Milling Plan* | Restricting the Hauling of infested logs will limit unwanted Beetle spread. Ensure Hot Milling where appropriate. | See discussion section. | Licensee, through Cutting Permit clauses |
| **10** | **Follow-up** | *Evaluate past practices and monitor past areas* | Beetles left in slash, stumps or logs may continue to infest area. | Post Harvest Surveys are suggested in high-risk areas such as high hazard areas with many live beetles.<br>Annual review of BBB program | Licensee/MoF |

[16] Licensee Includes **SBFEP**

## *DISCUSSION OF BALSAM BARK BEETLE MANAGEMENT STRATEGIES:*

### INTEGRATED PEST MANAGEMENT ELEMENT - IDENTIFICATION

Strategy - *Hazard and Risk Assessments*

Hazard Ratings are to be established for all Licensees operating areas. A significant change in the forest cover may necessitate a new hazard rating. Criteria for establishing hazard ratings is as follows:

*Table 4-4 Hazard Assessment Procedures:*

| Hazard | Suggested Map Legend[17] | Criteria |
|---|---|---|
| Extreme | Dark Purple | Balsam Leading (>50%)<br>Age Class 7,8,9<br>Site Index ≥ 15 |
| High | Medium Purple | Balsam Leading (>50%)<br>Age Class 7,8,9<br>Site Index <15 |
| Moderate | Light Purple with Vertical lines | Balsam Secondary (21-49%)<br>Age Class 7,8,9<br>All Site Indices |
| Low | Light Purple | Balsam Secondary (21-49%)<br>Age Class 5,6<br>All Site Indices |

## *RISK RATING OF BALSAM BARK BEETLE STANDS:*

Balsam stands will be monitored for balsam bark beetle impact as part of the annual aerial overview. A separate flight for balsam bark beetle may be warranted due to the more scattered nature of balsam bark beetle. The Ministry of Forests will co-ordinate the annual overview with licensee and regional assistance.

Individual stands may be ground examined to determine the amount of Green, Red and Grey attack. This will be a licensee responsibility as part of their development planning process. A list of approved tree class codes for BBB infested trees is included as *Table* 4-2. Tree Class Codes 4 through 6 are also to be noted to assist in determining the length of time between classes. The relative abundance of tree classes dictates which attack impact class the stand. The priority for harvest is based on this assessment.

[17] Map Colour legend is being reviewed Regionally, and is subject to change

## INTEGRATED PEST MANAGEMENT ELEMENT - IDENTIFICATION

### Strategy – *Treatment Thresholds*

Thresholds for balsam bark beetle infested stands are based on the percentage of Green, Red or Grey attack in the stand itself, rather than on the number of individually attacked trees as is the case with other bark beetles. Stands are then classed into impact classes, which form the basis of a harvesting strategy. See *Table* 4-1 for a listing of BBB thresholds and subsequent harvest priority.

## INTEGRATED PEST MANAGEMENT ELEMENT - TREATMENT

### Strategy – *Harvest Priority*

As the graph in Figure 4-1 shows, a stand loses green merchantable volume quite quickly after the onset of BBB attack. Harvest priority (on a stand to stand basis) is based on the impact class of the individual stand. That impact class is based on the relative percentages of green, red or grey attack as outlined in *Table* 4-1. Stands that fall into more than one category should be assigned the higher of the applicable priorities.

Harvest priority and impact classes share the same numbering system. A Harvest Priority of 1 (Impact class 1) is the highest priority. Harvest priority and rationale is summarised as follows:

- The first priority in harvesting should be to sanitation harvest in stands that have been under BBB attack for a period of time, but before many of the attacked trees turn grey. Thus sawlog volume can be recovered, while destroying most of the local beetle population. These stands are classed as Impact class 1, and have a Red and Green BBB incidence of over 35%.
- The second highest priority are stands which have a slightly older attack and have a Red and Grey component of over 35%. Recovery of Red trees (dry sawlogs) before they deteriorate into Grey pulplogs is the rationale.
- Third priority is lightly infested stands (Green and Red attack between 20% and 35%, or Impact class 3). These stands are at risk to more mortality, but sawlog volumes will be retained longer than Impact Class 1 or 2 stands.
- Fourth priority is to harvest Impact class 4 stands which are very lightly infested (Green attack <20%) but which have a high hazard based on hazard and risk assessments.
- Lastly, older stands (Impact class 5) which have been heavily attacked and have a high proportion of pulplogs should be salvaged to recover pulp volume and get the stands back into production. Higher site quality stands will have the higher priority.

