Skeena-Stikine Forest District

Forest Health Strategy 2011-2012

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1 Introduction

1.1 General Objectives

The objective for the Skeena-Stikine Forest Health Strategy is to identify key forest health factors in the District and to identify the associated non-recoverable losses (NRLs) to the timber supply. It is also intended to clarify the forest health responsibilities for the Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) and the tenure holders operating within the district. The strategy is meant to address both stand and landscape level concerns by providing management tactics for all significant forest health issues. It is hoped that this strategy will help mitigate losses to crown timber from forest health agents, and aid in the management of healthy forests for the future.

1.2 Background

The implementation of an effective forest health strategy can augment and stabilize the timber supply of a TSA by increasing the success of regeneration practices, increasing the productivity of immature stands, and decreasing losses of mature timber due to forest health issues. These benefits imply a reduced risk to silviculture investments and a more stable planning environment, both of which are important to the Ministry and to the timber industry. In addition, ecologically appropriate forest health practices will reduce the risk of wildfire associated with widespread timber mortality, improve public safety in multiple use areas, and lower the risk to non-timber resource values.

The establishment of a proactive framework emphasizing the early detection of forest health problems and the prompt implementation of scientifically sound solutions will allow all licensees in the TSA to take full advantage of potential benefits. It will do this by ensuring that expenditures of resources are necessary, efficacious and cost effective. It is important to note that this strategy can be effective only through the consistent management of forest health agents by all players within the District. And although this Forest Health (FH) Strategy is not a legally binding agreement, it is intended to provide insights into best-management practices, information as to where other guidelines can be found, and a summary as to what activities are currently underway in the District. It should also provide a framework to co-ordinate and guide future forest health activities within the District.

This strategy has been designed to meet current forest health obligations by addressing forest health agents at two levels, at the stand level for most agents, and the landscape level for the epidemic factors. To facilitate this, an overview of each of the most important forest health issues currently active in each TSA within the district, has been included. These overviews consist of a section on the present significance of the issues, how it affects the forest, and possible management tactics. For the landscape level

agents: Bark Beetles and Dothistroma Needle Blight, detailed operational plans have been included. These components are guided by the priorities and objectives of the *Provincial Forest Health Implementation Strategy* and the *Provincial Bark Beetle Management Guidelines* and maintain the goal of protecting *"forest resources from damaging agents that threaten the resources' immediate and long-term value by maintaining a high standard of forest health practice across the land base."* Though the current focus of forest health activities within the District is pest control, it accounts for only a portion of all potential activities.

It is the intention of this Forest Health strategy to incorporate the principles of integrated forest management in order to effectively manage the interactions between our forest practices and the forest health agents that impact key resource objectives, and to apply ecologically sound techniques for the protection and enhancement of resource values. To achieve this goal, it will be important to recognize that, at this time, climate change is having a profound impact on the state of our forests. Therefore, the possible effects of climate change must be considered when managing for a healthy forest. As many of these effects have not yet been identified, maximizing species diversity in managed stands is one of the most effective means of reducing the risks associated with any single forest health factor. As the effects of climate change continue to impact both our managed and mature forests with assaults from Mountain Pine Beetle (MPB), increasing foliar disease outbreaks and ever-greater damage from other previously endemic forest health factors, managing for species diversity will become even more important.

1.3 Area Covered by the Plan

This Forest Health Strategy is confined to the Skeena-Stikine Forest District and is bound by provincial forest health direction. In accordance with this direction, the Skeena-Stikine Forest Health Strategy does not take any responsibility for addressing, reporting or conducting any activities in Parks or on private land or any additional areas excluded from the operational land base. However, when district overview flights are conducted, the intention will be to attempt to include parks and private land, as it is felt that having a complete picture of the forest health situation is the most effective way to manage. And while this strategy can suggest potential actions for these areas, it is up to the persons responsible to make such decisions. For parks, it is the responsibility of the Ministry of Environment to determine if these actions should be undertaken, and for all other excluded areas, it is up to the landholder to decide on their course of action on their property. Major licensees are required to consider forest health information as part of their Forest Stewardship Plan's (FSPs), and should build operational plans based on best management practices. The Wetzin'kwa Community Forest and Woodlot Licensees have many of the same responsibilities as the major licensees with regards to forest health, and are able to access the results of any detailed aerial surveys.

1.4 Primary Objectives, Potential Actions, and Agency Responsible

The following table, modified from the *Provincial Forest Health Strategy*, provides a listing of the primary objectives of the forest health strategy and the potential actions and the agency that would be responsible for their undertaking. The MFLNRO and the major licensees are committed to working proactively together, to ensure that innovative solutions can be found when management conflicts occur due to grey areas of responsibility.

Table 1: Forest Health Actions and Agency Responsibility

Objectives and Potential Actions	Government	Licensees (includes BCTS)	Community Forest & Woodlots
Objective 1 Maintain a detection program for damaging agents over the landbase.			
Conduct the annual aerial overview survey on all provincial forests.	**X**		
Annually compile and report the results of the provincial aerial overview survey.	**X**		
Conduct detailed aerial and ground surveys in identified areas required, to quantify the incidence and intensity of damaging agents to the standard in the appropriate guidebooks.	**X**		
Maintain a record of all survey information for the landbase.	**X**		
Standardize data collection when required to facilitate strategic objectives.	**X**		
Improve and refine detection methods.	**X**		
Objective 2: Assess current and future stand and landscape level hazard and risk from detected damaging agents, including the impact of forest management practices on resource values.			
Use the best current information to determine hazard and risk and probable impacts for all detected and potential forest health agents on the landbase.	**X**	**X**	**X**
Update existing hazard and risk rating as required and as inventories are updated	**X**		
Develop, support and implement modeling of pest dynamics and impact assessments for Timber Supply Reviews.	**X**		
Evaluate and prescribe approaches to deal with introductions of non-native, potentially harmful organisms.	**X**		

Objectives and Potential Actions	Government	Licensees (includes BCTS)	Community Forest & Woodlots
Objective 3: Identify significant pest risks to resource values and identify appropriate management strategies and tactics, while considering constraints and limitations imposed by other resource management imperatives.			
Develop and follow decision-making guidelines that direct the forest health activities by strategic priority.	**X**		
Consider all scientifically sound, forest health management strategies and tactics. New strategies and tactics are always being developed but they must be reviewed by provincial forest health specialists for scientific validity before being adopted as operational practices.	**X**	**X**	**X**
Identify knowledge gaps that limit the ranking and assignment of priorities and hinder identifying appropriate management strategies and tactics. Maintain open communications regarding such issues between licensees and the MFLNRO.	**X**	**X**	**X**
Define provincial performance measures for specific strategies and tactics.	**X**		
Objective 4: Implement mitigating strategies and tactics based on scientifically sound, forest health management practices.			
Assign mitigating strategies where deemed appropriate (include prevention, suppression, exclusion, and eradication through either direct or indirect control tactics Direct treatment efforts to meet the strategic forest health objectives identified in the Skeena-Stikine forest health strategy.	**X**		
Quantify, through TSR, the outcome of selected mitigating strategies and tactics, including doing nothing (e.g. change in quantified yields or diminished future management options).	**X**		
Accelerate implementation of mitigating strategies and tactics to deal with unforeseen outbreaks of damaging agents in a timely manner.	**X**	**X**	**X**
Objective 5: Evaluate results of forest health management practices over the short and long-term and modify practices accordingly.			
Inspect field practices to ensure forest management objectives are met.	**X**	**X**	**X**
Target applied research activities to support scientifically based standards of forest practice on Crown lands.	**X**	**X**	**X**
Review and revise scientifically sound, forest health management practices, as required.	**X**	**X**	**X**

1.5 Climate Change

There is general agreement that climate is changing. Summers have been wetter, and temperatures have been higher. Winters have become warmer, with generally, a reduced snow pack. It has been predicted that due to global warming, we shall see an influx of the Interior Cedar Hemlock (ICH) biogeoclimatic zone into the Bulkley TSA from the west. In the Skeena-Stikine Forest District, the Sub-Boreal Spruce zone is likely to transition to a more ICH-type climate. As the climate changes, there will be associated changes in species composition, growing conditions and climax forest conditions. Climate change is affecting how we manage our forests.

Some of the impacts of climate change have already been felt in this District. These impacts include the current Mountain Pine Beetle (MPB) epidemic, the Dothistroma needle blight infestation, and the widening ranges of many hard-pine stem rusts. To attempt to mitigate these consequences, a combination of short and long-term strategies will be incorporated into the planning process.

Forest health and climate change: A British Columbia perspective, 2010. Alex Woods, Don Heppner, Harry H. Kope, Jennifer Burleigh, and Lorraine Maclauchlan.

- http://se-server.ethz.ch/staff/af/fi159/W/Wo121.pdf or,
- http://frst318.forestry.ubc.ca/files/2013/01/Forest_Health_CC.pdf

2 Ranking of Forest Health Factors

To provide an effective allocation of resources, the identified forest health factors in the district have been ranked by TSA. This ranking incorporates the forest health factors from both the stand management component and the landscape level component of this forest health strategy.

The ranking of forest health factors is based on the following information and considerations:

- The collective knowledge of the Regional forest health specialists and the Skeena-Stikine district staff and local licensees,
- Known or suspected impacts to forest resource values,
- Availability of operational detection and treatment methods,
- Costs and benefits of applying detailed detection and treatment activities,
- Overall level of knowledge about the hazard and risk zones,
- Distribution of pests and current incidence levels,
- Resources required in obtaining missing information necessary for management of the pest.

Bulkley/Cassiar TSAs

Table 2: Ranking of Forest Health Factors by Potential Impact on Forest Management Activities

Very High	High	Medium	Low	Very Low
Mountain pine beetle	Western balsam bark beetle	Tomentosus root disease	Other foliar diseases	Rhizina root disease
	Dothistroma needle blight	Hard pine stem rusts	Various insect defoliators	Lodgepole pine dwarf mistletoe
	Spruce bark beetle	Mammal damage	Warren root collar weevil	Pine terminal weevil
	Abiotic		Spruce weevil	Black Army cutworm
			Stem Decay	Ips

Kispiox TSA

Table 3: Ranking of Forest Health Factors by Potential Impact on Forest Management Activities

Very High	High	Medium	Low	Very Low
Dothistroma needle blight	Spruce bark beetle	Western balsam bark beetle	Warren root collar weevil	Hemlock dwarf mistletoe
	Tomentosus root disease	Various insect defoliators	Other oliar diseases	Eriophyid mites
		Stem decay	Abiotic	
		Mountain pine beetle	Spruce weevil	
		Mammal damage	Rhizina root disease	
			Hard pine stem rusts	
			Northern pitch twig moth	

2.1 Provincial Aerial Overview Survey

The annual Provincial aerial overview survey provides some general data about the conditions of the forests. The table below shows a listing of the forest health agents found in the Skeena-Stikine Forest District, their current status, and a comparison with historical levels as identified from the annual overview survey. This list only consists of forest health agents that can be identified from the air, and ground truthed when funding and logistics can support it.

