Summary of Aerial Overview Surveys in the Southern Interior Forest Region - 2005

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2005 Overview of Forest Health in the Southern Interior Forest Region

Introduction

The 2005 Aerial Overview Surveys were carried out between July 12 and September 7, 2005. Three separate survey crews conducted the surveys for areas of the Southern Interior Region which included: the Cariboo (including Quesnel, Central Cariboo, Chilcotin, and 100 Mile House Districts, and Robson Valley TSA), Kamloops (including Kamloops, Cascades, and Okanagan Shuswap Districts, and the Clearwater portion of Headwaters District), and Nelson (including the Columbia, Arrow Boundary, Kootenay Lake, and Rocky Mountain Districts). A total of 351 hours and 62 days of fixed-wing flying were required to complete all surveys.

Surveys were carried out using the standardised Aerial Overview Survey protocols (**http://srmwww.gov.bc.ca/risc/pubs/teveg/foresthealth/index.htm**), and documented mortality and/or damage resulting from bark beetles, defoliators, and any other visible forest health factors, such as foliar diseases and abiotic damage. Severity ratings for major bark beetles were expanded in 2004 to include two additional categories: trace (less than 1% current mortality), and very severe (greater than 50% current mortality). This practice proved to be a very useful tool to improve the accuracy of volume loss estimates, and was therefore continued in 2005.

Weather conditions were generally good for the majority of the 2005 surveys. Conditions in general were much improved over both 2003 and 2004, when smoke and haze from wildfires caused visibility problems in many areas.

Bark beetle severity class	Current mortality	Defoliation severity class	Attributes
Trace	< 1%	Light	some branch tip and upper crown defoliation, barely visible from the air
Light	1-10%		
Moderate	10-30%	Moderate	thin foliage, top third of many trees severely defoliated, some completely stripped
Severe	30-50%	Severe	bare branch tips and completely defolated tops, most trees sustaining >50% total defoliation
Very Severe	50-100%		

The most damaging pest in the Southern Interior Region continued to be mountain pine beetle (4,668,431 ha); other pests causing large scale damage were western spruce budworm (458,409 ha) western balsam bark beetle (383,136 ha), spruce beetle (41,200 ha), and Douglas-fir beetle (41,166 ha).

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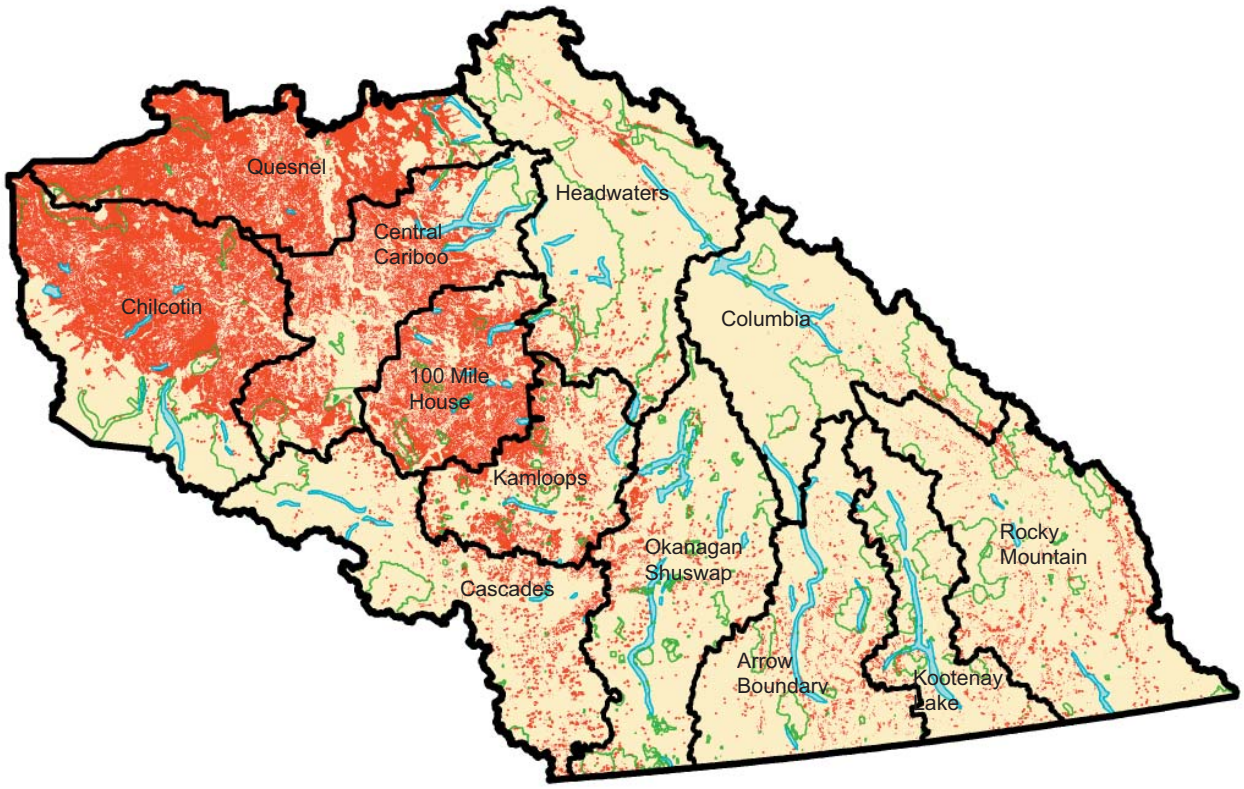


Figure 1. Mountain pine beetle infestations in the Southern Interior Forest Region, as mapped by the 2005 Aerial Overview Surveys.