## INTEGRATED PEST MANAGEMENT ELEMENT - TREATMENT

### Strategy – *Trap Trees*

Little has been done in the way of operational research into balsam trap trees. However it is known that BBB is attracted to large diameter downed logs and possibly to large diameter slash. It stands to reason then that trap trees would serve to attract beetles. Licensees are encouraged to try research level projects with district and regional assistance. Trap trees would probably only be effective if the population of BBB in the stand was relatively low (Stand Class 4 – *Figure* 4-1).

Until specific research or operational experience into BBB Trap Trees is available, the procedures and standards for Spruce Trap Trees may be used on an experimental basis.

## INTEGRATED PEST MANAGEMENT ELEMENT - TREATMENT

### Strategy – *Pheromone Baits*

Pheromone baits specific to BBB are available. Procedures for their use may be obtained from the manufacturer. It is likely that pheromone baits would only be effective if the population of BBB in the stand was relatively low (Stand Class 4 – *Figure* 4-1).

The District encourages the use of pheromone baits in such cases.

## INTEGRATED PEST MANAGEMENT ELEMENT - PREVENTION

### Strategy – *Reduce BBB Breeding Sources*

Since BBB, like spruce beetle, can breed in downed logs and even large slash, it makes sense to lessen the amount of such breeding sources. Licensees can ensure that waste material is minimised or destroyed on their harvesting areas. BBB usually infests the bole at a height over 1 m., so infested stumps are normally not of major concern.

Licensees are also responsible for monitoring large-scale windthrow patches within their allocated areas.

## INTEGRATED PEST MANAGEMENT ELEMENT – PREVENTION

### Strategy – *Hauling Ban and Milling Plan*

A ban on hauling infested logs *may* be warranted if there are susceptible balsam stands near the intended log storage yard. It is doubtful that BBB would exit from a moving logging truck during a short haul, but that possibility exists. Logs, which are infested or suspected of being infested, should not be hauled into the district from outside areas during the flight period. If under special circumstances, log hauling has to take place just before or during the flight period, hot milling will be required.

Hauling bans if required will be implemented on a district wide basis, and this requirement will be written in to Cutting Permit documents. Specific exemptions may be warranted if there are no beetles in that particular area as there is no need to ban the hauling of uninfested trees.

Licensees harvesting infested logs may be asked to provide assurance through a milling plan that all infested logs will be milled within 24 hours of their arrival (Hot Milling). The beetle situation may be worsened if adult beetles are allowed to exit the logs and re-infest nearby susceptible trees.

## INTEGRATED PEST MANAGEMENT ELEMENT – FOLLOW-UP

### *Strategy – Evaluate Practices and Monitoring*

An integral part of the strategy is a monitoring, or feedback loop whereby any actions taken are examined for their effectiveness. Through periodic monitoring, the district forest health forester and the regional entomologist will review the strategies included in the BBB strategy. Issues arising from this monitoring will be incorporated where applicable into subsequent refinements to the plan.

The following schedule outlines when portions of the BBB Strategy will be examined and updated if necessary:

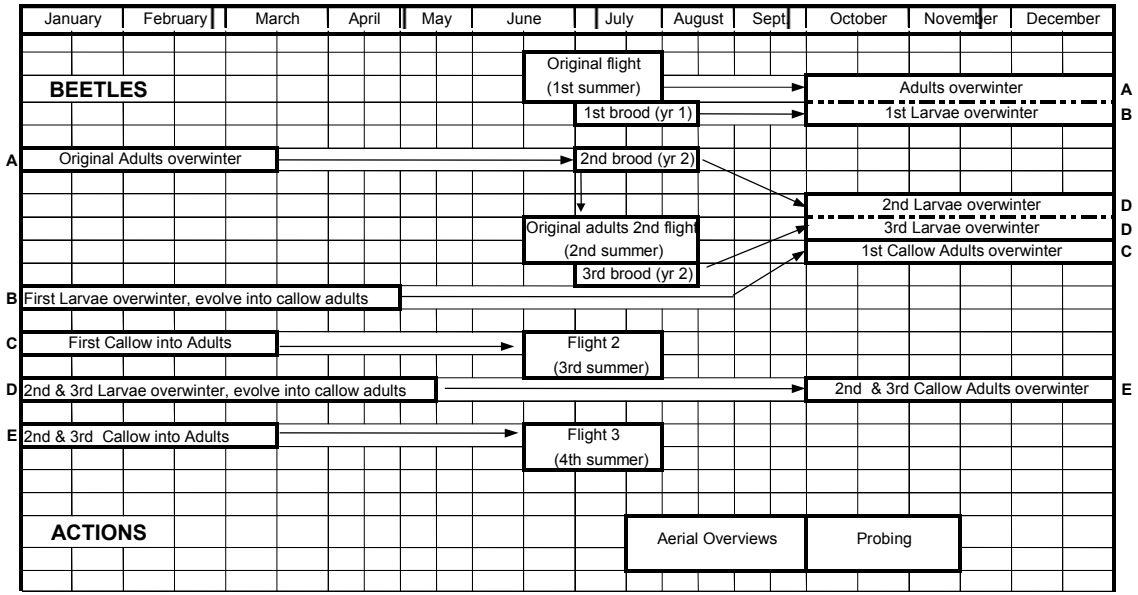
- Hazard Mapping – When warranted by a significant change in Forest Cover.
- Risk Mapping – Annually.
- Treatment Plans – Annually as required
- Harvesting Plans – In conjunction with Forest Development Plans or Amendments.
- Baiting Plans – Annually
- Treatment Thresholds – Biannually if warranted