2010 Summary of Forest Health Conditions in British Columbia
http://www.for.gov.bc.ca/ftp/HFP/external/!publish/Aerial_Overview/2010/FH%20Conditions%202010.pdf

Table 4: Skeena-Stikine FD Historical Comparison of Forest Health Agents

	Forest Health Factor	2010 (ha)*	2009(ha)	2008 (ha)	20007 (ha)	2006 (ha)
Bark Beetle	IBM: Mountain Pine Beetle (mature)	124,310	299,416	64,087	18,403	4,688
	IBS: Spruce Beetle		3,428	0.3	47	102
	IBB: W. Balsam Bark Beetle	309,433	404,835	100,116**	245,307	84,350
	IBI: Engraver Beetle (Ips)		410		0.3	
Insect Defoliators	ID: Insect defoliators (non specific)		1,886		2,550	
	IDB: 2 year budworm	1,287	22,704		519	4,164
	IDH: W. Blackheaded Budworm		1,492			
	IEB: Hemlock Sawfly		1,456			
	IDF: Forest Tent Caterpillars	1,001				
	IDX: Large Aspen Tortix			1,414	1,661	7,926
	ID6: Aspen Leaf Miner	82,844	33,646	5,259		
Foliar Diseases	DF: Unknown Disease		150			
	DFS: Dothistroma	2,553	20,182	38,827	1,558	1,564
	DFL: Pine Needle Cast	38	4,692			
	PDT: Cedar Leaf Blight				720	633
	DLV: Venturia spp.			912	40	
Other	NB: Fire	33,579	15,744	41	37	1,324
	NW: Windthrow		249	160	223	5
	NF: Flooding	83	515	11	193	300
	NS: Slide	3	64	49	232	
	ND: Drought		76			44
	NCY: Yellow cedar decline***		88.6	0.3		

Source: 2010 Provincial overview flight

* area of pest affected polygons

** low level of IBB recorded in 2008 is under-recorded due to a different survey methodology

*** Yellow cedar decline is linked to climate change/hydrology regimes

2.2 Estimated Non-Recoverable Losses for each TSA

As would be expected, forest health issues have a detrimental effect on timber supply. When it comes time to prepare the Timber Supply Review (TSR) for each TSA, there are several methods used for accounting for volume losses due to forest health factors. For TSR, mature timber volume is modeled with the timber growth modeling calculation VDYP. Many types of forest health factors for mature stands are considered to be adequately accounted for within VDYP, and thus, no further loss estimates are required. Those forest health factors which are not adequately accounted for must have a non-recoverable loss (NRL) calculated separately. For the Skeena- Stikine FD the 3 forest health factors of mature stands which presently have additional NRLs calculated are wildfires, windthrow, and mountain pine beetle. In addition, some of the forest health factors which are considered to be pests of young stands are accounted for with the Operational Adjustment Factors 1 and 2 (OAFs) when modeled under TIPSY/TASS. Below is a summary of the estimated NRL's from the Timber Supply Reviews for each TSA in the district.

It is recognized that more analysis is required to evaluate the relative impact of various forest health factors on the timber supply. As information and analysis regarding these relative impacts becomes available, it will be incorporated into the ranking of forest health factors and their associated NRL's.

Bulkley TSA: Non-Recoverable Losses (NRLs) from TSR3 Data (2011)

- **Mountain Pine Beetle** NRL's are being redefined under the current TSR process (2011), and will be calculated based on an MPB projection model. A detailed description of the modeling assumptions used can be found in the Bulkley TSR3 data package released in March 2011. For the base case MPB NRL for the Bulkley, predictions of losses are much lower than the worst case scenario predictions using the BC Provincial Scale Mountain Pine Beetle Model (BCMPB). Although BCMPB has been found to be fairly accurate in its predictions for pure pine stands, it is considered less reliable in predicting losses and spread in those TSA's (such as Bulkley) on the edges of the MPB epicenter with primarily mixed stands. BCMPB results thus define a conservative "worst case scenario" that will be considered through sensitivity analysis.
- **Balsam bark beetle** NRL's have been removed, as it is believed that these losses are adequately accounted for in the VDYP yield curves. Study results gathered and analyzed to date indicate that VDYP yield curves accurately address losses, and therefore no additional volume reductions are required. The regional entomologist is currently conducting a study to determine the degree to which this is true. Although study areas are located in Kispiox, Morice and Lakes TSA's, results are applicable to Bulkley TSA.
- Annual **windthrow** losses were approximated using results of a study conducted by SYMBIOS Research in the 1990's. SYMBIOS assessed data from 51 transects associated

with logged blocks, and 56 transects associated with undisturbed forest. They calculated an average background windthrow level of 0.718 m^3/ha in the undisturbed forest, and determined that windthrow associated with cutblock edges accounts for 4.14 m^3/ha of harvested area. The net increase in windthrow due to harvesting is thus 4.14 - 0.718 = 3.422 m^3/ha. At the 2001 analysis long-term annual harvest area rate (2000 hectares/year) this equates to a net annual loss of about 6,800 m^3 that is not accounted for by the inventory. It is estimated that 20% of cutblock edge-induced windthrow is salvaged, leaving an annual unsalvaged loss of about 5,500 m^3. Windthrow associated with catastrophic wind events is likely to be salvaged so was not included in this analysis.

- **Wildfire** NRL's have been taken from the Bulkley TSR 3 document. Annual wildfire losses were determined from 1977-1996 Northwest Fire Centre wildfire records. Records indicated a total lost volume of 56,818 m^3, which corresponds to an annual loss of about 2,800 m^3. It is estimated that approximately 10% of this volume is salvaged, which leaves an annual unsalvaged loss of about 2,600 m^3.
- The last TSR contained an unsalvaged loss estimate for ***Tomentosus* root rot**. However, Pests of Young Stands (POYS) (e.g. hard stem rusts, leader weevils) and *Tomentosus* occur sporadically in Bulkley plantations. In the absence of localized loss data, losses towards maturity due to POYS, and decreased growth attributable to *Tomentosus*, are assumed to be accounted for through a 5% Operational Adjustment Factor (OAF2) applied to TIPSY yield curves.

Table 4: Bulkley TSA: Non-recoverable losses (Data from TSR 3 2011)

Mountain Pine Beetle	MPB projection model
Windthrow	5,500 m^3/year
Wildfire	2,600 m^3/year

Kispiox TSA: Non-Recoverable Losses (NRLs) (Data from TSR3 2007)

- **Windthrow** data was extracted from the inventory, and the total activity period covers 1971 to 1991 (21 years). No records related to windthrow are available in the inventory for periods prior to 1971 or after 1991. Data selection was limited to the timber harvesting land base of the Kispiox TSA. Cutblock-edge blowdown was not quantified, as no reliable data source exists.
- **Wildfire** data was obtained from the inventory file for fires from 1978 to 1988, and from the Northwest Fire Centre for the period 1989 to 1998. The total activity period for this analysis covers the years 1978 to 1998 (21 years). The inventory file contains records of wildfire and salvage activity beginning in 1958. Wildfire/salvage activity for 1958 to 1977 was not used in data compilation due to the extraordinarily high fire activity during 1958 to 1961 period and the absence of reliable data covering the period 1962 to1977

(i.e. large number of fires and area burned and no records available respectively). Data selection was limited to the timber harvesting land base of the Kispiox TSA. To estimate the volume losses, the total area burned or blown down was calculated. For the same areas, the size of the area salvaged was calculated. The difference represents the unsalvaged area. Volume losses were estimated by using the average volume per hectare for all merchantable stands in the TSA from the draft *Kispiox TSA Inventory Audit* (387 m^3/ha).

- Studies conducted prior to TSR II estimate annual unsalvaged volume of 52,000 m^3/yr due to tomentosus root disease. Unsalvaged losses due to balsam bark beetle are estimated at 138,535 m^3/yr for the first decade and 13,850 m^3/yr for subsequent decades. As part of TSR II a review of VDYP demonstrates that these losses are factored into VDYP yield estimates and as such, no additional volume reductions are required. There is still some uncertainty regarding the appropriate losses to assume for managed stands and the extent to which these losses are accounted for within managed stand yield estimates in the mid to long-term. Operational adjustment factor (OAF) reductions applied to managed stand yield curves may accommodate some of these losses. Operational adjustment factor reductions for tomentosus root disease in managed spruce leading plantations are being refined. These refinements may lead to increases in OAF2 reductions for managed stands which may be examined through sensitivity analysis if the updated information becomes available within the TSR schedule. The Regional Entomologist is currently conducting a study to re-assess balsam bark beetle losses. These results can be used in future timber supply analyses or may be considered as part of the determination process.

These numbers were derived from those in the *Kispiox TSR 3* and the *Cranberry TSR 2*, as they have since been amalgamated into one TSA.

Table 5: Kispiox TSA: Non-recoverable losses (Data from TSR3 2007)

Windthrow	1,132 m^3/year
Wildfire	12,105 m^3/year

Cassiar TSA: Non-Recoverable Losses (NRLs) (Data from TSR2 1999)

- **Wildfire** suppression began in the 1950s, and at that time the level of response to wildfire depended on the number of other fires burning elsewhere in the province. By the 1970s, suppression efforts aimed to extinguish all fires. By 1980, the selective suppression period began, in which suppression efforts were focused around communities, highways, other infrastructure, and valuable timber. Selective suppression has continued from 1980 to the present and was used to estimate NRLs due to wildfire in the *Cassiar TSR 2*.
- **Balsam Bark Beetle (IBB)** was included in the *Cassiar TSR 2* (1999) NRLs calculations. At this point in time IBB would not be calculated as an NRL and would be considered to be

covered under the existing VDYP model. At the time of TSR2, a review of 1994-1996 forest health overview maps revealed that IBB was present at endemic levels in balsam leading stands in several BEC variants, and was building to increasingly severe levels in the ESSF. Endemic levels of IBB were understood to be accounted for in natural stand yield curves (VDYP). The extent to which yield curves include more epidemic IBB levels was uncertain. It was generally believed that yield estimates excluded epidemic losses. Therefore, unsalvaged losses to IBB were investigated for susceptible stands in the ESSF. Interpretation of an operational study conducted in balsam-leading stands in the Bulkley TSA led to the estimation of an annual loss in the Cassiar TSA balsam-leading stands of 0.65 m^3/ha per year. All losses to IBBB were assumed to be unsalvaged.

Table 6: Cassiar TSA: Non-recoverable losses (Data from TSR2 1999)

Western Balsam Bark Beetle	1, 412 m^3/year
Fire	47,200 m^3/year

These numbers are based on information gathered for the *Cassiar TSR 2*.

3 Strategies for Priority Forest Health Factors

3.1 Overview

The stand level management component of this strategy is intended to provide a ranking and an overview of all *significant forest health f*actors [a]ctive in the TSA's of the Skeena-Stikine Forest District, and to provide links to specific strategies for reducing the risk of unacceptab**l**e impacts arising from those factors. These strategies will conform largely to strategies addressed by forest health guidebooks or Ministry of Forests, Lands and Natural Resource Operations (MFLNRO) guidelines; however, strategies that differ from those presented in guidebooks will be identified and justified.