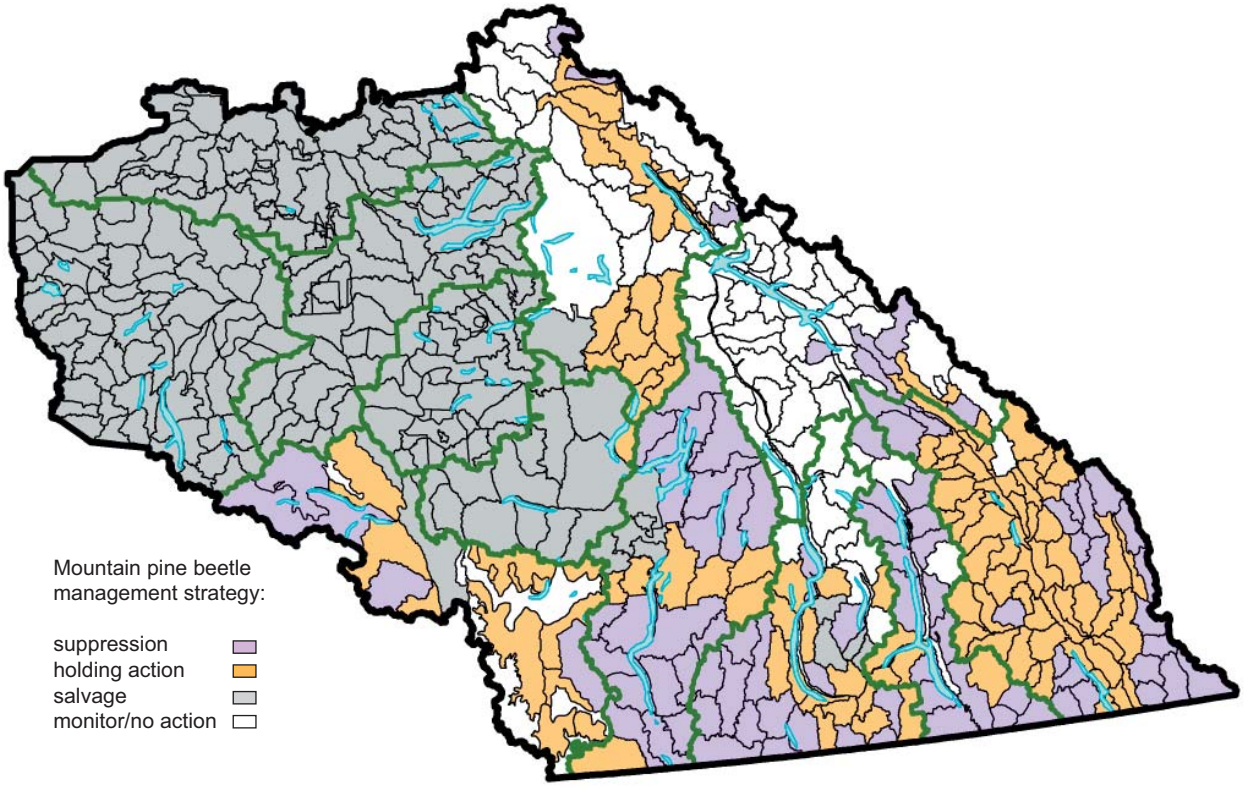


Figure 2. Beetle management unit boundaries and mountain pine beetle strategies as of January, 2006.

Table 1. Area summaries for forest health factors mapped during the 2005 aerial overview surveys

Forest District and Damaging Agent	Area of Infestation (ha)					
	Trace	Light	Moderate	Severe	Very Severe	Total
Mountain Pine Beetle						
Chilcotin	312,903.9	486,609.0	386,255.7	118,830.9	4,863.9	1,309,463.4
Quesnel	134,630.2	164,252.4	400,309.3	445,697.4	144,133.0	1,289,022.3
Central Cariboo	198,916.6	173,769.6	178,787.3	96,222.9	52,474.7	700,171.1
100 Mile House	87,238.4	272,017.6	193,147.8	64,063.5	7,092.5	623,559.7
Kamloops	36,101.4	124,079.5	79,651.1	27,587.6	22,892.2	290,311.9
Cascades	14,596.8	55,705.5	26,673.4	5,715.1	697.2	103,388.0
Arrow Boundary	2,435.8	44,336.3	48,226.1	5,591.1	0.0	100,589.3
Headwaters	42,948.8	39,199.2	14,437.0	2,122.4	343.0	99,050.5
Rocky Mountain	4,655.2	56,312.5	30,772.1	5,243.2	0.0	96,983.0
Okanagan Shuswap	7,404.8	41,825.7	21,477.1	6,069.9	1,895.5	78,672.9
Kootenay Lake	2,238.0	27,836.5	11,081.8	863.3	0.0	42,019.5
Columbia	352.7	26,814.7	7,013.1	1,659.0	0.0	35,839.5
Total	**844,422.6**	**1,512,758.4**	**1,397,831.6**	**779,666.3**	**234,392.0**	**4,769,070.9**
Douglas-fir Beetle						
Central Cariboo	15,843.1	615.4	62.1	3,839.9	0.0	20,360.5
Chilcotin	7,984.2	2,691.7	0.0	2,548.1	0.0	13,224.1
100 Mile House	2,461.4	576.7	0.0	10.5	0.0	3,048.6
Headwaters	211.8	0.0	0.0	0.0	0.0	211.8
Rocky Mountain	0.0	1,157.7	623.4	0.0	0.0	1,781.1
Arrow Boundary	76.7	1,270.0	242.6	1.8	0.0	1,591.1
Columbia	117.7	104.1	72.8	0.0	0.0	294.5
Okanagan Shuswap	67.5	94.1	21.5	0.0	0.0	183.1
Kootenay Lake	0.0	54.5	82.1	0.0	0.0	136.6
Cascades	0.0	62.5	24.5	2.7	0.0	89.8
Kamloops	0.0	0.0	0.0	72.5	0.0	72.5
Total	**26,762.4**	**8,624.8**	**1,129.0**	**6,475.6**	**0.0**	**42,991.8**
Spruce Beetle						
100 Mile House	398.5	4,470.7	5,379.0	2,679.5	795.9	13,723.6
Central Cariboo	1,325.2	4,337.4	1,105.8	3,122.9	717.0	10,608.2
Headwaters	5,212.2	2,390.6	1,637.1	717.2	33.3	9,990.4
Cascades	0.0	1,220.8	1,638.4	235.8	17.2	3,112.2
Quesnel	95.8	1,450.1	668.4	398.8	0.0	2,613.0
Kamloops	0.0	192.3	128.9	0.0	0.0	321.2
Chilcotin	220.8	84.5	0.0	0.0	0.0	305.3
Okanagan Shuswap	0.0	100.1	123.9	8.8	0.0	232.7
Columbia	0.0	29.3	138.6	0.0	0.0	167.9
Kootenay Lake	0.0	92.8	0.0	0.0	0.0	92.8
Arrow Boundary	0.0	20.7	0.0	0.0	0.0	20.7
Total	**7,252.4**	**14,389.2**	**10,820.0**	**7,162.9**	**1,563.4**	**41,188.0**
Western Balsam Bark Beetle						
Headwaters	80,770.1	14,655.4	726.3	0.0	20.2	96,172.0
Okanagan Shuswap	56,162.6	20,671.9	233.6	16.1	0.0	77,084.1
Quesnel	66,385.6	3,903.3	451.8	0.0	0.0	70,740.6
Central Cariboo	19,519.6	5,032.8	656.3	0.0	0.0	25,208.8
Rocky Mountain	856.0	20,637.6	377.4	0.0	0.0	21,871.0
Chilcotin	19,462.4	2,150.0	90.7	0.0	0.0	21,703.1
100 Mile House	14,657.8	658.3	129.6	0.0	0.0	15,445.7
Arrow Boundary	2,260.9	11,957.3	451.7	0.0	0.0	14,669.9
Cascades	5,824.8	7,571.4	192.5	55.3	0.0	13,644.0
Columbia	639.3	9,241.9	37.4	0.0	0.0	9,918.6
Kootenay Lake	214.6	8,491.4	173.8	0.0	0.0	8,879.8
Kamloops	5,464.1	2,292.8	0.0	0.0	0.0	7,756.9
Total	**272,217.9**	**107,263.9**	**3,521.0**	**71.3**	**20.2**	**383,094**.3

Table 1 continued. Area summaries for forest health factors mapped during the 2005 aerial overview surveys