The following Code list was developed by Bugbusters Pest Management Ltd. and is currently being used by them in ground probing. It is presented here for information only. The Bulkley District will continue to use the codes outlined in *Table* 4-2, until such time as probing codes can be standardised.

*Table 4-5 Balsam Bark Beetle Attack Codes:*

| Tree Code | Phase of Attack | Year and Type of Attack |
|---|---|---|
| **1** | Green Attack, Unconfirmed | Resin and Pitch visible above 2m on bole, but no symptoms at breast height. |
| **2** | Green Attack, Confirmed | Frass and Resin visible on bole or beetles verified under bark in larval stages, at breast height on bole. |
| **3** | Red Attack | Frass and/or resin, some beetles in brood adult phase ready to fly the following season. |
| **4** | Red Tree | Red Foliage, still fairly full crown, but beetles gone. Evidence of beetle activity may or may not be present under bark at breast height. |
| **5** | Grey Trees | Old beetle killed tree, Needles mostly gone (>50% of crown), Most fine branches retained, Bark still intact. Barely merchantable. |
| **6** | Grey Trees | Old beetle killed tree, bark cracked/sloughing off, fine branches mostly gone. Non-Merchantable. |
| **Bo** | Grey Trees | Dead Balsam with no evidence of bark beetle attack. Killed by some other unidentified agent (insect or pathogen). |

*Table 4-6 BBB Calendar of Events*[14]




[14] Letters to right of text continue at left of text.

Dates are approximate and may change slightly depending on local weather conditions

# PINE STEM RUSTS

# CHAPTER 5 PINE STEM RUSTS - STRATEGIES, BULKLEY T.S.A. FOREST HEALTH PLAN

Pine Stem Rusts are potentially one of the most damaging diseases of young pine trees in the area. The Bulkley TSA has four main rusts, which are listed below in *Table* 5-1. The first three rusts are widespread throughout the SBS zone within the district, while the fourth is present only at higher altitudes. All four rusts however are—at present—only of immediate concern in a few local areas (see Risk Maps).

Of the four species of rusts in the area, three belong to the genus Cronartium, and thus have similar life cycles and modes of infection. *Table* 5-1 lists some details on the four primary rusts prevalent in the Bulkley TSA. More detail on rust life cycles is included in the text.

*Table 5-1 Characteristics of Pine Stem Rusts in the Bulkley TSA:*

| Rust Name and Pine Host | Alternate Host | Mode of Infection on Pine | Signs/Symptoms | Rate of Growth |
|---|---|---|---|---|
| *Western Gall Rust* *Endocronartium harknesseii* Lodgepole Pine | None | Epidermis of elongating new growth (candles) | • Hard galls on branch or bole.<br>• Blistered bark. | • Galls grow slowly on bole.<br>• On branches, galls grow slowly, but bole may grow into them. |
| *Comandra Blister Rust* *Cronartium comandrae* Lodgepole Pine | Bastard toad-flax *Geocaution lividum* | Through new needles on stem or branch | • Oval shaped bark canker.<br>• 1.5 times longer than wide. | • On bole, spreads 4.5 cm/year vertically and 3 cm/yr. laterally.<br>• On branches, 2.5 to 6 cm. annually towards bole. |
| *Stalactiform Blister Rust* *C. coloesporioides* Lodgepole Pine | Indian Paint brush *Castellia* spp. | as C*omandra* | • Elongated diamond shaped swollen bark canker.<br>• 10-20 times longer than wide. | • 18 cm/yr. Vertically on bole, 1 cm./yr. horizontally.<br>• Branches, up to 7 cm. per year towards bole. |
| *White Pine Blister Rust** *C. ribicola* Western White and White Bark Pine | *Ribes* species (gooseberries and currants) | as C*omandra* | • Diamond shaped Bark canker. | • Bole - up to 5 cm./yr.<br>• Branch - average 4.5 cm./yr. toward bole. |