Dothistroma Needle Blight *(Dothistroma septosporum)*

Very High to High priority

Management Objective

- To reduce losses and mortality in stands impacted by Dothistroma
- To prevent similar stand management situations from occurring in the future
- To actively restock those plantations which have become NSR

Ranking Rationale

Dothistroma needle blight is currently considered a high priority forest health factor in the Bulkley TSA and a very high priority in the Kispiox TSA. The Dothistroma needle blight epidemic has developed rapidly and the severity and extent of the damage was not predicted. On a positive note, the *2010 Summary of Forest Health Conditions in British Columbia* noted a marked decline in needle blight infections in the Skeena-Stikine FD in 2010. There was a recorded high of 38,827 ha affected in 2008, followed by a reduction to 20,182 ha in 2009, and a large decline to 2,553 ha in 2010. This dramatic reduction was expected due to the dry summer of 2009. In 2010 the observed occurrences were scattered along the Kispiox River, Kitwancool Lake and adjacent to Moricetown.

Because Dothistroma is considered to be a pest that primarily impacts younger stands, no NRLs have been calculated for the Kispiox or Bulkley TSAs, instead affected stands are assumed to be subject to an extended regeneration delay. Although there has been a reduction in the infection rate in 2010, the expectation is that we will continue to see greater losses of immature pine stands due to the continued climate change predictions.

Dothistroma is not currently considered a forest health concern in the Cassiar TSA, but has been observed as far north as Dease River Crossing which is in the Boreal White and Black Spruce (BWBS dk) biogeoclimatic zone.

Management Tactics

- Incidence levels should continue to be monitored, especially in high-hazard areas in the ICH and SBS subzones. High hazard areas are shown on a map attached in the Appendices.
- Monitor annual precipitation as there is a correlation between infection levels and warm, summer rain and high relative humidity.
- Funding sources (FFT, LBI) will continue to be explored to maintain a comprehensive monitoring and treatment program, particularly in post free -growing stands, and to update management protocols.
- Lodgepole pine is no longer a preferred species for management in the Interior Cedar Hemlock (ICH) biogeoclimatic zone (this is reflected in the current Regional Stocking Standards).
- Species diversity is encouraged during plantation establishment – a maximum of 20% pine is allowed in high hazard areas. Avoid planting pine in cold-air ponding sites. Avoid planting pine in wetter ecosystems and areas of higher relative humidity, for example, adjacent to swamps, watercourses and brushy sites.
- When surveying pre-free growing stands, silviculture surveyors must be well versed in the current *Free Growing Damage Standards* and the *Foliar Damage Assessment Procedure*s.
- When surveying post-free growing stands, silviculture surveyors must apply the *SDM Damage Criteria*, and be well versed in survey standard operating procedures which apply - for example, the Dothistroma survey standards developed for the Kalum and Skeena-Stikine Forest Districts.

Detailed tactics associated with the district Dothistroma program are attached in the Appendices (*Dothistroma Monitoring Program: 2011 Status Report).*

Dothistroma Stand Establishment Decision Aid
Authors: Larry McCulloch, Alex Woods 2008
http://www.forrex.org/publications/jem/ISS50/vol10_no1_art1.pdf

Dothistroma Needle Blight Strategic Plan (2006)
Kalum and Skeena-Stikine Forest Districts

Dothistroma Ground Survey Process Decision Making Matrix
Kalum and Skeena-Stikine Forest Districts

Mountain Pine Beetle *(Dendroctonus ponderosae)*

Very High to Medium priority

Management Objective

- To actively manage mature lodgepole pine stands to limit mountain pine beetle outbreaks (where still feasible) and to assist in the recovery of dead volume.

Ranking Rationale

Overall MPB damage in the Northern Interior Forest Region (NIFR) reduced in 2010 from an all time high in 2009. Some areas continue to experience increased levels of attack, although the rate of MPB activity in the Bulkley TSA has proven slower than predicted.

Mountain Pine Beetle (MPB) is considered a very high priority forest health factor in the Bulkley/Cassiar TSAs. Approximately 26 % of the stands in the Bulkley THLB are dominated by pine. MPB attack peaked in 2009 at 299,416 ha, and reduced in 2010 to 124,310 ha *(Provincial Overview Survey 2010)*. Most of the attacks continue to occur in the southern half of the Bulkley TSA, with a progression northward. It is expected that this kind of loss will continue for the next few years, after which it will decline as available pine stands decrease. A 2009 helicopter flight identified a small amount (192 ha) of MPB mortality in immature lodgepole pine stands in the southern area of the Bulkley TSA. At this point in time there is no expectation of increasing losses in the immature stands of the Bulkley, although the total area of young pine stands impacted by MPB in 2010 for the NIFR increased from 2009. Some of the areas affected, well south of the leading edge of the epidemic, were believed to receive a new influx of beetles brought in by wind.

MPB is a low to moderate priority in the Kispiox TSA due to the relatively small volumes of susceptible lodgepole pine. Beetle Management Unit (BMU) strategies have been assigned for a couple of watersheds in anticipation of an increase in infestation levels. For most of the TSA however, if small infestations occur within susceptible timber types, they can be dealt with using the guidelines laid out in the *Bark Beetle Management Guidebook*.

Management Tactics

The management of mountain pine beetle should conform to those tactics outlined in the *Provincial Bark Beetle Management Technical Implementation Guidelines*, the *Bark Beetle Management Strategy – Bulkley TSA*, and the *Bark Beetle Management Guidebook*.

In the Bulkley TSA, this management revolves around the provincially designated Emergency Bark Beetle Management Units (EBBMU's). These units are used to prioritize treatments and set performance measures – see the Appendices. Incidence levels should continue to be monitored, especially in high-hazard areas in the SBS subzones.

- BMU Management expectations

- Small Scale Salvage continues to be used as a tool to manage MPB attack centres.
- Funding sources (FFT, LBI) will continue to be explored to maintain a comprehensive monitoring and treatment program and to update management protocols.
- When surveying MPB affected low volume stands for potential silviculture investment, surveyors must apply the *SDM Damage Standards* , and be well versed in the silviculture survey standard operating procedures which apply to the funding source – for example, the Forests For Tomorrow survey procedures which are most applicable to MPB damaged post free-growing stands.
- Species diversity is encouraged during plantation establishment.

Further information regarding the district Bark Beetle Operational Program can be found in the Appendices.

Provincial Bark Beetle Management Technical Implementation Guidelines 2003
http://www.for.gov.bc.ca/hfp/health/fhdata/ProvBBStrategy.pdf

Bark Beetle Management Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/beetle/betletoc.htm

Spruce Bark Beetle *(Dendroctonus rufipennis)*

High priority

Management Objective

- To actively manage high hazard mature spruce stands to reduce and limit spruce beetle outbreaks.

Ranking Rationale

Spruce Bark Beetle is considered a high priority forest health factor in the Skeena-Stikine Forest District due to the high percentage of spruce in the district and, a history of sizeable outbreaks which have affected management practices in the past. It is currently at endemic levels in the district and outbreaks are considered on a case-by-case basis.

Management Tactics

Management of spruce beetle should conform to those tactics outlined in the *Provincial Bark Beetle Management Technical Implementation Guidelines*, the *Bark Beetle Management Strategy – Bulkley TSA*, and the *Bark Beetle Management Guidebook*.

The district strategy includes an aggressive management policy towards spruce beetle in order to prevent an epidemic level infestation. Provincial hazard and risk ratings are utilized in the district to determine possible problem areas (map?). In these areas, extra care is taken when harvesting, and potential outbreaks are addressed immediately. In these high hazard areas, larger-diameter spruce, the preferred breeding ground for spruce beetle, will not be left on the

ground following harvesting. It is also possible that pre-falling of spruce trap trees in any proposed cutblock with a high proportion of mature spruce may be required.

Further information regarding the district Bark Beetle Operational Program can be found in the Appendices.

Provincial Bark Beetle Management Technical Implementation Guidelines 2003
http://www.for.gov.bc.ca/hfp/health/fhdata/ProvBBStrategy.pdf

Bark Beetle Management Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/beetle/betletoc.htm

Western balsam bark beetle *(Dryocoetes confusus)*

High to Medium priority

Management Objective

- To monitor for any major outbreaks of western balsam bark beetle, and otherwise, to harvest infested trees as per regular harvest plans.

Ranking Rationale

Western balsam bark beetle (IBB) is considered a high priority forest health factor in the Bulkley/Cassiar TSAs. According to the *2010 Provincial Overview Survey* the incidence of IBB continues to remain high in the Skeena-Stikine - 309,433 ha affected in 2010 at trace levels. Approximately 48% of the stands in the Bulkley THLB are dominated by subalpine-fir.

In the Kispiox TSA, there are large areas of subalpine-fir leading stands that are susceptible to IBB, and therefore, it is considered to be a moderate forest health risk. The impacts of IBB on the timber supply have been examined in the most recent timber supply review, and it is highly recommended that the sample plots from this study be re-examined before the next TSR.

At present the losses from IBB are considered to be captured in the VDYP model. A study is in place which would provide more accurate information regarding the NRLs from IBB but at present this study has been put on hold.

Management Tactics

The attack dynamics of IBB do not lend themselves to direct control actions. Control actions generally mean more logging of the subalpine-fir profile as a preventative measure to decrease the chance of future outbreaks and the resultant loss of volume. At present, management of MPB takes precedence over IBB in the Bulkley TSA. Unless a major outbreak of IBB occurs, management will be restricted to the harvest of infested trees as they occur within harvest settings resulting from typical development planning activities. In the Kispiox TSA, control of IBB is limited to incidental harvesting.

Provincial hazard ratings will be utilized in the Skeena-Stikine District to determine possible problem areas. In these areas, extra care shall be taken when harvesting and potential outbreaks addressed immediately.

Management of balsam beetle should conform to those tactics outlined in the *Provincial Bark Beetle Management Guidelines, the Bark Beetle Management Strategy – Bulkley TSA* and the *Bark Beetle Management Guidebook*.

Further information regarding the district Bark Beetle Operational Program can be found in the Appendices.

Provincial Bark Beetle Management Technical Implementation Guidelines 2003
http://www.for.gov.bc.ca/hfp/health/fhdata/ProvBBStrategy.pdf

Bark Beetle Management Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/beetle/betletoc.htm

Tomentosus Root Disease *(Inonotus tomentosus)*

High to Medium priority

Management objective

- To reduce the impact to forest productivity.

Ranking Rationale

Tomentosus root disease is a medium priority forest health factor in the Bulkley/Cassiar TSAs. Tomentosus is one of the most damaging diseases of spruce in the Kispiox and is thus considered a high priority forest health factor.

Although the MFLNRO inventory appears to account for the mature volume loss in its yield model VDYP (OAF 2), this volume loss estimate illustrates the potential for increased stand productivity if Tomentosus root disease is proactively managed. The impact of Tomentosus root disease on the productivity of second growth stands is being investigated. It is hoped that more accurate Operational Adjustment Factors (OAFs) for root disease may be developed.