Forest District and Damaging Agent	Area of Infestation (ha)					
	Trace	Light	Moderate	Severe	Very Severe	Total
Fir Engraver Beetle						
Rocky Mountain	24.8	1,521.1	42.8	0.0	0.0	1,588.7
Arrow Boundary	0.0	324.0	142.0	0.0	0.0	466.0
Kootenay Lake	0.0	298.3	0.0	0.0	0.0	298.3
Columbia	0.0	122.7	0.0	0.0	0.0	122.7
Total	**24.8**	**2,266.1**	**184.8**	**0.0**	**0.0**	**2,475.7**
Western Spruce Budworm						
Central Cariboo	0.0	150,175.0	38,751.0	4,308.1	0.0	193,234.1
100 Mile House	0.0	98,345.4	9,100.6	673.1	0.0	108,119.1
Cascades	0.0	74,891.6	17,295.7	103.7	0.0	92,290.9
Chilcotin	0.0	21,577.7	20,507.5	15,807.2	0.0	57,892.3
Kamloops	0.0	6,397.3	327.6	0.0	0.0	6,724.9
Okanagan Shuswap	0.0	74.1	0.0	0.0	0.0	74.1
Quesnel	0.0	73.9	0.0	0.0	0.0	73.9
Total	**0.0**	**351,534.8**	**85,982.5**	**20,892.0**	**0.0**	**458,409.2**
Western Hemlock Looper						
Headwaters	0.0	2,251.1	39.5	0.0	0.0	2,290.7
Columbia	0.0	1,391.1	0.0	49.5	0.0	1,440.6
Arrow Boundary	0.0	621.0	97.2	0.0	0.0	718.2
Total	**0.0**	**4,263.2**	**136.7**	**49.5**	**0.0**	**4,449.5**
Birch Leaf Miner						
Kamloops	0.0	467.0	1,030.4	0.0	0.0	1,497.4
100 Mile House	0.0	1,168.8	0.0	0.0	0.0	1,168.8
Headwaters	0.0	0.0	90.6	0.0	0.0	90.6
Okanagan Shuswap	0.0	85.6	0.0	0.0	0.0	85.6
Total	**0.0**	**1,721.3**	**1,121.0**	**0.0**	**0.0**	**2,842.3**
Larch needle Cast						
Kootenay Lake	0.0	595.3	0.0	0.0	0.0	595.3
Rocky Mountain	0.0	77.0	0.0	0.0	0.0	77.0
Total	**0.0**	**672.3**	**0.0**	**0.0**	**0.0**	**672.3**
Pine Needle Cast						
Kootenay Lake	0.0	0.0	259.0	0.0	0.0	259.0
Rocky Mountain	0.0	0.0	46.3	0.0	0.0	46.3
Okanagan Shuswap	0.0	0.0	13.4	0.0	0.0	13.4
Total	**0.0**	**0.0**	**318.8**	**0.0**	**0.0**	**318.8**
Bear Damage						
Rocky Mountain	24.8	1,348.3	3.9	0.0	0.0	1,377.0
Total	**24.8**	**1,348.3**	**3.9**	**0.0**	**0.0**	**1,377.0**
Windthrow						
100 Mile House	0.0	1,213.3	0.0	160.0	0.0	1,373.4
Quesnel	0.0	0.0	0.0	503.3	0.0	503.3
Central Cariboo	0.0	81.5	0.0	213.2	169.5	464.2
Rocky Mountain	0.0	0.0	0.0	104.6	0.0	104.6
Columbia	0.0	0.0	0.0	96.6	0.0	96.6
Okanagan Shuswap	0.0	9.8	0.0	9.5	0.0	19.3
Kootenay Lake	0.0	5.7	0.0	0.0	0.0	5.7
Total	**0.0**	**1,310.3**	**0.0**	**1,087.1**	**169.5**	**2,566.9**
Redbelt						
Chilcotin	1,176.0	739.6	30.2	368.2	0.0	2,314.0
Total	**1,176.0**	**739.6**	**30.2**	**368.2**	**0.0**	**2,314.0**

Regional Overview

Mountain Pine Beetle, *Dendroctonus Ponderosae*

Mountain pine beetle populations continued to expand in 2005; however, the rate of expansion in terms of overall area affected, was less than in the past few years. This is due mainly to the fact that most susceptible stands in the Cariboo, which account for the majority of the infested area in the Southern Interior Region, have already been infested, and the amount of susceptible pine is diminishing. Infestations covered a total of 4,853,830 hectares in 2005, an increase of 15% over 2004 levels. Most notable was the increased levels of mortality, as expressed by severity ratings in the overview survey. Nearly 50% of all affected area was classified as sustaining moderate or greater mortality, and the area of severe and very severe mortality has more than doubled in 2005, to 932,917 hectares (Figure 4). Infestations in most other areas of the Region have continued to expand rapidly; affected area has increased by 2 - 4-fold in most Districts outside of the Cariboo, for the second year in a row.

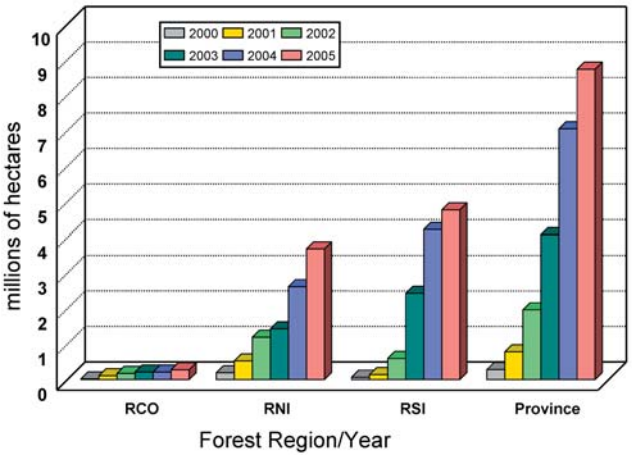


Figure 3. Area affected by mountain pine beetle from 2000-2005 in British Columbia (RCO = Coast Forest Region; RNI = Northern Interior Forest Region; RSI = Southern Interior Forest Region)

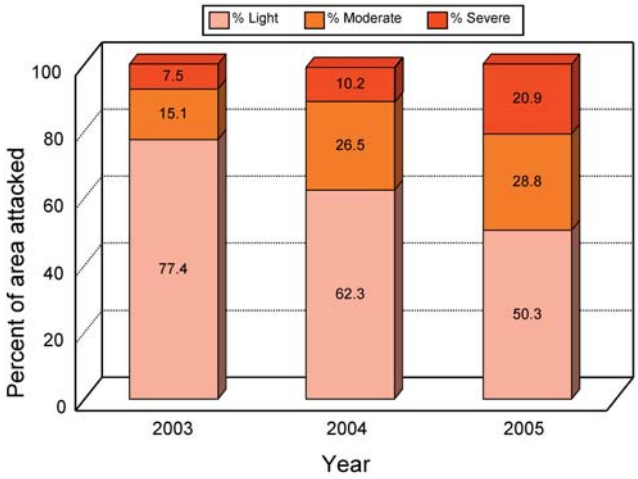


Figure 4. Proportion of mountain pine beetle infested area classified as Trace/Light, Moderate, and Severe/Very Severe, from 2003 - 2005 in the Southern Interior Forest Region.

Table 3. Area infested, number of polygons, and average polygon size, for mountain pine beetle in the Southern Interior Forest Region, 2001-2005.

Year	Area Infested	Number of Polygons	Average Polygon Size (ha)	Number of Spot Infestations	Number of Trees Killed in spot infestations
2001	141,176	4,760	29.7	3,672	37,074
2002	612,054	7,349	83.3	6,308	56,054
2003	2,525,722	13,133	192.4	5,270	42,372
2004	4,220,498.5	41,057	101.9	4,932	63,410
2005	4,853,830	49,381	95.6	3,839	35,033

The average polygon size has remained high, at 95.6 hectares, while the number of spot infestations dropped from 4,932 in 2004, to 3,839 in 2005 (Table 3). This illustrates the widespread, continuous nature of the infestation in much of the Region, especially in the Quesnel, Central Cariboo, Chilcotin, 100 Mile House, and parts of the Kamloops District, where much of the landbase is covered by large areas of mature, susceptible pine stands. Infestations continue to follow a more scattered, broken pattern in other areas of the Region, as pine stands tend to be less continuous, with more elevational and topographical breaks, and/or the outbreak is still in the expansion phase.