***Note that while there is no Western White Pine in the Bulkley, there are a few areas of White Bark Pine. Although not a commercial species, the very survival of White Bark Pine is threatened by White Pine Blister Rust, and the above data is presented for information purposes.**

## *LIFE CYCLES*

### WESTERN GALL RUST: (*ENDOCRONARTIUM HARKNESSII*)

The galls of Western Gall Rust are perennial, hard and woody, ranging in size from 2 to 10 cm. in size. Mature trees may have larger galls on their bole. The galls are noticeable throughout the year. Dead galls will remain on a dead branch until the branch breaks off. Galls on the main stem are often the points at which stem breakage occurs.

Western Gall Rust has a straightforward life cycle. Infections are contained within the woody gall itself, and are not systemic throughout the tree. In late spring, the galls form blisters which burst, releasing orange coloured spores. These spores can travel many kilometres, infecting the elongating epidermis of new growth on branches or the main leader. The same tree may also re-infect itself.

The galls grow slowly in size from year to year, producing a crop of spores every spring, until they girdle and kill the branch or bole. At that point the gall also dies and production of spores ceases. Since branch galls themselves grow very slowly, they are no threat to the tree unless the bole grows into them, thus infecting the bole. At present a distance of 5 cm between the bole and the edge of a living gall is considered the minimum acceptable distance[18]. Branch galls closer to the bole than 5 cm. or on the main bole itself, are considered lethal.

### COMANDRA AND STALACTIFORM: (*CRONARTIUM* SPP.)

The remaining Pine Stem rusts, all being of the genus Cronartium, have similar life cycles. In addition to pine trees, they all have an alternate host; that is, they spend a portion of their life cycle on another distinct herbaceous or shrub species. See *Table* 5-1 for a listing of the rusts and their respective alternate hosts.

In late spring of the year, the flat, rough infection cankers on infected pine trees blister and break open, revealing and releasing bright orange spores. These spores are long lived and can travel many kilometres. Unlike gall rust however, these spores cannot infect other pine trees, only the secondary or alternate host as listed in *Table* 5-1.

On the secondary host, approximately 2 weeks after infection, small colourful growths emerge and soon release spores. These spores can re-infect additional secondary hosts. This may occur a number of times that summer. At the end of the summer, brown hair-like structures appear on the secondary host which soon begin to produce a different sort of spore. The second series of spores produced by the secondary host are carried by the wind to infect pine trees. These spores released by the herbaceous host are fragile and very short-lived. Therefore they are limited to how far they can travel and can only infect pine trees in their immediate vicinity.
The rust infection on the secondary host dies when the leaves drop in the fall or the host dies. The same plant however can be re-infected the next year when the pine host once again releases its spores.

[18] Note that the June 1996 *Pine Stem Rust Guidebook* states a minimum acceptable distance of 10 cm. This was recently changed in the January 1999 revision to 5 cm. That is consistent with Provincial Free Growing Damage Standards.

## COMANDRA AND STALACTIFORM: (*CRONARTIUM* SPP.) CONTINUED

Pine can only be infected through new needles, either on branches or the main stem. One to three years after being infected, the pine host will form an infection blister, which bursts in late spring, releasing orange spores, thus continuing the life cycle.

The pine cankers live a long time, dying only when the branch or tree dies from either the girdling action of the rust or stem breakage. Unlike gall rust, the infection can spread out from the infection canker at a relatively rapid rate (see *Table* 5-1). There is also a portion of infection adjacent to the canker, situated under the bark where it remains invisible to the naked eye.

Comandra rust elongates horizontally almost as fast as it does vertically and thus it can girdle a tree sooner than a Stalactiform canker would. For all *Cronartium* species, any branch gall within 60 cm. of the bole is considered lethal.

The incidence of pine stem rusts has noticeable "wave years" where there are widespread infections throughout a localized area. Although these waves occur approximately every 10 years, they are very difficult to predict. It is thought that optimal conditions of temperature, humidity, and wind are required for this to happen.

The rather narrow wave year phenomenon apparent in rust infected areas suggests that the rust present in an area will not likely increase due to new infestations (the exception being gall rust). However, as infected pine trees may not show cankers until up to 3 years after infection, there is a chance that invisible infections may be present in a stand up until that stand is about 10 years old. After that the rusts should have shown themselves to be present. The incidence of rust in a 25-year-old stand has usually expressed itself completely.