Management Tactics

- In the Bulkley or Cassiar TSAs follow the strategies and tactics for Tomentosus root disease management outlined in the *FPC Root Disease Management Guidebook* or consult Regional MFLNRO experts.
- For the Kispiox TSA, follow the *Tomentosus Root Disease Management in the Kispiox* document attached in Appendix X. This document outlines the extreme risk of planting spruce in the Kispiox if the Tomentosus centres are not pre-identified.

FPC Root Disease Management Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/root/roottoc.htm

Abiotic

High to Low priority

Ranking Rationale

Wildfire ranks as a high priority forest health factor in the Cassiar TSA. In 2010, 33,579 ha were burnt in the Cassiar. Other abiotic forest health factors in the district are sporadic and affect very small areas. These forest health agents are snow damage, windthrow, flooding, slides, drought and yellow cedar decline.

Management Tactics

- Wildfires are managed by Protection Branch.
- Plant a mix of species to reduce long term risks.
- Review the Nadina Forest District Windthrow Strategy.

Hard Pine Stem Rusts

Medium to Low priority

Commandra Blister Rust (*Cronartium comandrae)*
Stalactiform Blister Rust (*Cronartium coleosporioides)*
Western Gall Rust (*Endocronartium harknessii)*

Management Objective

- To reduce losses of volume and mortality in young lodgepole pine stands impacted by rusts, and to prevent similar stand management situations from occurring in the future.

Ranking Rationale

Hard pine stem rusts are currently considered a moderate priority forest health factor in the Bulkley and Cassiar TSAs. They can result in significant losses in pine, particularly on those stems in the seedling to pole size range. It is likely that these losses have been accounted for in the current operational adjustment factors. However, hard pine stem rusts are becoming more prevalent in areas previously considered as low hazard. Stands in the vicinity of Tzezakwa Creek on the 4000 Road have been hit particularly hard recently, with incidence levels greater than 50% in some cases. However, the cause behind the distribution of severely damaged stands within the district is not well understood. It is possible that with climate change, this district will experience wetter summers – a likely precursor to higher incidence levels of hard

pine stem rusts. Thus, it may be necessary to look at planting alternate species to reduce plantation risk.

In the Kispiox TSA, hard pine stem rusts were historically of very minor concern. Since the advent of Dothistroma and the reduction in the significance of lodgepole pine for the future timber supply, the hard pine rust risk has been reduced even more in significance.

Management Tactics:

Hard pine stem rust management in the Bulkley TSA should conform to those tactics outlined in the *Pine Stem Rust Management Guidebook*.

- The District has created a High Risk Rust Area Map (Appendix X) to assist in identifying known high rust risk areas within the district.
- In high risk areas where there is a history of significant rust damage, or in areas where the rust incidence is increasing, additional care must be taken when developing planting regimes. Maximizing species diversity through the planting of non-host species is the most effective means of managing this forest health factor.
- Do not juvenile space lodgepole pine stands in high risk areas.
- Ensure that surveyors are fully versed in the identification of rusts and the rust survey standards. Conduct silviculture surveys during the sporulation window (June thru July).
- Any pine leading plantations submitted for FG declaration with 5% total rust incidence or greater, and less than 10 years old will be reviewed by the District.
- The District will run a forest health query from RESULTS, and build a list of known rust affected plantations. A monitoring plan will be established to revisit known rust affected stands, and build a better understanding regarding long term rust risks for the district.

These suggestions are backed by the Northern Interior Regional Pathologist and recorded in FREP report #13 "*Are Free-Growing Stands Meeting Timber Productivity Expectations in the Lakes Timber Supply Area?*"
http://www.for.gov.bc.ca/hfp/frep/publications/reports.htm#rep13

FPC Pine Stem Rust Management Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/PINESTEM/PINE-TOC.HTM

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		

Mammal Damage

Medium priority

Management Objective

- To reduce seedling mortality and damage by small mammals such as voles and hares.

Ranking Rationale

Currently mammal damage is a moderate priority forest health factor. Vole and hare populations and the potential damage their feeding can cause are highly cyclical. At this time, it is believed that the hare population is on the increase. The reforestation of Dothistroma and MPB affected stands has been hindered due to prime habitat conditions for vole and hare – notably the increased cover which provide a protection from predators, and the increased herbaceous growth as a food source. Frank Doyle is currently conducting research on this issue.

Management Tactics

- Incidence levels should continue to be monitored and their priority reassessed at the annual review stage.
- If there is a known risk then the time of planting and stock size should be adjusted accordingly.
- In areas of increasing hare populations, it is important to be aware that planting under canopies generally leads to greater hare damage due to limited predator access. The Forests For Tommorow program experienced problems with hare browse when underplanting below MPB killed stands. It was generally found that the preferred treatment was to remove the dead overstorey prior to reforesting the site. The Dothistroma

reforestation program has trials in place testing the value of seedling protectors and various stock sizes to mitigate hare browsing. Refer to Skeena Stikine FD for a copy of the research report *2009 Annual Report: Mitigating the impacts of Snowshoe Hare browse damage on underplanted seedling trees in Dothistroma infested pine stands.*

- Refer to Appendix X for a chart outlining the *Factors impacting the risk of damage and mortality to unprotected seedlings by snowshoe hares in north central BC*

Stem Decay (Heart and Butt Rots)

Medium to Low priority

Brown crumbly rot (*Fomitopsis pinicola)*
Brown str*ingy trunk rot/Indian paint fungus (Echinodontium tinctorium)*
Red ring rot *(Phellinus pini)*
Schweinitzii butt rot *(Phaeolus schweinitzii)*

Management objective

- To continue to monitor.

Ranking Rationale

Heart rots are a low priority forest health factor in the Bulkley and Cassiar TSAs. Mature and over-mature stands of spruce affected by these rots are often mistaken for stands infected by Tomentosus root disease. There is no known relationship between mature stand infections and subsequent risk to plantations. Heart rots are subject to windthrow events. The losses resulting from brown crumbly butt rot are accounted for in the current decay, waste and breakage factors.

Stem decay fungi are a moderate forest health factor in the Kispiox TSA, due primarily to the abundance of over-mature western hemlock and true firs. A thorough review of the decay, waste and breakage factors for the TSA could have significant implications for timber supply forecasts.

Management Tactics

Incidence levels should continue to be monitored and their priority reassessed at the annual review stage.

Various Insect Defoliators

Medium to Low priority

2 Year Budworm *(Choristoneura biennis)*
Other budworms *(Choristoneura spp.)*

Western black-headed budworm (*Acleris gloverana*),
Western hemlock looper *(Lambdina fiscellaria lugubrosa)*
Hemlock Sawfly *(Neodiprion tsugae)*
Forest tent caterpillars *(Malacosoma californicum pluviale)*
Birch leaf miner *(Fenusa pussila)*
Large aspen tortix (*Choristoneura conflictana)*
Aspen leaf miner

Management objective

- To reduce height and volume losses.

Ranking Rationale

There are several defoliating insects that are considered low priority forest health factors throughout the district, and these insect populations tend to be cyclic. The losses resulting from these insect defoliators are accounted for in the current operational adjustment factors (OAF 2).

Management Tactics

- It is important to report any defoliation as early as possible, as these outbreaks are usually of short duration, and damaged timber may be prioritized for harvest, otherwise the management tactics should conform to those tactics outlined in the outlined in the *FPC Defoliator Management Guidebook*.
- Species diversity in plantation establishment should also be encouraged.

FPC Defoliater Management Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/defoliat/defoltoc.htm

Spruce weevil *(Pissodes strobi)*

Low priority

Ranking Rationale

Spruce weevil is a low priority forest health factor. The losses resulting from spruce weevil are accounted for in the current operational adjustment factors (OAF 2). Stand level climatic factors and topography are the main factors in weevil development and spread. Although it does not cause mortality, the forking, heavy branching and deformities can cause substantial losses in lumber recovery.

Management Tactics

- The best method of dealing with this insect is to ensure that there is a good species mix on the site. This should be included in the stocking standards for high hazard sites.

- Consider leaving mature deciduous trees on site to act as shade trees. The coolness from the shade may reduce weevil survival.
- Delay spacing until trees are 7 m tall.
- Assess adjacent spruce stands for levels of incidence.
- Incidence levels should continue to be monitored and their priority reassessed at the annual review stage.

Create a map – maybe from Art's model – provincial hazard mapping.
Get updated version from Art Stock in Nelson. These sites have been identified in the degree-day hazard rating model, which can be found here:
http://www.for.gov.bc.ca/HFD/library/Frbc1997/FRBC1997MR122.pdf.

Spruce Weevil and Western Spruce budworm Forest Health Stand Establishment Decision Aid
Authors: Don Heppner and Jennifer Turner 2006
http://www.forrex.org/publications/jem/ISS38/vol7_no3_art6.pdf

A Degree Day Hazard Rating System for White Pine Weevil for the Interior of British Columbia
http://www.for.gov.bc.ca/HFD/library/Frbc1997/FRBC1997MR122.pdf

Northern Pitch Twig Moth *(Petrova albicapitana)*

Low priority

Ranking Rationale

This insect can cause damage in lodgepole pine plantations. More work will need to be done to determine its actual impact.

Management Tactics

More information on these impacts may come from the re-measurement of damage assessment plots in the Kalum District. See the *Kalum District Forest Health Strategy* for more information.

Other Foliar Diseases

Low priority

Pine needle cast (*Lophodermella concolor)*
Spruce Needle Blight *(Rhizosphaera kalkhoffii)*
Spruce Needle Cast *(Lirula macrospora)*
Delphinella needle cast *(Delfinella abietis)*
Fir-fireweed rust (*Pucciniastrum epilobii*) -affects true firs
Venturia populina - affects black cottonwood and aspen

Cedar Leaf Blight *(Didymascella thujina)*

Ranking Rationale

While foliar diseases other than Dothistroma needle blight are currently considered low priority forest health factors, the progression of Dothistroma in the Kispiox TSA should be seen as a warning of the potential risk that foliar diseases may pose. This risk may intensify given current predictions of climate change. Currently, the losses resulting from these defoliators are minimal.

According to the *2010 Summary of Forest Health Conditions in British Columbia*, the Skeena-Stikine had a substantial level of Pine Needle Cast infections identified in 2009 (4,692 ha), which then declined to 38 ha (one polygon) in 2010. The reduction in the overall level of Pine Needle Cast in the Northern Interior Forest Region follows the same trend as Dothistroma, and is likely attributable to the drier weather of the 2009 summer.

Management Tactics

Incidence levels should continue to be monitored and their priority reassessed at the annual review stage. Species diversity should also be maintained to ameliorate the risk posed by single species stands.