Overwintering mortality surveys were conducted in the spring of 2005 (March - April), in most Districts. In general, larval mortality was very low during the winter of 2004-2005, and populations exhibited high rates of increase (see results on page 36, and specific Forest District sections of this report). However, in some areas of the Region, extended periods of cool, wet weather occurred during the 2005 beetle flight period, resulting in a poorly coordinated flight. As a result, 2005 green:red ratios (the ratio of new, green attacked trees to previous red attacked trees) were generally lower than in the past few years (Table 4). This phenomenon was particularly evident at higher elevations, and was more common in the west Kootenays, parts of the Rocky Mountain District, and in the Okanagan. However, in most areas with more widespread, older infestations,such as the Cariboo, and in parts of the Kamloops, Headwaters, and Cascades Districts, green:red ratios continued to be very high. It is expected that in most areas of the Region, the area affected, and severity of attack, will again increase in 2006.

Beetle management units continue to be downgraded in many areas. Over 40% of the land base of the Region is now designated as Salvage, where the main objective is to recover timber value before it degrades, and to regenerate and rehabilitate the landscape. No direct control activities are taking place in these areas, as they would have little effect on the beetle population. Over 90% of the area designated as Salvage is in the Quesnel, Central Cariboo, Chilcotin, 100 Mile House, and Kamloops Districts (see table 5 and Figure 2).

Table 4. Green:red mountain pine beetle ratios for the Southern Interior Forest Region, 2005.

Forest District	Average Green:Red Ratio	Range
Kamloops	5	1 - 10
Cascades	2-5	1 - 50
Okanagan Shuswap	2	<1 - 3
Headwaters	9	<1 - 24
Columbia	3	<1 - 8
Rocky Mountain	2.4	<1 - 4.2
Kootenay Lake	2	<1 - 3
Arrow Boundary	n/a	
Quesnel	11	3 - 24
Chilcotin	8	8 - 16
Central Cariboo	5.6	<1 - 9
100 Mile House	7.5	< - 25
Regional Average	5.3	

Janice Hodge, aerial surveyor.

Table 5. Beetle management unit designations in the Southern Interior Forest Region as of January 2006, by number of units, and area in hectares.

District	Suppression	Holding Action	Salvage	Monitor	Total
Quesnel	0	0	71 (2,077,316)	0	**71 (2,077,316)**
Central Cariboo	0	0	51 (2,063,411)	0	**51 (2,063,411)**
100 Mile House	0	0	43 (1,235,998)	0	**43 (1,235,998)**
Chilcotin	0	0	69 (2,870,249)	0	**69 (2,870,249)**
Kamloops	0	1 (34,779)	13 (1,278,885)	0	**14 (1,313,664)**
Cascades	4 (635,398)	12 (950,406)	3 (221,137)	6 (449,234)	**25 (2,256,176)**
Okanagan Shuswap	24 (1,692,710)	7 (515,277)	5 (241,180)	0	**36 (2,449,168)**
Headwaters	0	17 (934,794)	4 (163,286)	22 (1,816,295)	**43 (2,914,375)**
Columbia	5 (206,818)	4 (79,059)	0	49 (1,858,432)	**58 (2,144,309)**
Arrow Boundary	16 (811,374)	14 (582,982)	4 (119,518)	10 (534,200)	**44 (2,048,074)**
Kootenay Lake	17 (844,661)	4 (196,674)	0	6 (199,522)	**27 (1,240,857)**
Rocky Mountain	23 (919,300)	53 (1,839,774)	0	1 (41,458)	**77 (1,240,857)**
Grand Total	**89 (5,110,262)**	**112 (5,133,745)**	**263 (10,270,981)**	**94 (4,899,140)**	**558 (25,414,128)**

Since 2003, an increasing number of younger lodgepole pine stands have been experiencing attack by mountain pine beetle, and mortality rates have been high in many of these stands. Often, this young stand mortality is not well recorded by the aerial overview surveys. A study was initiated in 2005, to quantify the levels of attack, and to determine the current and future risk of damage. Results of year 1 of this study are summarized on pages 36 - 49 of this report.

Mountain pine beetle attack in a 40-year old lodgepole pine stand near Tagai Lake, Prince George Forest District.

Attack levels in provincial parks in the Southern Interior Region increased to 241,030 hectares, up from 194,720 hectares in 2004 (Table 7). As well, an additional 24,766 hectares of attack was mapped in the four National Parks, in the Columbia and Rocky Mountain Districts. 149 separate provincial parks have measurable levels of attack, and 74 of these sustained at least 100 hectares of attack. Half of all attack in provincial parks is within the Chilcotin and Quesnel Districts. As in 2004, Itcha Ilgachuz and Bowron Lake Parks accounted for approximately half of all attack in provincial parks, in the Southern Interior Region. Minimal control efforts are taking place in most provincial parks, with a few exceptions, such as Silver Star, Manning, and Lac Le Jeune parks. An ecological burn was conducted in June of 2005 in Yoho National Park, and further burns are planned for 2006.

Lac Le Jeune Provincial Park, situated south of Kamloops, stopped single tree treatments for mountain pine beetle two years ago when the Beetle Management Unit in which it is located was downgraded to Holding Action, and then to Salvage, due to large increases in beetle populations. However, the community of Lac Le Jeune, which runs along the lake and adjacent to the park, took a proactive approach to saving pine on their private land. They initiated a project with Phero Tech Inc. (under the direction of Dr. John Borden, and coordinated by Glen Sparrow) to protect their properties from montain pine beetle. An integrated pest management program was conducted, involving removal or destruction of attacked trees and application of verbenone. The program was very successful and will be continued in 2006. Lac Le Jeune Park is now in the process of removing attacked trees and will be working with the Ministry of Forests and Range, and the community, in 2006 to reduce risk to the Park and adjacent private land.

Table 6. Area of Shore - Safranyik mountain pine beetle susceptibility class, by District, in the Southern Interior Forest Region.

Forest	Area of mountain pine beetle susceptibility class (hectares)				
District	Nil	Low	Moderate	High	Total Susceptible Area
Chilcotin	431,007	355,547	443,153	814,228	1,612,928
Quesnel	416,051	242,788	394,970	482,811	1,120,568
Cascades	274,150	515,929	307,776	188,871	1,012,576
Rocky Mountain	291,732	694,950	220,248	73,533	988,731
Okanagan Shuswap	299,281	364,335	224,722	172,192	761,249
Central Cariboo	314,168	285,752	235,808	204,068	725,628
Arrow Boundary	259,635	409,968	163,723	61,907	635,598
100 Mile House	316,786	233,556	177,999	211,357	622,912
Kamloops	141,231	300,141	180,668	89,440	570,248
Headwaters	84,628	233,159	73,892	33,399	340,450
Kootenay Lake	70,099	183,008	46,241	18,374	247,623
Columbia	38,846	104,211	39,015	14,521	157,746
Total	**2,937,612**	**3,923,343**	**2,508,215**	**2,364,700**	**8,796,258**

Table 7. Area of mountain pine beetle in provincial parks in the Southern Interior Region in 2005. Numbers in brackets refer to additional areas within National Parks*.