*Table 5-2 Pine Stem Rust Strategies for the Bulkley Forest Health Plan*

| # | IPM Element | *Strategy* | *Rationale* | *Procedures* | *RESPONSIBILITY?*[19] |
|---|---|---|---|---|---|
| **1** | **Identification** | *Establish Hazard and Risk Assessments for Pine Stem Rusts* | • Allows the anticipation of likely pest problem areas and focuses activities on priority areas. | • Map Rust Zone, as well as spot occurrences of rust activity.<br>• Update Risk based on recent surveys. | • District to establish and Maintain.<br>• Updated periodically with survey information. |
| **2** | **Detection and Monitoring** | *To correctly detect Stem Rust activity and record appropriately* | • Correctly Identify Rusts in Surveys.<br>• Keep Risk Rating current.<br>• Anticipate Rust occurrence in high-risk areas. | • Rust identification to be an integral, ongoing part of survey procedures.<br>• Survey with rusts in mind within a 2-km. radius of existing high-risk stands. | • District will co-ordinate training through BSC.<br>• Surveyors will ensure rusts are surveyed and reported correctly. |
| **3** | **Detection** | *Timing of Surveys* | • Survey when Rusts are readily visible. | • All FG or SMP surveys in known rust zone or in suspected rust area to be conducted between June 15 and July 15. | • Surveyors.<br>• Contract Co-ordinators. |
| **4** | **Injury Threshold** | *Assign further surveys or treatments based on severity of rust* | • Concentrate on problem areas; conserve funding. | • Assign survey and/or treatment regimes based on rust severity. Ongoing part of survey activity. Adopt thresholds from GuideBook. (See *Table* 5-3). | • Project planner/ Prescribing Forester. |
| **5** | **Prevention** | *Establish mixed stands in high Rust areas* | • Lower susceptibility of stand to Rust damage. | • In Rust Zone, and where ecologically suited, establish species other than Pine, or encourage mixed stands. | • Licensee. |

[19] Licensee includes SBFEP

Table 5-2: Pine Stem Rust Strategies for the Bulkley Forest Health Plan (continued).

| # | IPM Element | *Strategy* | *Rationale* | *Procedures* | RESPONSIBILITY?[19] |
|---|---|---|---|---|---|
| **6** | **Treatment** | **A:** *Sanitise stand during stocking control treatments* | • Eradicate rust infected stems, leaving healthy stems as crop trees. | • Ensure appropriate contract specifications to deal with rust.<br>• Ensure cutters are trained to recognize rust, and target lethal rust infected stems to be cut. | • Licensee, Contract Co-ordinator<br>• Assistance in Training from DSO, Regional Pathologist. |
| **7** | **Treatment** | **B:** *Stand Tending Treatment Regimes* | • Ensure sufficient crop trees left to cushion subsequent rust impacts. | • Choose **Minimal**, **Alternate** or **Intensive** levels of treatment (see text and *Table* 5-4). | • Prescription writer and project planner. |
| **8** | **Treatment** | **C:** *Timing of Treatment* | • Treat when rusts most visible. | • Limit stand tending activities in Rust zone or in high rust stand to between June 15 and July 15. | • Licensee, Contract Co-ordinator. |
| **9** | **Treatment** | *Rehabilitation* | • Rehabilitation of Stands infected with Rusts | • Likely not necessary except in small areas. | • Licensee/District |
| **10** | **Follow-up** | *Revisit all treated stands in Rust Zone or High Hazard area.* | • Evaluate success of treatment.<br>• Maintain Risk Maps. | • Re-visit (walkthrough) 2 years after treatment, during rust period. Note and map rust incidence if need be. | • District Silv. Officer, and Regional Pathologist. |

*STRATEGIES*

## INTEGRATED PEST MANAGEMENT ELEMENT - IDENTIFICATION

Strategy - *Hazard and Risk Assessments*

**Hazard and Risk:**
It is unclear what environmental factors—if any—predispose a stand to Rust attack. Virtually any young pine stand (less than 25 years old) is potentially in jeopardy of rust infection. The hazard therefore is closely related to the risk i.e. the proximity to current rust infections. Hazard rating on a landscape scale therefore, is simply any pine leading stand less than 25 years old with known rust infections over 5%, or within 2 km. of a known rust infected stand. Risk assessments are accomplished by mapping current rust incidence.

In the Bulkley, the most prevalent rust infected stands are located in the Fulton River area, near Coffin Lake, and along the Bulkley River. A map showing these areas and a list of affected mapsheets is included in Appendix 5-1. This area will be considered the "Rust Zone", and will require special survey and treatment considerations as outlined in the following sections. As results from silviculture surveys become available, the map will be updated as required on a stand by stand basis.