Warren Root Collar Weevil *(Hylobius warreni)*

Low priority

Ranking Rationale

This insect is considered a low priority forest health issue in plantations of pine and spruce. Unfortunately, recent experience in other TSAs has indicated that there is an increased risk of Warren root collar weevil in plantations adjacent to MPB killed stands. This is related to the migration of adult weevils from dead stands into adjacent plantations - especially in areas where adjacent mature stands of pine have been dead for 4-5 years. This pest is being monitored at the Regional and District levels in various TSAs. Based on this monitoring, the ranking of Warren root collar weevil may increase in the future. A UNBC research project has been completed in the Lakes TSA. The results indicate that there is a pattern of increasing mortality and that mortality should continue to increase in direct correlation to MPB-killed stands

Management Tactics

- Incidence levels should continue to be monitored and their priority reassessed at the annual review stage.

- The use of mixed species in planting will reduce the possibility of damage from this insect.

In the Lakes and Morice TSAs where Warren root collar weevil levels have been more severe tactics to consider in high hazard areas (especially SBSmc subzones in areas where adjacent standing MPB-killed trees have been dead for 5 years):

- Include a general assessment of root collar weevils within the area to be harvested and the adjacent mature pine stands for an indication of weevil populations.
- Delay planting by 2-3 years. Seedlings will not be attacked until they have a root collar of at least 2 cm.
- Plant a less susceptible tree species along cutblock edges. Host species are mainly Lodgepole pine, but also Engelmann, white, and hybrid spruce.
- Reduce duff layers - this includes treatments such as broadcast burning, scarification mounding and disc-trenching.
- Increase planting density - recommend higher than 1600 sph in anticipation of mortality.
- Delay spacing until stand is at least 20 years old.
- Produce hazard and risk mapping.

Warren Root Collar Weevil Stand Establishment Decision Aid
Authors: Larry McCulloch,Brian Aukema,Ken White,Matthew Klingenberg, 2009
http://www.forest-insects.umn.edu/pdfs/2009/09McCullochBCJEM10.pdf

Rhizina Root Disease (Rhizina undulata)

Low to Very Low priority

Ranking Rationale

The risk of plantation failures due to Rhizina root disease have all but disappeared due to a decrease in the use of broadcast burning for site preparation. Consequently, Rhizina is considered a very low priority forest health factor. The losses resulting from Rhizina are accounted for in the current operational adjustment factors (OAF 1).

Management Tactics

Incidence levels should continue to be monitored and their priority reassessed at the annual review stage. Avoid broadcast burning in the Interior Cedar Hemlock (ICH) biogeoclimatic zone.

Engraver beetles *(Ips spp.)*

Very Low priority

Management objective

- Avoid population build-up.

Ranking Rationale

This insect is considered a low priority forest health issue in young pine plantations. Engraver beetle populations increase significantly following MPB epidemics, which could have implications for young pine stands. Recent experience in the Vanderhoof District indicates that there is an increased risk of significant loss in plantations that are adjacent to MPB killed stands. So far in the DSS there have been no reports of significant Ips damage.

Management Tactics

- Spacing in plantations adjacent to MPB killed stands should be avoided.
- Dispose of slash in a timely manner

Dwarf Mistletoes

Very Low priority

Lodgepole Pine Dwarf Mistletoe *(Arceuthobium americanum)*
Western Hemlock Dwarf Mistletoe *(Arceuthobium tsugense)*

Ranking Rationale

Lodgepole pine dwarf mistletoe is currently a very low priority forest health factor in the district. It is possible that losses due to dwarf mistletoe could increase in the Bulkley TSA as MPB spreads and the incidences of small-patch harvesting increases. The losses resulting from Lodgepole pine dwarf mistletoe are accounted for in the current operational adjustment factors (OAF 1).

Western hemlock dwarf mistletoe has been found only in the western-most portion of the Kispiox TSA, in the Mill Lakes area. In other areas of the TSA, old gnarly branches on hemlock trees have sometimes been mistakenly identified as dwarf mistletoe.

Management Tactics

Management tactics should conform to those tactics outlined in the *FPC Dwarf Mistletoe Guidebook*. In stands severely infested with dwarf mistletoe, avoid small-patch harvesting. If that cannot be avoided, openings should be planted with a combination of non-host species.

FPC Dwarf Mistletoe Guidebook
http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/dwarf/dwarftoc.htm

Pine Terminal Weevil *(Pissodes terminalis)*

Very Low priority

Ranking Rationale
This insect is considered a low priority forest health factor in pine plantations.

Management Tactics
Incidence levels should continue to be monitored and their priority reassessed at the annual review stage.

Black Army Cutworm *(Actebia fennica)*

Very Low priority

Ranking Rationale
This insect is considered a low priority forest health factor in plantations of pine and spruce. Damage to plantations can be high if the preferred food-source (herbaceous vegetation) is absent when larvae emerge. The losses resulting from black army cutworm are accounted for in the current operational adjustment factors (OAF 1).

Management Tactics
Incidence levels should continue to be monitored and their priority reassessed at the annual review stage.

Eriophyid mites *(Trisetacus campnodus)*

Very Low priority

Ranking Rationale
These mites are considered a very low priority forest health pest in the Kispiox TSA, but it can cause fairly significant damage in some lodgepole pine plantations.

Management Tactics
There are currently no direct control measures available for this mite, but monitoring their incidence should be continued.

Invasive Plants

Not Ranked

Background
The Provincial Forest Health Program (2007) has identified Invasive Alien Plants as one of its key issues that forest managers face in British Columbia. The introduction and spread of a

variety of invasive alien plant species are adversely affecting ecological, economic, and social values. Among their many impacts, invasive alien plants threaten rare and endangered species, reduce land values and crop and forage yields, and decrease land and aquatic recreational use. They reproduce rapidly, are resilient and can overwhelm existing native vegetation. Invasive alien species are managed in the Skeena-Stikine Forest District through an inter-agency approach directed by the Northwest Invasive Plant Council, as a sub-group of the BC Invasive Plants Council.

Management Objective

- To limit or prevent the introduction or spread of invasive alien species in the district by following the guidance of the Northwest Invasive Plants Council and the BC Invasive Plants Council.

Management Tactics

Report invasive plant locations through the Invasive Alien Plants Program (IAPP), either directly or through the Northwest Invasive Plants Council hotline 1-866-44WEEDS;

- Recognize and report the 5 main invasive plant species of concern in the Skeena-Stikine District:
  - Field Scabious (*Knautia arvensis*),
  - Orange Hawkweed (*Hieracium aurantiacum*),
  - Common Tansy (*Tanacetum vulgare*),
  - Marsh Plume Thistle (*Cirsium palustre*)
  - and Burdock (*Arctium spp.*)

http://www.agf.gov.bc.ca/cropprot/weedguid/weedguid.htm#regional

- Promote awareness and facilitate species identification programs.

Northwest Invasive Plant Council website
http://www.nwipc.org

MoFR Invasive Alien Plant Program (IAPP)
http://www.for.gov.bc.ca/hra/Plants/index.htm

Invasive Plant Council of BC– TIPS/best management practices
http://www.invasiveplantcouncilbc.ca/resources/targeted-invasive-plant-solutions-tips

4 Current Forest Health Activities

Mountain Pine Beetle BMUs

The majority of BMUs.

The Bulkley TSA became eligible for Forest For Tommorrow funding as of 2008. This funding allows for the surveying and reforestation of not satisfactorily restocked (NSR) stands without existing lisencee obligations. To date, a small area of MPB affected immature lodgepole pine has been identified for ground surveying in 2010 for potential treatment.

Spruce Bark Beetle BMUs

Dothistroma Monitoring and Reforestation

Underplanted SX Trials

In April 2010 the key messages supplied through Frank Doyle's research were:

- The high understorey herb-shrub growth that is evident in Dothistroma and MPB attacked stands has created ideal hare habitat.
- When planting trials were initiated, at what we now know was the decline in hare numbers, up to 70% of underplanted spruce seedlings were browsed.
- New growth is now clearly evident, on any seedlings that survived the last hare peak.
- Assuming the hare population trend fits with other monitored northern hare populations, we will see a dramatic increase in hare numbers over the next few years, and a comparable increase in damage /mortality to seedlings trees.
- Predictably, sites with low understorey cover (<30% cover, >0.5m high) have the lowest rates of hare browse damage on seedlings.

Ongoing questions -as hare populations increase:

- For unprotected seedlings will the new growth be subsequently browsed?
- Within the SX Trials, how effective will the tree shelters and other planting strategies be at mitigating future high rates of hare browsing?
- Which strategy will ultimately result in acceptable (and cost effective) stocking standards in underplanted Doth and MPB stands?
- Will we see comparable high rates of seedling browse in both underplanted, and harvested Doth (MPB) stands as a result of the now established high understorey herb-shrub cover?

Rust Hazard and Risk Rating

Further work is required to create a known Rust Risk map for the Skeena-Stikine FD.

Stand Development Monitoring

FREP and the SDM team, have developed the Stand Development Monitoring (SDM) protocol. It is designed to provide the MFLNRO with updated information on the productivity and health of free-growing stands 10+ years after declaration.

The free-growing declaration is currently the last mandatory entry of stand attributes used in the forest inventory system for stands between that early stage of development and possible harvest decades in the future. Given climate change and its affects already manifest in the forests of BC we may no longer be able hold such a high degree of confidence in our managed stand assumptions and perhaps instead should rely on improved monitoring. SDM will provide data to check both the basic assumption that free-growing stands remain on a productive stable growth trajectory and the assumptions embedded within the growth and yield model used to forecast future stand productivity. Such information is clearly relevant to the sustainable forest management certification process and can be used to validate criterion and indicators.

SDM data can ultimately be used to support revision of standards associated with current practices and in so doing support adaptive management of this critical stage in forest management. Such adaptive management techniques will be essential under climate change.

Given its direct tie to management practices through the use of operational silviculture records, SDM is uniquely positioned to become both the provincial MFR mid-rotation stand monitoring protocol, as well as the benchmark measure on which to base a systematic approach of adaptive management for those same silvicultural practices.

General Objectives of Stand Development Monitoring

A. To assess the health and productivity of young stands in BC under changing climatic conditions.
B. To review the effectiveness of government policies and reforestation practices that govern managed stand initiation and management decisions.
C. To support sustainable forest management (SFM) certification processes.
D. To develop in-house expertise within the Ministry of Natural Resource Operations (Forest Districts) regarding the health and productivity of managed stands in their respective Timber Supply Areas.

The Skeena-Stikine FD will be undertaking training in the SDM monitoring protocol, and will undertake collecting SDM samples to meet the FREP sampling requirements for the district.

Woods, A. 2010. *Stand Development Monitoring (SDM): What have we learned so far, and how can this help us adapt to a changing climate?* Presentation on March 18, 2010 in FORREX Online Webinar Series
http://www.forrex.org/program/forest/ESM/PDF/Webinars/Forest_Productivity_Research/PPTs/Woods_18Mar10.pdf

Woods, A. 2010. Forest and Range Evaluation Program Stand Development Monitoring (SDM). Forest and Range Evaluation Program, BC Ministry of Forests and Range, Victoria, BC. FREP Extension Note #10.
http://www.for.gov.bc.ca/ftp/hfp/external/!publish/FREP/extension/FREP_Extension_Note_10.pdf

5 Conclusion

The Skeena-Stikine Forest District relies heavily on its forested land base, to provide a perpetual supply of various forest resources: for employment, recreation, water, and the future. It is therefore important to keep the forests as healthy as possible by monitoring all current and emerging forest health issues within the district. This includes conducting annual overview flights, keeping tabs on any emerging forest health issues, and addressing current forest health agents with all available resources. Additional information on the detection, the treatments, or the current status of forest agents can be accessed through the Forest Practices and Investment Branch website (http://www.for.gov.bc.ca/hfp/health/index.htm), through the *Field Guide to Forest Damage in British Columbia (http://www.for.gov.bc.ca/hfp/publications/00198/)*, or through the Forest Practices Code guidebooks. Links to resources have been provided throughout the document.