Forest District	Total Number of Parks	Number of Parks with MPB	Total Park Area	Hectares MPB in Parks
Quesnel	18	13	202,497	58,442
Chilcotin	13	10	390,766	70,505
Kamloops	49	22	66,498	21,585
100 Mile House	29	19	48,342.6	24,273
Central Cariboo	11	9	195,766	24,111
Headwaters	40	13	848,744	20,845
Okanagan Shuswap	110	11	186,990	3,170
Columbia	21	3	50,929 (387,783)	231 (16,176)
Arrow Boundary	33	7	169,813	7,929
Kootenay Lake	23	6	215,975	7,649
Rocky Mountain	35	9	272,461 (41,517)	1,892 (8,590)
Cascades	35	9	200,814	397
Total	**417**	**117****	**2,849,616 (429,300)**	**241,029 (24,766)**

*National Parks - Yoho, Kootenay Lake, Glacier, and Mount Revelstoke.

**Several parks cross over District boundaries, hence the total number of Parks in the Southern Interior Region is 117, rather than 131, as indicated by the data presented in this table.

In many areas, the sheer number of mountain pine beetle – killed pine made detection of other intermixed species mortality very difficult. Because of this "masking" effect, other pests may have occasionally been underrepresented. This most likely occurred with spruce beetle and western balsam bark beetle in the eastern Quesnel, Central Cariboo, and 100 Mile House Districts, and in the Bonaparte Plateau area of the Kamloops Forest District. Douglas-fir beetle mortality may also have been partially masked in many areas with mixed lodgepole pine – Douglas-fir stands.

Ponderosa pines in many areas of the Southern Interior Region are also being severely impacted by the mountain pine beetle. In particular, locations near past wildfires (e.g. Kelowna, Kamloops, Merritt) are seeing mixtures of mountain pine beetle, western pine beetle, turpentine beetle and other secondary insects attacking the ponderosa. Even more surprising is the development rates and brood success of the mountain pine beetle observed in some Ponderosa pines. For example, attacked Ponderosa pine on the Thompson Rivers University campus in Kamloops that were being cut and disposed of in late February 2006 contained vigorous overwintering brood adult mountain pine beetles. Also present were larvae (the normal overwintering stage) and prepupae. this could suggest a very early emergence and flight of mountain pine beetle in these low elevation, hot, dry sites.

Extensive red-attacked lodgepole pine forests in Vanderhoof Forest District.

Extensive grey attack (standing dead) lodgepole pine, and salvage operations, in Vanderhoof Forest District.

Western Balsam Bark Beetle, *Dryocoetes confusus*

Western balsam bark beetle mortality was mapped on 383,094 hectares in 2005, an increase of over 30% from 2004 levels. Most of this increased area was in the trace category (less than 1% current mortality) and was due to an increased mapping threshold instituted in the Kamloops and Nelson areas in 2005. A concerted effort is being made to record all visible levels of western balsam bark beetle mortality, which resulted in increases of 3 – 10-fold in these areas in 2005. In general, populations of this insect change gradually over the landscape, and most subalpine fir stands sustain some level of mortality on an annual basis.

Douglas-fir Beetle, *Dendroctonus pseudotsugae*

Douglas-fir beetle populations continued to expand in 2005, and were mapped on 42,992 hectares. Infested area has been increasing annually in the Region since 2002. The majority of the mortality was in the Central Cariboo and Chilcotin Districts, where attack was widespread in the Williams Lake, 141 Mile, Soda Creek, and Lees Corner areas. Area mapped in the Chilcotin District increased from 3,040 hectares in 2004, to 13,224 hectares in 2005. Significant mortality was also observed in the 100 Mile House, Headwaters, Rocky Mountain, and Arrow Boundary Districts; lesser areas were mapped in all other Districts except Quesnel, where no Douglas-fir beetle activity was seen. Over 60% of all area in the Region was classified as Trace; the majority of the remainder was split between Light and Severe.

Table 8. Number of "spot" infestations of Douglas-fir beetle in the Southern Interior Forest Region, by District, 2005.

District	# spots	# trees
Kamloops	11	100
Cascades	54	435
Okanagan Shuswap	124	903
Headwaters	8	55
Columbia	25	45
Rocky Mountain	83	543
Arrow Boundary	182	682
Kootenay Lake	21	38
Quesnel	1	5
Chilcotin	37	383
Central Cariboo	109	1,156
100 Mile House	22	197
Total	**677**	**4,542**

Spruce Beetle, *Dendroctonus rufipennis*

Total infested area decreased significantly, from 76,920 in 2004, to 41,188 hectares in 2005. Most of this decrease was due to significant drops in area mapped in the Quesnel and Central Cariboo Districts; decreased attack was also observed in the 100 Mile House and Okanagan Shuswap Districts. The drop is most likely due to a combination of: host depletion in many of the infested stands; poor colour fading and masking of spruce beetle mortality by overlapping mountain pine beetle mortality; and, the two-year life history of the spruce beetle (i.e. every other year sees a larger level of attack). hectares. Spruce beetle is often very difficult to detect from the air, due to poor/inconsistent colour change of attacked trees. For this reason, the area experiencing spruce beetle mortality is often much higher than reported by the Aerial Overview Surveys. Ground surveys and reconaissance in many affected areas indicte that populations are increasing, largely fuelled by windthrow and drought stress on host trees. Infested area increased in the Headwaters District, by over 3-fold, to 9,990

Spruce beetle mortality, Cayoosh Creek area.

Western Spruce Budworm, *Choristoneura occidentalis*

Western spruce budworm populations declined in many areas of the 100 Mile House and Central Cariboo Districts, and overall total defoliated area fell, from 615,000 hectares in 2004, to 458,409 hectares in 2005. However, due to a sharp increase in population levels in the Chilcotin District, the proportion of defoliated area that was classified as moderate or severe increased, from 15% to just over 23%. Defoliated area also increased slightly in the Cascades and Kamloops Districts. Aerial spray programs, utilizing *B.t.k.*, were carried out in the 100 Mile House, Central Cariboo, Chilcotin, and Cascades Districts.

Egg mass sampling was conducted during the fall of 2005, to assess population levels and predict defoliation levels in 2006. Sampling was conducted at a total of 206 sites; 2006 population levels are expected to be the highest in the Chilcotin District, and in the Lillooet – Carpenter Lake area of the Cascades District (see Table 9).

Table 9. Summary of Southern Interior Forest Region fall 2005 western spruce budworm egg mass sampling results, showing predicted 2006 defoliation.

	Number of sites in each defoliation category					
District	**Nil**	**Light**	**Moderate**	**Severe**	**Total number of sites**	**Average # egg masses/10m² foliage***
Cascades						
Lillooet	1	8	23	8	40	105.2
Merritt	1	74	24	3	102	40.3
Chilcotin	0	2	1	7	10	185.2
Central Cariboo	3	49	14	3	69	41
100 Mile House	1	74	18	2	95	42.5
Total	**6**	**207**	**80**	**23**	**316**	

*Nil = no egg masses found
Light = 1-50 egg masses/10 m² foliage
Moderate = 51-150 egg masses/10m² foliage
Severe = >150 egg masses/10m² foliage

Top-kill on Douglas-fir caused by western spruce budworm defoliation, near Merritt.