**Procedure –** ***The District will establish and maintain Rust Hazard Maps***

## INTEGRATED PEST MANAGEMENT ELEMENT – DETECTION AND MONITORING

Strategy – *Monitoring and Identification of Rusts*

**Monitoring:**
Rust identification must be an integral part of the management of a stand. It is important to accurately depict rust activity within a stand, and not merely note its presence or absence. Silviculture surveys, especially free growing and pre stand tending surveys or stand management prescriptions should record objective estimates of rust incidence. The species of rust, its position on the tree (branch or stem), location in the block, and percentage of trees lethally affected must all be reported. See Injury Threshold Section for a discussion on survey intensity levels. Surveyors must be skilled in rust identification. The district silviculture officer and regional pathologist can assist in this regard.

Any pine stand less than 25 years old, situated either in the rust zone or within 2 km. of a known rust infected stand, should be examined for rusts at survey time or prior to any treatments. Walkthroughs or reconnaissance level surveys may be carried out to identify rusts. Stands within the Known Rust Zone outlined in Appendix I should be automatically surveyed with rusts in mind.

**Procedure -** ***Stands in Rust Zone, Suspect Zone or within 2 km of a known rust infected stand must be surveyed with rusts in mind and the rust incidence recorded appropriately***

## INTEGRATED PEST MANAGEMENT ELEMENT - DETECTION

Strategy – *Detection and Timing of Surveys*

**Gall Rust:**
Since the perennial woody galls of Gall Rust are readily apparent at all times; no special strategy is required. Surveyors are expected to recognize gall rust and record it accordingly.

***Cronartium spp.***
Infections of Cronartium species are very difficult to detect throughout the year, except when they are releasing their orange or yellow-orange spores, and then they are quite noticeable. This takes place anywhere from May to July, depending on the weather conditions present that spring. A warm spring will accelerate spore production while a cool; wet one will delay it. The period from June 15 to July 15 is thought to be a time period when most spore production will be evident regardless of weather conditions. Surveys to detect rusts, or stand tending treatments in known or suspected rust areas are therefore restricted to this time period.

At other times of the year, the Cronartium rusts are much more difficult to detect. The bark surrounding advanced infections is furrowed and rough, and there may be resin flow near the margin of the canker. The blisters, after they have burst, remain on the tree for a few weeks. Squirrels like to feed on the canker edges, and they often remove the bark on the face of the canker. Branch infections of Stalactiform can often reach into the adjacent bole with little to no symptoms. A flattening of the bole above the infected branch is sometimes evident. This is due to the death of new tissue just below the bark surface. Infected trees often, but not necessarily show red flagged branches or spiked (dead) tops. A stem infection will kill the tree by girdling, but occasionally the infection weakens the tree to the point that it bends over, even while still green. This is often a sign that other infections are present in the stand.

**Procedures –** ***Free Growing and Stand Tending surveys or Stand Management Prescriptions in stands within the Rust Zone, or which are known to have Cronartium species rusts must be surveyed between June 15 and July 15.***

## INTEGRATED PEST MANAGEMENT ELEMENT - DETECTION

### Strategy – *Injury Thresholds*

Injury Thresholds are used for survey as well as treatment purposes. Thresholds are based on the percentage of rust infected stems to total stems. During a survey, a given tree may only be counted once, regardless of the number of infections it has. The survey should note the extent, position on the tree (bole or branch) and location in the stratum or stand, as well as the species of rust. Only lethal infections are tallied and counted towards the total rust infected stems[20]. Non lethal infections should be noted in the comment section.

Survey thresholds are divided into pre-Free Growing (< 15 years stand age) and Stand Management (15 to 25 years) phases. This is due to the fact that rusts may be present but barely noticeable in the first phase, but in all likelihood will have expressed themselves in the second.

Survey thresholds are determined from a silviculture survey, a walkthrough, or a detailed forest health survey. In suspected rust areas, a walkthrough or reconnaissance level survey should be carried out first. Rust information can be quickly gathered on a line survey between regular survey plot centres. The reconnaissance will characterise the level of rust infections in the stand into one of the categories outlined below in *Table* 5-3. Further surveys or stratification may then be necessary. *Table* 5-3 also lists the numerical ranking than can be applied to the Bulkley Silviculture Strategy (BSS) Ranking Key[21] for Forest Health Risk.