6 List of Resources

7 Appendices

APPENDIX 1: Bark Beetle Operational Plan

Bark Beetle Operational Plan

7.2 Introduction

Pine volumes comprise approximately 25% of the Bulkley inventory. Pine-leading stands are unevenly distributed in the TSA. Extensive concentrations occur in certain landscape units (Babine, Torkelson, Deep Creek, Chapman , Reiseter, Harold Price, Nilkitkwa, Telkwa, Copper, Kitseguecla/Trout), but concentrations are scattered in remaining units (Bulkley Valley, Corya, Blunt). Mountain Pine Beetle (MPB) has historically been present in the TSA at endemic levels.

Until 2003, MPB infestation areas were localized and treatable. Detailed aerial overview surveys were conducted annually and infestation centres were marked by GPS waypoint. Waypoints were coded and successfully treated as "fall and burn", "small-scale salvage", "harvest" or "no treatment".

Since 2003, a major MPB epidemic centered in the BC interior has been occurring. Fortunately, strong westerly prevailing winds slowed spread into Bulkley TSA. Provincial Forest Health Overview Survey flights reveal that spread of the epidemic did occur from 2003-2008 in south and east central Bulkley landscape units, resulting in significant pine mortality.

However, since 2008 the spread of the epidemic through Bulkley TSA has slowed considerably. It is also understood that the MPB epicentre has started to collapse.

- 2009 detailed aerial overview surveys with follow-up transect and waypoint-based ground probing revealed that concentrations of Babine, Torkelson, Harold Price, and Blunt LU pine-leading stands are being affected by pockets of infestation as opposed to a continuous wave of attack.
- beetle management unit designation flights conducted in 2009 and 2010 over the entire TSA revealed very few units with extensive new spread, with exception of certain concentrations within Nilkitkwa, Harold Price, Trout Creek, and Telkwa.

For the base case, it is assumed that Bulkley TSA current infestation levels will stay static – i.e. Bulkley will not experience future waves of attack from the MPB epicentre. Infestation levels will revert to previous endemic status within next 2 decades, with the exception of a few infestation pockets.

It is assumed that major licensees will target <u>all currently</u> infested, red or dead sawlog potential Pli-leading stands for harvest over the next 2 decades to maximum levels permitted by land base constraints. 2010 Provincial overview survey results are used as the basis for defining the extent of the current infestation. Provincial overview spatials are used to group pine-leading types; the overview survey call on degree of infestation is then applied to the pine component of the grouped types per the following table.

Table 1 Provincial overview survey severity codes and stand mortality assumptions

Severity	% trees in polygon with red attack	% assumed for TSR
Trace (T)	<1	1
Light (L)	1-10	5
Severity	**% trees in polygon with red attack**	**% assumed for TSR**
Moderate (M)	11-30	20
Severe (S)	31-50	40
Very Severe (V)	>50	75

It is assumed that sawlog potential of the pine component of pine-leading stands will persist for 5 years (with the year of analysis set as year 0), after which if not already harvested by the model it will revert to pulp. An (HMM + 5 year) stand quality code shall be developed for currently infested stands using this assumption.

It is assumed that dead pine will persist as standing inventory for 15 years, after which if not already harvested by the model it will fall down. Thus after 15 years this volume will be removed from the inventory to be counted as NRL (pro-rated over a 5-year period). An (HMM + 15 years) stand quality code shall be developed for currently infested stands using this assumption.

After 20 years, it is assumed that MPB NRL's will revert to their previous historic levels as defined for TSR2 (3,000 m3/year).

Results from the BC Provincial Scale Mountain Pine Beetle Model (BCMPB) project depict a different near-future condition for Bulkley forests. BCMPB predicts that the beetle infestation is expected to overrun Bulkley TSA by 2016, and that cumulative pine mortality is expected to rise from 19% in 2010 to 71% in 2016 before tapering off to a 2% or less increase in following years.
Although BCMPB has been found to be fairly accurate in its predictions for pure pine stands, it is considered less reliable in predicting losses and spread in those TSA's (such as Bulkley) on the edges of the MPB epicenter with primarily mixed stands. BCMPB results thus define a conservative "worst case scenario" that will be considered through sensitivity analysis.

7.3 Background

In response to government policy and direction associated with Defined Forest Area Management (DFAM), a Bulkley Timber Supply Area (TSA) DFAM was established in early 2003. This sub-committee included representatives from West Fraser (Pacific Inland Resources), Canfor (representing Moricetown Band Council), BC Timber Sales,

and the Wetzin'kwa Community Tenure and it established strategies for managing forest health obligations in the Bulkley TSA. Since then, although the responsibility for Forest Health activities and strategies has been returned to the government, the original sub-committee has agreed to continue to manage certain forest health issues in the area as members of the Bark Beetle Management Committee. The committee maintains as a primary goal the fulfillment of its Bark Beetle obligations in the Bulkley TSA. These obligations include:

- Conducting bark beetle detection activities;
- The preparation of an annual tactical plan describing bark beetle treatments.
- Conducting treatment activities recommended in the tactical plan.
- Preparing annual report on the effectiveness of the tactical plan

This operational plan has been designed to meet these obligations by addressing all bark beetle suppression activities. These components are guided by the priorities and objectives of the Provincial Forest Health Strategy and the Provincial Bark Beetle Management Strategy and maintain the goal of protecting *"forest resources from damaging agents that threaten the resources' immediate and long-term value by maintaining a high standard of forest health practice across the landbase."*

The Forest Investment Account (FIA) currently delivers funding of Beetle Management Activities.

Bark beetle activities in the Kispiox TSA have been limited as there is relatively little mature pine inventory, and consequently very little MPB, and the Cassiar TSA has thus far escaped any significant MPB incursions due to its location.

7.4 Bark Beetle Management Committee

Committee members consist of the following agencies:

- Pacific Inland Resources (a Division of West Fraser Mills Ltd.);
- British Columbia Timber Sales – Babine Business Area;
- Moricetown Band Council (Represented by Canfor, Houston operations)
- Ministry of Forests and Range, Skeena Stikine District (Stewardship and Tenures);
- B.C. Parks (Represented by the Ministry of Environment).
- Wetzin'kwa Community Forest Tenure

All agencies have further agreed that operations within the Bulkley TSA will be guided by the ***Bulkley Bark Beetle Committee Terms of Reference*** (refer to Appendix 1).

7.5 Budget

Currently, the Bulkley TSA is allocated funding through the Forest Investment Account (FIA) to cover bark beetle management activities. The Bark Beetle Management committee makes suggestions regarding how much money they believe will be necessary to complete anticipated MPB management activities for the upcoming year. Yet ultimately, funding decisions are made at the provincial level. Therefore, implementation of forest health activities, specifically bark beetle management, will be undertaken on a priority basis and will not exceed the allocated budget; treatments will be limited to fund availability. In 2009, FIA funding was non-existent, severely restricting the scope of beetle management activities for 2009-10.

7.6 Management Overview

The goal of the bark beetle suppression component of the Forest Health Strategy is to address the serious bark beetle problem occurring within the Bulkley TSA. The impacts from mountain pine beetle, spruce bark beetle, and balsam bark beetle are not limited to timber losses; there are also significant impacts on recreation, fish and wildlife, watershed management, range, landscape and aesthetics, cultural heritage and other resource values. Bark beetle suppression strategies will be developed and implemented with due consideration for these other resources, while maintaining a strong economic approach rooted in providing a mid and a long-term supply of fibre to the local mills. Any bark beetle suppression strategies must also consider several objectives outlined in the provincial MPB Action Plan. These objectives are to:

1) Encourage immediate and long-term economic sustainability for communities;
2) Maintain and protect worker and public health and safety;
3) Conserve the long-term forest values identified as Objective Set By Government in Higher Level Plans and Forest and Range Practice Regulations;
4) Recover the greatest value from dead timber before it burns or decays, while respecting other forest values;
5) Prevent or reduce damage to forests in areas that are susceptible but not yet experiencing epidemic infestations;
6) Restore the forest resources in areas affected by the epidemic;
7) Maintain a management structure that ensures effective and coordinated planning and implementation of mitigation measures.

Balancing such diverse objectives will require careful planning. Therefore, the bark beetle suppression strategies outlined here will provide tactical guidance to forest managers in their attempts to control the spread of bark beetles and to minimize the loss of crown timber and other non-timber resource values. These strategies provide the basis for the Beetle Tactical Plan. This tactical plan and its associated strategies are

consistent with the methods outlined in the Provincial Bark Beetle Management Guidelines. The Bulkley Tactical Plan will be updated annually and contain Beetle Management Unit (BMU) strategies, targets for detection and treatments, and estimated costs for carrying out detection and treatment activities.

7.7 Management Tactics

An array of potential management tactics are available to assist the forest manager in achieving the performance measures attached to each of the provincial bark beetle management strategies. The selection of the appropriate tactic will attempt to balance the risk from beetle infestations and the need to maintain other resource values. To facilitate this balance, particularly where there are constraints due to other resource values, a decision matrix has been developed. This matrix identifies the range of tactical options available to address beetle suppression, given the constraints related to specific resource values. This matrix has been developed to address both mountain pine beetle and spruce bark beetle management issues. Because the nature of balsam bark beetle attack dynamics do not lend themselves to direct control actions, other than the harvesting of infested trees, no matrix has been developed for this forest health factor at this time. Due to recent changes in management direction regarding the protection and usage of certain forest resources, this matrix is expected to be revised soon.

Table 2: Spruce and Pine Beetle Decision Matrix

Area Type	***Treatment Tactic*** *(See Table 3)*		
	Low	***Moderate***	***High + Extreme***
Protected: (Core, SMZ-1, Wildlife Habitat Management Areas and Riparian Reserve)	6	6	1,3,4,6
Comments: Harvesting for forest health reasons should only be considered if adjacent timber, outside of the Core, is at risk. (See Risk Rating Table 5 or 7) Refer to LRMP and Higher Level Plans for restrictions.			
7.7.1.1.1.1.1.1 (Special Consideration: *7.7.1.1.1.1.1.2 (Landscape Corridor, Riparian Management Zone)*	1,3,4,5,6	1,3,4,5,6	1,3,4,5,
Comments: • Refer to Bulkley Higher Level Plans for restrictions.			
7.7.1.1.1.1.1.3 Minimal Constraints: *7.7.1.1.1.1.1.4 (Enhanced Timber Development, Integrated Resource Management, SMZ-2)*	1-6	1-6	1-6

Comments: Harvesting will be encouraged where practical and efficient.