2005 western spruce budworm spray program

Several high priority stands were identified for aerial spray with *B.t.k.* (Foray 48B, applied at 2.4 litres/hectare), following assessment of 2004 defoliation and eggmass sampling results. Despite the presence of high budworm populations, many affected stands in the Cascades District were not considered high priority, due to the fact that many of these areas contained a high proportion of non-host species, or had stand structures considered to be less susceptible to budworm impacts. In contrast, a high proportion of the affected areas in the Cariboo had very susceptible stand structures, and were considered a high priority for treatment. A total of 30,417 hectares in 20 separate spray blocks were treated. Application was completed using Aerospatiale 315B Lama and Hiller UH12ET helicopters, operated by Western Aerial Applications Ltd. of Chilliwack, B.C. No physical spray block boundary marking (i.e. ballooning) was used in 2005, at any of the spray sites, as on-board GPS spray swath guidance systems were used by all spray aircraft.

A total of 2,387 hectares in four blocks were treated near Princeton, on June 6-7 (Table 10). Early, warm spring conditions caused differential insect and bud development between lower and higher elevation sites. Therefore, when spraying commenced, significant damage had already occurred on some low elevation sites. Within a day following treatment, an unanticipated low pressure system, with high levels of associated rainfall, moved over the Princeton area; efficacy of the spray was therefore reduced significantly. Egg mass sampling during the fall of 2005 indicated that population reductions were achieved to some degree, and despite moderate defoliation in 2005, populations are not expected to increase to any large degree (populations are, however, expected to spread and cover a more extensive area around Princeton in 2006).

Sixteen blocks totalling 28,030 ha were treated in the Central Cariboo, Chilcotin, and 100 Mile House Districts June 20-25 (Table 10). As in the Princeton area, warm early season weather resulted in advanced larval development at many lower elevations sites There also were significant delays to the spray operations due to adverse weather conditions. These two factors resulted in reduced efficacy in some areas, especially at lower elevations. The most effective treatments were at higher elevations and in areas where larval development was slower. Egg mass population sampling conducted during the fall indicated that populations were reduced in all 2005 spray blocks. Increased populations were predicted for several other areas, especially in the Chilcotin, and it is estimated that at least 50,000 hectares of high-priority stands could require treatment in 2006.

Final costs of the spray program were $22.23/hectare in the Cariboo blocks, and were, due to the use of in-house personnel, slightly lower in the Princeton blocks. The *B.t.k.* accounted for over half of the program cost.

Lama 315B helicopter applying B.t.k.

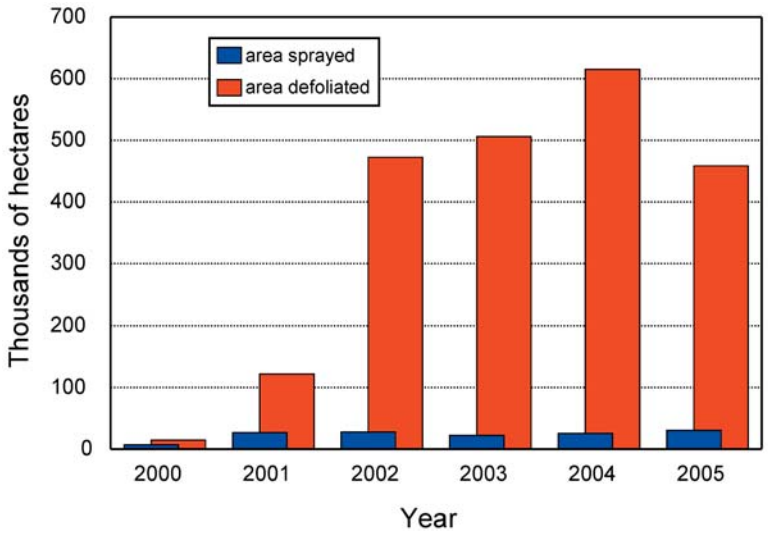


Figure 5. Area defoliated by western spruce budworm and area treated with *B.t.k.* in the Southern Interior Forest Region from 2000 - 2005.

Table 10. Spray blocks treated with B.t.k. in the Southern Interior Region in 2005, with areas separated to illustrate the to different spray programs.

Forest District	Location	Hectares Sprayed	Data treated
100 Mile House	Dog Creek	629	June 20, 2005
100 Mile House	Pigeon Creek	1,296	June 20, 2005
100 Mile House	China Lake North	685	June 20, 2005
100 Mile House	China Lake South	551	June 20, 2005
100 Mile House	China Gultch	514	June 20, 2005
100 Mile House	Wild Goose Lakes	1,050	June 20, 2005
100 Mile House	Chasm	3,019	June 20, 2005
Central Cariboo	Place/Mayfield	3,318	June 23, 2005
Central Cariboo	Joe's Lake	4,076	June 23, 2005
Central Cariboo	Brigham	2,076	June 23, 2005
Central Cariboo	Alixton Lake	1,070	June 25, 2005
Central Cariboo	Gulatch Lake	2,160	June 25, 2005
Central Cariboo	Brunson Lake	1,325	June 25, 2005
Central Cariboo	Soda Creek	1,794	June 25, 2005
Chilcotin	Hanceville North	1,595	June 21, 2005
Chilcotin	Hanceville South	2,874	June 21, 2005
Total		**28,030**	
Cascades	Princeton-Snowpatch	465 ha	June 6-7, 2005
Cascades	Princeton-WL 350	180 ha	June 7, 2005
Cascades	Princeton-China Road	1,030 ha	June 6, 2005
Cascades	Princeton-Summers Creek	712 ha	June 7, 2005
Total		**2,387 ha**	
Region Total		**30,417**	

Western Hemlock Looper, *Lambdina fiscellaria lugubrosa*

Defoliation was observed in the Columbia and Arrow Boundary Districts, and was mapped on 2,159 hectares. Nearly all of the defoliated area was classified as light, indicating low populations. Populations have declined to pre-outbreak levels in most areas. Additional defoliation (2,291 hectares) in western hemlock stands was observed at several locations in the McBride and Kinbasket Lake (Canoe Reach) areas of the Headwaters District; access difficulties prevented ground checks to verify defoliator species. Likely candidates include western hemlock looper, hemlock sawfly, and saddleback looper (see page 29 for a more in-depth explanation). Mortality, due to repeated defoliation over the last 4 years, was observed on just under 5,000 hectares in the Region. Most of this mortality was in the Columbia District, and in the Okanagan Shuswap District.

Monitoring traps (6 traps per site) deployed by the Ministry of Forests at 27 sites in the Columbia, Okanagan Shuswap, and Headwaters Districts had very low catches. The average number of male moths caught per trap for all 27 sites was only 8, and no site averaged higher than 25 moths/trap (Table 11). Additional trapping conducted by the Canadian Forest Service a 8 sites in the Columbia District, and 12 sites in the Headwaters District, also showed low moth catches. In general, sites located near areas with active hemlock looper populations catch an average of several hundred moths/trap. Predictive egg sampling was carried out cooperatively by the Ministry of Forests and the Canadian Forest Service, at 22 sites in the Columbia District. No viable eggs were collected in any of the samples. No visible defoliation is expected until the beginning of the next outbreak cycle.

Two-Year Cycle Budworm, *Choristoneura occidentalis*

Little defoliation was recorded in 2005, as it was an "off" year in the feeding cycle of most populations of this insect. Just under 2,000 hectares of defoliation was mapped in the northern end of the Headwaters District. In the upper Coldwater River area of the Cascades District, budworm defoliation was observed on both Douglas-fir and subalpine fir stands in close proximity to one another. It is likely that this defoliation was caused by western spruce budworm populations that have expanded into these adjacent subalpine fir stands.