*Table 5-3* *Survey Thresholds*
(Note that Treatment thresholds are included in *Table* 5-4.)

| **Stands <15 yr.** | | **Stands >15 yr.** | | **Survey Strategies** |
|---|---|---|---|---|
| % Lethal Infections | Rank for BSS[4] Key | % Lethal Infections | Rank for BSS[21] Key | |
| 0-10% | 0 | 0-15% | 0 | • Continue with Survey, No alteration due to rusts. |
| 10 – 20% | 1 | 15 - 25% | 1 | • Increase Survey Intensity,<br>• Conduct a Forest Health Survey, Stratify block into Rust strata. |
| >20% | 20 | >25% | 20 | • Conduct a Forest Health Survey,<br>• Cancel or Delay Treatment, Consult District Silviculture Office, or Regional Pathologist. |

**Procedure –** ***Survey practices or intensity will be adjusted as per the Survey Thresholds listed in Table 5-3. The BSS Stand Ranking key will reflect the rust incidence.***

[20] This is especially important when assessing Gall rust, as branch infections >5 cm. from the bole may be accepted. In the case of *Cronartium* infections, **All** infections may be considered lethal due to the very restrictive criteria of branch infections being >60 cm. from the bole in order to be non-lethal.

[21] BSS Key is a stand-ranking key contained within the Bulkley Silviculture Strategy. The key takes various factors into account when reviewing a stand prior to treatment.

## INTEGRATED PEST MANAGEMENT ELEMENT - PREVENTION

### Strategy – *Mixed Stands*

The prevention strategy for rusts is to minimise the amount of pine in a high rust area. Where ecologically feasible, other species should be planted, or mixed in with the pine. Planting at a higher target stocking is an option to consider. Its main drawback is the prospect of patchy overstocking, as rust mortality is seldom uniform. Consult with district silviculture officer or regional pathologist if contemplating this tactic.

Research is continuing into genetically resistant pine trees, but this is not yet operationally feasible.

**Procedure -** ***The Prevention strategies listed will be followed.***

## INTEGRATED PEST MANAGEMENT ELEMENT - TREATMENT

### Strategy – *Treatments and Timing*

The presence of rust in a stand does not immediately preclude stand tending as an option, but it must be considered. The success of activities like spacing or pruning may be seriously jeopardised if the presence of rusts is not taken into account.

Any stand considered for stand tending treatment in the Bulkley must be assigned a priority ranking using the ranking key outlined in the Bulkley Silviculture Strategy. Forest health is only one factor in this key, but it is an important one. The ranking key values for various levels of rust are included in *Table* 5-3.

Once it is decided that a rust infected stand is to be treated, the following strategies will apply.

**A: Sanitation**

It is possible to sanitise a stand of rust infections simply by cutting down all the rust infected trees. However, it is often difficult to ensure that 100% of the rust infected trees are identified and removed, and there is a real risk of cutting down healthy trees and leaving invisibly infected ones.

The emphasis on leaving healthy trees and cutting infected ones should be **strongly** stressed to the cutters, even though a rust infected tree may look like a more suitable crop tree. Contract specifications and instructions to the cutters should be clear in this regard.

Leaving a rust infected tree uncut after spacing will not cause the rust to spread (except possibly with gall rust), but it will almost certainly cause the death of that particular tree, which could lead to voids or understocking.

When spacing in a rust infected stand, it is important to recognize the difference between lethal and non-lethal rust infections. This is especially imperative in the case of Gall Rust, as only galls on the main stem or within 5 cm. of the stem are considered lethal. Otherwise suitable crop trees with non-lethal galls need not be cut, and doing so is a needless waste. The *Cronartium* rusts, on the other hand, seldom have non-lethal infections due to the very restrictive requirement to be at least 60 cm. from the bole. Thus all *Cronartium* infections can safely be cut unless otherwise specifically indicated.

Removing canker-infected branches or even incising the canker itself are possibilities to protect individual high value stems, but these are impractical on a large scale. Removing the alternate host of *Cronartium* rusts is likewise impractical.

**Procedure –** ***Stand Tending Contracts will ensure that rust standards are in the contract, and that all workers associated with the project are aware of these standards and can identify rust infected trees.***

**B: Treatment Thresholds**

The primary treatment strategy for Pine Stem Rusts is to cut down rust infected stems, leaving a slightly higher leave tree density to account for any subsequent mortality. *Table* 5-4 outlines the three treatment regimes to follow depending on the amount of rust in the stand.

In lightly infected stands (**Minimal** regime as below), no special requirements are needed, other than instructing the cutters to target infected stems. There will inevitably be some rust trees left behind, but the low level of infection should not overly jeopardise the health of the stand.