This decision matrix is based upon the bark beetle suppression treatments, listed in the following table, which can be utilized for controlling both pine and spruce beetles.

Table 3: Bark Beetle Suppression Tactics

Tactic Number	*Bark Beetle Treatments*
1	Fall and Burn
2	Pheromone baiting/Trap Tree – Hold to Log
3	Single tree harvesting of infected trees
4	Small scale salvage (<1.0 hectare patches)
5	Standard harvest practice (retaining other species)
6	No treatment

Hazard and risk ratings are two important tools that can be utilized in beetle planning, and they were both considered when constructing the tactical matrices. Both hazard and risk ratings have distinct meanings. They can be used to identify target stand before they are attacked, and to estimate the risk to a stand located near one that has been hit by beetles.

Hazard ratings are an estimate of how vulnerable a certain type of tree or stand is to attack by beetles. They are functions of tree or stand characteristics, and are dependent upon qualities such as the percentage of the target species in the stand, the age class of the stand, and the site index. This ranking can be used for long-term planning; to pinpoint extreme or high hazard stands in an attempt to prevent beetles from moving into an area.

Risk ratings are estimates of the probability and expected severity attacks by beetles, and it is dependent is some manner upon the hazard rating. It depends on the location of current infestations adjacent to high or extreme hazard stands. It is a ranking that can also be used in tactical planning, although it is only relevant in the short-term. Stands need to be re-assessed for risk every year – after beetles have flown.

Hazard and risk tables have been constructed for both Spruce Beetle and Mountain Pine Beetle, and these tables can be found in the corresponding sections of this document.

7.8 Reforestation considerations

As with all other forest pests, it is important to factor in the possible effects of climate change when planning for the reforestation of beetle affected areas. At this time, the most effective tactic is to consider planting with a variety of species and thus limiting forest monocultures, which become high hazard beetle forests.

7.9 Emergency Bark Beetle Management Units (EBBMU's)

The Bulkley TSA has been divided into fourteen EBBMU's. The division of the TSA into these units aids in the planning of treatments and the dispersal of Bark Beetle funds from the government. There are three management phases, each of which has specific targets that must be met in order to maintain its designation. Each EBBMU has been given one of these designations based upon what level of treatment is appropriate. This is determined by considering the current level of MPB in it, the success of the previous year's tactical plan, and which treatment can be pursued. The government updates EBBMU's annually, after consultation with the District. During all phases, the goal is to limit the effect of the MPB infestation on our forests while maintaining both the timber supply and all Land and Resource Management Plan (LRMP) values. For all planning purposes, in the Bulkley TSA, Beetle Management Unit (BMU) strategies are to be consistent with EBBMU strategies.

The first phase is labelled 'Aggressive', and in this phase, an attempt is being made to control, or limit the spread of the MPB infestation. It is expected that 80% of the infestation will be treated or attempted to be treated. Treatments utilized in this phase include **fall & burn, bait to hold, and harvesting**. Every effort is made in this phase to target affected pine and leave all other trees – thus helping to maintain the mid-term timber supply.

The second phase is called 'Containment', and a BMU moves into this phase once 80% of all the infestation sites can no longer realistically be treated. In the Containment phase, an attempt is being made to contain the infestation through **harvesting** of both high/extreme hazard and high risk pine stands. Fall & burn is no longer considered an effective treatment in this phase.

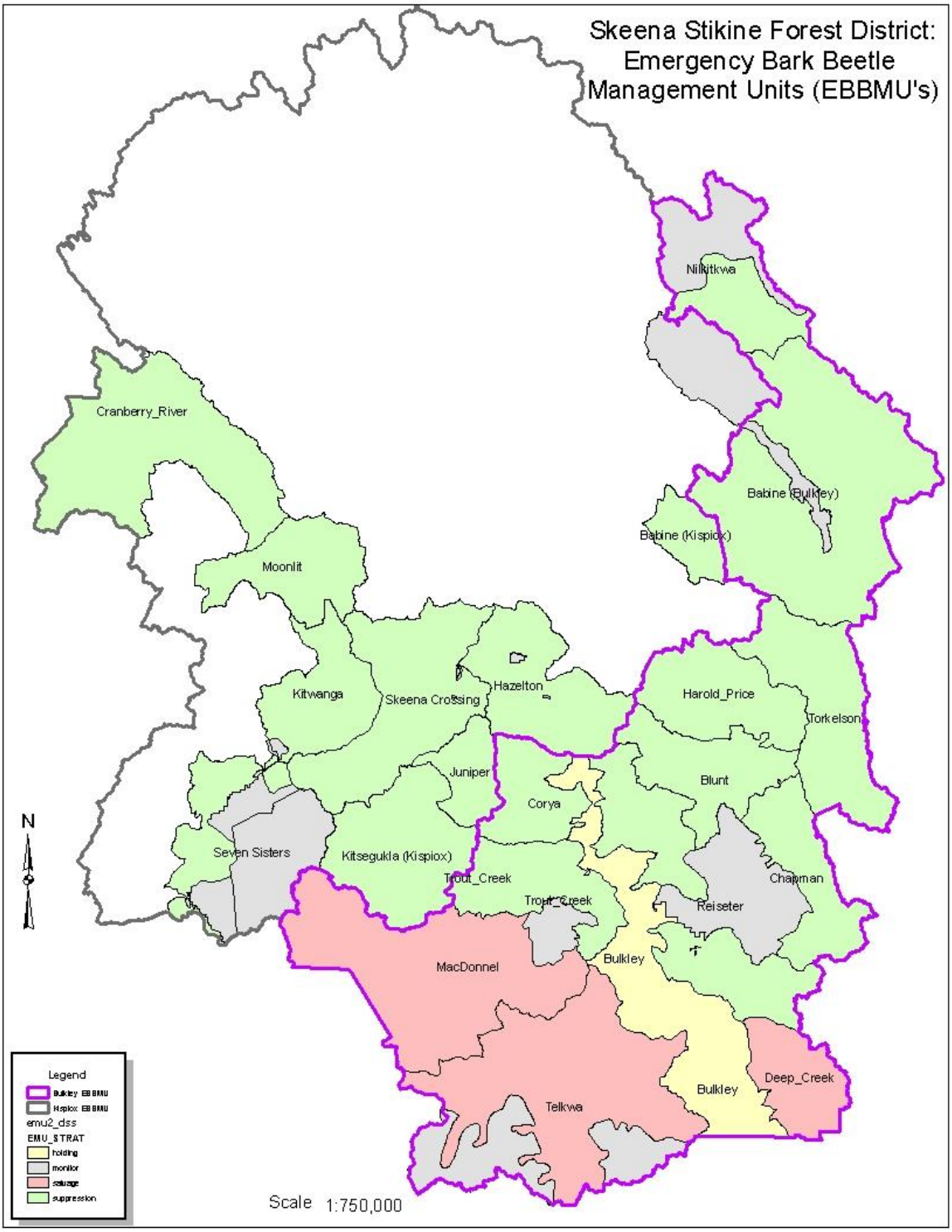
The third phase is called 'Salvage', and this phase begins when it is no longer possible to harvest 80% of the current beetle attacked trees. In this phase, the focus of harvesting is on high risk and hazard stands while protecting the components of other species in those stands, and in extracting value from beetle killed stands.

The EBBMU's located in the Bulkley TSA are:

- Copper;
- Telkwa;
- Kitseguecla;
- Corya;

- Trout Creek;
- Bulkley;
- Deep Creek;
- Chapman;
- Reiseter;
- Blunt;
- Harold Price;
- Torkelson;
- Babine;
- Nilkitkwa.

The associated geographic areas of responsibility are shown on the following map. Details regarding management strategies and estimated costs for implementing these strategies are provided in the tactical plan.


Skeena Stikine Forest District:
Emergency Bark Beetle
Management Units (EBBMU's)
Nilkitkwa
Cranberry_River
Babine (Bulkley)
Babine (Kispiox)
Moonlit
Kitwanga
Skeena Crossing
Hazelton
Harold_Price
Torkelson
Juniper
Corya
Blunt
N
Seven Sisters
Kitsegukla (Kispiox)
Trout_Creek
Trout_Creek
Chapman
Reiseter
MacDonnel
Bulkley
Bulkley
Deep_Creek
Telkwa
Legend
Bulkley EBBMU
Kispiox EBBMU
emu2_dss
EMU_STRAT
holding
monitor
salvage
suppression
Scale 1:750,000

Provincial hazard and risk ratings have been modified for use in the Bulkley. They are used to red flag areas where certain treatments may be more appropriate, and to prioritize treatments.

Table 4: Hazard Rating – Pine

Hazard Class	*Criteria*
Extreme	- Pine Leading Species (>70%) - Age Class 5 – 9 - Site Index – All
High	- Pine Leading Species (50-69%) - Age Class 5 – 9 - Site Index – All
Moderate	- Pine Secondary Species (21 – 49%) - Age Class 5 – 9 - Site Index – All
Low	- Pine Leading - Age Class <5 - Site Index – All

Table 5: Risk Rating – Pine

Risk Rating	*Description*
Extreme	Extreme Infestations in the stand –more than 30% green attack
High	High Infestations in the stand – more than 10- 30% green attack.
Moderate	Moderate Infestation in the stand - Less than 10% green attack.
Low	No Green attack

MPB Tactical Plan Overview

In the Bulkley TSA, a similar process is followed every year to address the current MPB infestation.

Helicopter Overview Flight and Tactical Plan

In late August or early September of each year, a MPB overview flight is conducted. All BMU's that are currently in the Aggressive phase are flown by helicopter. If additional funding is available, other high-priority areas, such as parks, may also be flown. With this flight, all sites in the TSA with three or more red, and likely MPB trees, are globally positioned (GPS'd). These infestation centers are commonly referred to as waypoints.

All waypoints are then mapped onto District ortho photos and assigned a preliminary treatment tactic by the forest tenure holder who is responsible for treatments in their operating area. These treatments are grouped into four basic treatments:

- Timber harvesting;
- Fall & Burn;
- Hold to Log;
- No Treatment.

The treatments assigned at this stage are based upon several variables. These could include, but are not limited to:

- Access to the general area of the site;
- Distance of the site from established roads;
- The number of red trees in the waypoint;
- Stand hazard and risk;
- The historic infestation levels for the area.

No treatment is a treatment generally only selected where the infestation levels are low, and/or the stand MPB hazard is low, or the area is within an Ecological Reserve.

This information forms the basis of the Tactical Plan. This plan is used to guide treatment activities, and considers current infestation levels, as well as past and anticipated future harvesting opportunities. Treatments chosen at this stage may change after the sites have been visited during the detailed ground probing. The tactical plan is completed by November 30 of each year.

On-the-Ground Probing

Detailed on-the-ground beetle probing usually begins in mid-September and is completed by November 30th for most activities; by February for search and destroy treatments. All sites that have been determined to be likely candidates for timber harvesting or for fall & burn are visited by probing crews. These crews ascertain the numbers of green trees that are infested with MPB (current attack).