Gypsy Moth, *Lymantria dispar*

No gypsy moth adults were caught in any of the 467 (144, 150, and 173 in each of the old Nelson, Cariboo, and Kamloops Regions) permanent pheromone trapping sites in the SIR.

Fir Engraver Beetle, *Scolytus ventralis*

A total of 2,476 hectares of Douglas-fir were affected by fir engraver beetle mortality, in the Rocky Mountain, Arrow Boundary, Kootenay Lake, and Columbia Districts. Most of the mortality was classified as Light.

Xylotrechus longitarsis

Table 11. Average number of western hemlock looper moths caught per 6-trap cluster from 2002 - 2005 in the Southern Interior Forest Region.

Site	District	Location	Average Trap catches 2002	2003	2004	2005
1	Headwaters	Serpentine	156	77	3.5	11.7
2	Headwaters	Thunder River	172	69	10.8	8.8
3	Headwaters	Mud Lake	505	71	13.2	7.0
4	Headwaters	Murtle Lake Road	433	150	8.5	11.3
5	Headwaters	Finn Creek	271	29	1.7	7.0
6	Headwaters	Tumtum	207	no traps	no traps	no traps
	District Average		**291**	**79**	**7.5**	**9.2**
7	Okanagan Shuswap	Scotch Creek	954	567	4.5	0.8
8	Okanagan Shuswap	Yard Creek	273	780	0.2	0.7
9	Okanagan Shuswap	Crazy Creek	315	1110	4.2	4.5
10	Okanagan Shuswap	Perry River North	1,294	1471	75	8.2
11	Okanagan Shuswap	Three Valley Gap	374	238	25.5	21.3
12	Okanagan Shuswap	Perry River South	1,084	958	30	6.0
13	Okanagan Shuswap	Kingfisher Creek	1,203	203	8.7	24.8
14	Okanagan Shuswap	Noisy Creek	128	145	4.8	24.8
15	Okanagan Shuswap	Shuswap River E.R.	347	457	107.3	3.0
16	Okanagan Shuswap	Greenbush Lake	302	2860	192.3	0.3
17	Okanagan Shuswap	Adams River	189	no traps	1.3	9.7
	District Average		**588**	**806**	**38.4**	**8.1**
66	Columbia	Sutherland Falls	n/a	n/a	2.5	2.5
72	Columbia	Trout Lake	n/a	n/a	7.0	6.2
73	Columbia	Martha Creek	n/a	n/a	16.6	7.7
74	Columbia	Goldstream River	n/a	n/a	2.2	5.3
75	Columbia	Downie Creek	n/a	n/a	no traps	1.3
76	Columbia	Bigmouth Creek	n/a	n/a	2.3	8.5
78	Columbia	Carnes Creek	n/a	n/a	1.2	4.3
83	Columbia	Begbie Creek	n/a	n/a	9.2	12.7
84	Columbia	Pitt Creek Rec Site	n/a	n/a	1.8	1.0
85	Columbia	Redrock	n/a	n/a	1.8	22.7
87	Columbia	Jumping Creek	n/a	n/a	3.3	9.4
	District Average		**n/a**	**n/a**	**4.8**	**7.4**

Birch Leaf Miner, *Fenusa pusilla*

Birch leaf miner populations and associated defoliation increased slightly in the Kamloops and 100 Mile House Districts, and minor amounts of defoliation were also seen in the Headwaters and Okanagan Shuswap Districts. Affected area totalled 2,842 hectares, most of which was classified as Light defoliation.

Windthrow

Windthrow was observed on 2,567 hectares in 2005, most of which was in the eastern Quesnel, Central Cariboo, and 100 Mile House Districts. Spruce beetle populations are also active in these areas, and repeated windfall events over the last few years may be contributing to maintenance and/or buildup of these populations.

Douglas-fir Tussock Moth, *Orgyia pseudotsugata*

Defoliation was observed in two small areas near Vernon, in the Okanagan Shuswap District, totalling just over 36 hectares. Subsequent ground surveys in September failed to locate a significant number of new egg masses; this, combined with a lack of feeding on understory trees and lower crowns, indicates that the population had declined during the feeding cycle, presumably due to NPV virus. No defoliation is anticipated to occur at these sites in 2006. Defoliation was also observed in the Kamloops area, on 19 hectares. Access difficulties prevented any ground reconnaissance to determine population status at this site.

6-trap clusters, placed at 20 locations in the Kamloops, Cascades, and Okanagan Shuswap Districts, caught an average of 16.4 moths/trap. Catches were very low at 13 of the sites, and moderate at 6 sites (Table 12). Trap catches were very high (average 79.8 moths/trap) at a single site adjacent to the defoliated stands near Vernon. 6-trap clusters placed at 24 sites in the 100 Mile House District caught an average of only 0.7 moths/trap.Additional single-trap sites distributed throughout high hazard areas of the Okanagan-Shuswap, Cascades, and Kamloops Districts, caught low numbers of moths (Table 13). Three-tree beatings conducted at all 6-trap cluster sites were positive at only 2 sites (1 larva at each site). The status of tussock moth populations at sites of mapped 2005 defoliation does not seem to indicate an impending outbreak at this time.

Table 12. Average number of Douglas-fir tussock moths caught per 6-trap cluster from 2001 - 2005 in the Southern Interior Forest Region.

		Average trap catches				
Site	**Location**	**2001**	**2002**	**2003**	**2004**	**2005**
1	McLure	1.3	0.2	6.3	3.3	0.0
2	Heffley Creek	13.8	6.7	76.3	5.5	38.0
3	Inks Lake	9.7	7.8	30.0	1.5	0.3
4	Six Mile	8.2	3.5	67.0	9.7	33.6
5	Battle Creek	17.2	10.7	67.7	5.6	1.2
6	Barnes Lake	39.2	10.3	52.2	6.7	1.5
7	Veasey Lake	56.7	16.3	83.0	2.7	0.0
8	Pavilion	17.7	1.0	9.7	0.3	0.0
9	Stump Lake	3.8	0.0	3.2	1.2	3.75
10	Monte Creek	5.5	3.5	10.7	13.8	40.2
11	Chase	14.2	28.0	36.3	11.2	9.3
12	Yankee Flats	0.7	1.7	1.0	0.3	2.0
13	Vernon	19.6	28.8	24.8	22.7	79.8
14	Wood Lake	6.8	0.3	1.1	6.7	11
15	Kelowna	6.2	0.5	no traps - fire	no traps	no traps
16	Summerland	16.8	1.5	0.0	0	4.5
17	Kaleden	5.7	1.2	0.3	0.3	18.6
18	Blue Lake	4.2	2.7	9.2	8.4	39.8
19	Stemwinder Park	49.3	2.5	1.2	1	29.5
20	Ashnola River	46.7	1.2	0.5	0	14.3
21	Spences Bridge	19.7	0.7	21.3	1.5	0.0
	Regional Average	**6.0**	**17.3**	**25.1**	**5.1**	**16.4**

Table 13. Average number of Douglas-fir tussock moths caught per trap (single trap per site) from 1994 to 2005.