*Table 5-4 Treatment Regime Thresholds and Post Spacing Densities:*

| | Pre Free Growing <15 yr. | | Post Free Growing 15-25 yr. | | |
|---|---|---|---|---|---|
| **Treatment Regime** | **Current Rust Incidence** | **Post Treatment Stocking Density** | **Current Rust Incidence** | **Post Treatment Stocking Density** | **Tactic** |
| *Minimal* | 0-10% | Target Stocking (TSS) | 0-15% | Target Stocking (TSS) | Eradicate infected stems |
| *Alternate* | 10-20% | TSS plus 2X current rust incidence. | 15-25% | TSS plus rust incidence | Eradicate infected and leave extra stems |
| *Intensive* | >20% | N/A | >25% | N/A | **Do Not Treat**, or **Delay** Treatment. |

For the **Alternate** regime, it is assumed that some rust infected stems will be missed during the treatment, and extra stems are left to compensate. In younger stands, the target stocking standard after spacing is increased by an amount equal to twice the infected stems per ha. For example a stand (with a final target density of 1000) which has a 15% infection level would have a revised leave tree prescription of 1300 (1000 plus {(2x 0.15) x 1000}). In older stands, the final density is increased by the same amount as the equivalent rust infected stems. At an incidence of 15% rusts, 1150 stems {1000 + (0.15 x1000)} would be left.

For **Intensive** levels of rust i.e. over 20% when young or over 25% when older, spacing is a risky undertaking and should be discouraged, or at least delayed for 3 to 5 years to allow the rust to fully express itself. The district silviculturalist and regional pathologist should be consulted in such cases.

**Procedure -** ***The target post Stand Tending density will be adjusted as outlined in Table 5-4.***

**C: Treatment Timing**
To assist the cutters in identifying rust trees, any stand tending activity in the Bulkley Rust Zone (See Map in Appendix 5-1) or in a stand identified as having a high level of rust must be carried out between June 15 and July 15. This period is when the rust infections are most noticeable and rust infected trees can be easily selected. For any alternate or intensive treatment strategy, stand tending is also restricted to this time period, regardless of where the stand is located.

**Procedure –** ***Stand Tending will only take place between June 15 and July 15 in the areas outlined above.***

## INTEGRATED PEST MANAGEMENT ELEMENT - TREATMENT

### Strategy - *Rehabilitation*

It is rare within the Bulkley that an entire stand is infected with rusts to the point that it falls below minimum stocking, but it is possible to have small portions of a stand so affected. If the voids that result are no more than 3 or 4 tree heights in diameter, then normal juvenile spacing practices of leaving more trees around the perimeter of the void and retaining less than ideal crop trees within the void should be followed. In larger voids, fill planting is an option and if possible, species other than pine should be re-established. Adjustments to the OAF 1 (spatial voids) may be a consideration in severely rust infected stands.

**Procedure -** ***Consult the District Silviculture Officer if large Voids originating from Rust infections are present or suspected.***

## INTEGRATED PEST MANAGEMENT ELEMENT – FOLLOW-UP

### Strategy – *Follow-up Monitoring*

The district will consider follow-up surveys (walkthroughs) a year or two after stand tending treatments in stands in the rust zone, or in a high hazard stand. This will determine the treatment success, and assess the present level of rusts–if any.

The Hazard Maps will be updated biannually as stands enter or leave the rust susceptible time frame (0 - 25 years of age). Risk maps will be updated, as survey information becomes available.

*Appendix 5-1 Bulkley "Rust Zone"*

The following Mapsheets are known to contain young Pine stands with considerable Stem Rust infections. Surveys or treatments therein will follow the guidelines laid out in the previous Strategies.

| | | |
|---|---|---|
| 93L 045 | 93L 065 | 93L 087 |
| 93L 055 | 93L 066 | 93L 088 |
| 93L 056 | 93L 067 | 93L 097 |
| 93L 057 | 93L 077 | |

The following Mapsheets are ***suspected*** of having Rust Infections, but at either a lower, or unsubstantiated level compared to the preceding *Table* . Further surveys will confirm the rust incidence, but in the interim, blocks in this zone should be carefully examined to detect rusts.

| | | |
|---|---|---|
| 93L 074 | 93L 085 | 93M 003 |
| 93L 075 | 93L 094 | 93M 004 |
| 93L 076 | 93L 095 | 93M 014 |
| 93L 084 | | |

Other Mapsheets in the District not listed in the above *Tables* may have Rusts, but normal survey procedures may be followed.

See the attached Map for an illustration of the "Rust Zone"

*Appendix 5-2* *Map*