Based on these numbers, final decisions are made as to what treatments will be carried out on each of the sites visited. In some cases, where current infestation levels are low or if the sites are in stands with very little pine, 'no treatment' is recommended. In areas where the infestation levels are high, a final determination on harvesting or fall & burn treatment is made based on the size of the infestation and the available access to the site.

Fall & Burn

Fall & Burn activities generally start in November and continue through to March. This treatment is typically reserved for isolated sites that cannot be accessed for harvesting. They may also be used as a mop-up treatment to clean up areas surrounding current cutblocks, as this combination of treatments has proved to be particularly effective in the Bulkley. At such sites, crews fall each MPB infested tree, buck and stack the tree onto the stump, and then burn the pile.

Hold to Log

This tactic is selected for areas where harvesting cannot be completed before the next beetle flight. Pheromone baits are hung around the area of infestation to contain the beetles until harvesting can commence.

Small-Scale Harvesting

Small-scale salvage harvesting usually begins in late November and continues through to March. If access to the site exists, and the infestation size is large enough to warrant harvesting, small-scale salvage is usually selected as the treatment option. This means that the infestation centers are within 800m of an existing operable road, with the size of the opening generally less than 1 hectare.

Clear Cutting with Reserves

Where the infestation is considered large enough, more conventional harvesting tactics will be utilized. This method can be broadly categorized as clear-cutting with reserves. When utilizing this technique an attempt is made protect as many other species as possible for future harvest both within stands and in patches. Protecting other species could include retaining older trees of other species, or the protection of advance regenerating younger trees.

For all of the above treatments, the Bulkley Standards for Detection and Completion (located in the Appendix) should be utilized.

Harvesting Strategies

For the duration of this epidemic, harvesting should be concentrated in pine stands which are immediately at risk. To accomplish this, licensees may delay of harvesting on existing cutting permit blocks in areas that do not have extreme or high risk pine stands. On any of these blocks application of the 'Take or Pay' option would be subject to DM approval**.** This ensures that the mills have the capacity to mill all of the MPB wood each year and preserves unthreatened timber for future timber supply.

When determining which stands should be targeted for harvesting, stands will be considered in this order:

1) High and Extreme risk and extreme hazard Pine Stands. (Most Pine + Most Beetles)
2) High and Extreme risk and high hazard Pine Stands;
3) Moderate Risk and Extreme Hazard Pine Stands;
4) Moderate Risk and High Hazard Pine Stands:
5) Moderate Risk and Moderate Hazard Pine Stands (least Pine + least Beetles)

When harvesting MPB stands, it is vital to protect the existing non-pine over and under-stories. This is important both to protect stand integrity and to allow all the uncut trees to contribute to mid-term timber supply. Where possible on extreme and high hazard pine stands and low to moderate risk of blow down, use an Over-story Removal harvest strategy that protects existing spruce and balsam where it exceeds $5m^2$/ha basal area.

Finally, when harvesting MPB timber, all possible efforts will be made to control the incidental spread of MPB by salvaging, hauling, and milling efficiently and effectively.

These strategies will be implemented to delay the beetle infestation for as long as possible, to benefit all licensees and the TSA as a whole. To achieve this, licensees can propose alternative strategies for harvesting of MPB in areas that are currently constrained such as Cores and LRC's. It is understood that no harvesting is also a viable strategy, and that this will be necessary in areas that are inaccessible or where other values are a higher priority. The Skeena Stikine District will assist the licensees in determining if these alternative strategies are maintaining the overall intent of the HLP objective for the area (CORE, Landscape Corridor, Key Caribou Habitat, etc) and whether they are verifiable

It is also important to note that with increased beetle presence in the Bulkley TSA, there may be an accompanying fire hazard. Licensees have an excellent record of working with the municipalities to manage the Community Interface and reduce fire hazard in the surrounding area. The MOFR is committed to aiding these efforts as much as possible, working proactively together with all stakeholders. One consideration the MoFR must make if the there is a significant increase in the Beetle activity is how to manage the Chief Forester's AAC partition. The Chief Forest partitioned the Bulkley TSA AAC into Sawlog, Marginal Sawlog and Pulp to ensure utilization of the timber profile. To this end the DM with assistance from licensees will track the portion of sawlog harvest that occurs in Extreme Hazard Pine stands (>70% Pine) to control Bark Beetle for consideration by the Chief Forest in his determination in Bulkley TSR III.

7.10 Local Performance Measures

The Skeena Stikine District has specified three performance measures (in concert with the Province) which are to be reported to monitor the success of beetle suppression tactics and to provide justifications for further funding allocations. Each performance measure will be reported for each beetle management unit (BMU).

Performance Measure 1

Survey and Detection Overview: Report on each BMU, the BMU strategy, the area (ha) of the BMU, the area of the helicopter overview survey, the number of way points and the number of red trees identified.

The overview flight and the accompanying percentage calculations should be completed by August 31 of each year and are shown in table 7.

Table 6: Example of a Detailed Overview Flight Summary

BMU Name	Strategy	Area (ha)	Area Surveyed (ha)	# of Waypoints	# of Red Trees
Deep Creek	Aggressive	24306	24306	72	347
Nilkitkwa	No Action	44551	0	0	0
Babine	Aggressive	120542	120542	88	254

7.10.1.1.1.1.1 Performance Measure 2

Tactical Plan: Prepare a TSA map detailing all of the waypoints identified on the overview flights and show expected treatment type and responsibility. This will form the basis of the annual tactical plan and will guide treatments within the TSA.

Overview flight information should be used to identify waypoints and to prepare a tactical plan with specific management strategies. This should be considered a living document, with changes made to proposed treatments as more information becomes available. It is expected that additional trees identified through ground surveys will be treated as funding permits. This tactical plan should be completed by November 30 of each year. This report can be summarized in a simple table such as is pictured below.

Table 7: Example of Tactical Plan Summary

BMU Name	Strategy	# of Waypoints for			
		No Treatment	Fall & Burn	Small-scale Harvest	Harvest
Deep Creek	Aggressive	2	34	28	39
Nilkitkwa	No Action	22	0	0	0
Babine	Aggressive	5	45	25	18

Performance Measure 3

Plan Achievement (Annual Report): The third performance measure is a report detailing what percentage of each BMU strategy has been achieved. This report should identify each BMU, the strategy, and whether or not the target treatment objectives were met. This report summary and its accompanying rationale will aid in the determination of funding allocations for the following year. Note: Achieving 80% of target is not always a suitable expectation for certain BMU's.

~~Data from the tactical plan should be input into the PMOIS tracking system which can be used to identify which waypoints were treated and which method was utilized. This PMOIS information can be located online at: http://www.pmois.com/pmois2004/Default.aspx?DfamId=1~~.

Bait-to-hold areas should not be included in the calculations of this performance measure. Only areas which have been treated by Fall & Burn or Harvesting should be considered a treatment. This system can then be used to calculate the actual percentage of waypoints which have been addressed by BMU. This number is expected to indicate how successful management efforts were in meeting area specific objectives (such as 80% treatment of all waypoints). This number will also reflect the commitment to addressing both large-scale outbreaks and smaller, local populations.

The only accepted BMU strategies and the associated target for 2007/2008 is:

Aggressive: Treatment Target - 80% of Waypoints

The report should be summarized as per Table 9. A paragraph rationalizing the treatment decisions and how the targets were met, or not met, should also be included. This report should be completed by April 30 of each year.

Table 8: Sample Annual Report Summary

BMU Name	Tactic	Treatment Target %	# Of Waypoints	# Of Waypoints Treated	Actual % Treated	Red Trees	Green Trees	Red: Green Ratio	Target Met
Deep Creek	Aggressive	**80**	72	51	**70**	100	400	**1:4**	No
Nilkitkwa	Aggressive	**80**	15	2	**13**	10	12	**1:1**	No
Babine	Aggressive	**80**	88	75	**85**	100	150	**1:1.5**	Yes

Table 9: Hazard Rating – See Pine Beetle

Hazard Class	*Criteria*
Extreme	- Balsam Leading Species (>70%) - Age Class 7,8,9 - Site Index ≥ 15
High	- Balsam Leading Species (50-69%) - Age Class 7,8,9 - Site Index <15
Moderate	- Balsam Secondary Species (21 – 49%) - Age Class 7,8,9 - Site Index – All
Low	- Balsam Secondary Species - Age Class 5 or 6 - Site Index – All

Harvesting Strategies

Due to high endemic populations and the complex attack dynamics of IBB, there are currently only two types of harvesting strategies that will be seriously considered for dealing with Balsam beetle in the Bulkley TSA. These are:

A. Sanitation harvesting for balsam beetle suppression, maximizes the extraction of currently infested balsam stands before most of the trees have turned grey. This helps to reduce the existing population and to prevent further spread. The highest priority is given to stands with a high hazard rating and a high risk of spread. All harvesting methods can be used.

B. Salvage harvesting to recover balsam trees that have been previously attacked by IBB and no longer have any living broods. Salvage harvesting is primarily conducted to recover damaged timber before it loses its value for potential wood products. The goal is to harvest Red trees, which are dry sawlogs, before they deteriorate into Grey pulplogs. This tactic does not reduce balsam beetle populations, but is the first step in returning the site to forest production.

Table 10: Hazard Rating – Spruce

Hazard Class	*Criteria*
Extreme	- Spruce Leading Species (>70%) - Age Class 7, 8 or 9 - Site Index >= 15
High	- Spruce Leading Species (50-69%) - Age Class 7, 8 or 9 - Site Index < 15
Moderate	- Spruce Secondary Species (21 – 49%) - Age Class 7, 8 or 9 - Site Index – all
Low	- Spruce Leading - Age Class 5 or 6 - Site Index – all

In general, the order of hazard for spruce stands is:

1) Stands in creek bottoms;
2) Better stands of Spruce on benches, slopes, and high ridges;
3) Poorer stands on benches, slopes, and high ridges;
4) Mixtures of Spruce and Lodgepole Pine and/or Balsam;
5) Stands containing all immature Spruce.

Table 11: Risk Rating - Spruce

Risk Rating	*Description*
High	Infestations within 2 km of a high or extreme hazard stand (>10 red/grey topped spruce).
Moderate	Infestation between 2 and 10 kilometres of a high or extreme hazard stand (>10 red/grey topped spruce).
Low	Infestations more than 10 km from a high or extreme hazard stand (>10 red/grey topped spruce).

Harvesting Strategies

There are two types of harvesting strategies that can be utilized for controlling spruce beetle in the Bulkley TSA. These are:

A. Sanitation harvesting for spruce beetle suppression maximizes the extraction of currently infested spruce stands in order to reduce the existing population and to prevent their spread. The highest priority is given to stands with high levels of new attack, high hazard, and a high risk of spread. All harvesting methods can be used.

B. Salvage harvesting recovers most spruce that were attacked by spruce beetle and such trees no longer have any living broods. Salvage harvesting is primarily conducted to recover damaged timber before it loses its value for potential wood products. This tactic does not reduce spruce beetle populations, but is the first step in returning the site to forest production.