	Forest District					
		Okanagan Shuswap			Cascades	
Year	Kamloops (±100 traps)	Salmon Arm (9 traps)	Vernon (±46 traps)	Penticton (27-30 traps)	Merritt (±30 traps)	Lillooet (15 traps)
1994	19.5	NT	NT	NT	0.1	8.0
1995	10.4	NT	0.9	3.6	2.6	NT
1996	1.9	NT	1.5	4.4	1.9	1.2
1997	17.0	0.0	2.5	9.3	17.0	1.6
1998	25.8	0.0	10.6	24.4	25.8	4.9
1999	4.8	0.0	6.8	27.0	19.7	2.5
2000	3.6	2.9	5.9	19.3	17.0	2.0
2001	3.1	0.1	1.9	4.9	4.8	1.0
2002	15.2	2.0	5.6	6.6	13.8	2.4
2003	25.8	11.9	11.9	5.0	5.9	5.4
2004	18.7	6.0	9.8	4.9	4.2	2.0
2005	1.7	0	1.5	0.2	1.4	0

NT= no traps placed

Wildfire

Wildfire activity was quite limited in 2005, and mainly restricted to a few large fires in the Cascades and Okanagan Shuswap Districts. A total of 6,433 hectares were burned, most of which was in 3 large fires in the Spences Bridge, Oliver, and Merritt areas. The low level of wildfire activity was due to a combination of high early season rainfall, low temperatures, and an overall reduction in lightning activity.

Redbelt

Redbelt winter damage was observed on 2,314 hectares in the Chilcotin District. The majority of the damage occurred in the 1,300 – 1,600 metre elevation range. Most of the damage was trace to light, with minimal effects (foliage loss, and crown and/or branch dieback).

Satin moth defoliation in the Robson Valley.

Other

Other forest health factors observed during the 2005 Overview Surveys included western pine beetle (70 hectares in the Okanagan Shuswap and Rocky Mountain Districts), satin moth (394 hectares, scattered in many locations in the Region), forest tent caterpillar (148 hectares in Kootenay Lake and Arrow Boundary Districts), western blackheaded budworm (7 hectares in the Columbia District), larch needle cast (672 hectares in Kootenay Lake and Rocky Mountain Districts), pine needle cast (319 hectares, mostly in the Kootenay Lake District), and bear damage (1,377 hectares in the Rocky Mountain District). Additionally, abiotic mortality and/or damage was observed, such as drought mortality (39 hectares, flooding mortality (397 hectares), and slide damage (168 hectares).

Nelson Area Summary

The Nelson portion of the Aerial Overview Survey was conducted between July 25 and August 12, 2005, and required 108.5 hours of flight time over 18 days of flying. The surveys covered the area of the old Nelson Forest Region (Arrow Boundary, Columbia, Kootenay Lake, and Rocky Mountain Forest Districts). The Cranbrook and Boundary areas were surveyed first to avoid the high haze levels that often occur in these areas later in the summer. All National Parks (Yoho, Kootenay, Glacier, and Mount Revelstoke) were covered by the provincial overview surveys in 2005. Surveys were conducted by contract personnel (Marnie Duthie-Holt of Medi-For Forest Health Consulting, and Neal Emery of Nazca Consulting).

Arrow Boundary Forest District

Mountain Pine Beetle

Mountain pine beetle infestations continue to expand, doubling from just under 51,000 ha in 2004, to 100,589 ha in 2005. Following the ongoing trend, average polygon size remained virtually unchanged at 72.1 ha, while the number of polygons doubled, up from 707 in 2004, to 1,395 in 2005. The number of spot infestations has dropped dramatically, from 867 (13,005 trees) in 2004, to just 159 (960 trees) in 2005. This demonstrates the trend that small infestations are coalescing into larger, more continuous area of mortality in many areas of the District. Just over half of the affected area was classified as moderate (10-30%) or severe (30-50%).

Expansions were observed in most areas of previous beetle activity, with the most significant increases in the Murphy Creek – Old Glory Mountain, Renata, Slocan-Passmore, Inonoaklin Creek, and Valhalla Park areas. Additionally, a large number of new infestations were observed throughout the northern portion of the District, from Nakusp, north to Beaton and the Lardeau River. The most extensive areas of mortality continue to be in the central, south central, and east central areas of the District, and nearly all other areas are experiencing varying levels of mortality. Over 7,900 hectares of attack were mapped in parks, up from just under 3,000 hectares in 2004.

Overwintering mortality surveys carried out during the spring of 2005, showed a very low mortality rate of 48.7%, and a high population R-value of 11.3. These values indicate a vigorous, expanding population.

Western Balsam Bark Beetle

Mortality due to western balsam bark beetle was mapped on 14,670 ha in 2005, up from 3,713 ha in 2004.
This was scattered across most high elevation areas of the District, with the most extensive areas being in the upper Kettle River - Granby River area. Nearly all of the area mapped was in the trace (<1%) and light (1-10%) categories. This increase in area is largely a reflection of the increased mapping threshold used this year, where even very low mortality levels are being mapped, across the Province.

Douglas-fir Beetle

Mortality was mapped on 1,591 ha in 2005. Additionally, 680 trees were killed in 182 spot infestations. This is a large increase over 2004 levels, when only 5 ha of mortality and an additional 41 spot infestations were mapped. Population levels of this insect have fluctuated significantly during the last few years. Most of the activity was in the southwestern portion of the District, in the Kettle River, West Kettle River, Granby River, and Christina Lake areas.

Western Hemlock Looper

Defoliation of western hemlock due to western hemlock looper was mapped on 718 ha, in the Incomappleux River area. A further 259 ha of grey (cumulative mortality due to past defoliation) was observed in small pockets near Kuskanook Creek, Halcyon, Galena Bay, and Trout Creek.

Fir Engraver Beetle

Mortality has fallen from 2004 levels of 1,245 ha, to 466 ha. Most mortality continues to be in the Pend D'Oreille River, Rossland, and Montrose areas. An additional 100 trees were killed in 21 spot infestations.

Other forest health factors observed were: spruce beetle (21 ha in Kuskanax Creek), forest tent caterpillar (116 ha in the Grand Forks area), satin moth (30 ha east of New Denver), and 66 ha of an unknown defoliator (near New Denver, and in the upper Battle Creek area), and 65 hectares of wildfire.

Columbia Forest District

Mountain Pine Beetle

Total area of infestation has risen from 5,935 ha in 2004 to 35,840 ha in 2005. Of this total, 16,176 hectares were within Kootenay, Yoho, Glacier, and Mount Revelstoke National Parks, which were not fully covered by the provincial aerial overview surveys in 2004; therefore, the increase in the provincial forest landbase is not as great as would be indicated by the affected area totals. Nevertheless, infested area has increased by over three-fold in most areas outside of the National Parks, and by as much as 8-10 fold within the National Parks. The number of spot infestations has declined to 70 (325 trees), from 177 (2,665 trees) in 2004.

The most significant expansions were seen in the Beaverfoot – Kootenay River corridor, in the Columbia River valley in the Golden area, in the Columbia Reach area, in the Kootenay Crossing area in Kootenay National Park, and in Yoho National Park.

Green:red expansion ratios ranged from 1:1- 3:1, with some areas experiencing up to 8:1 expansion. Overwintering mortality surveys carried out during the spring of 2005 in the Golden area indicate low larval mortality rates of 58%, and an average population R-value of 12.6. These values all indicate a vigorous, expanding population.

2004 controlled burn in Yoho National Park.

Western Balsam Bark Beetle

Mortality was mapped on 9,919 ha, most of which was classified as light (1-10% current mortality). Mortality was scattered relatively evenly throughout the high-elevation forests of the District.

Douglas-fir Beetle

Douglas-fir beetle activity increased substantially, from only 5 hectares in 2004, to 295 ha in 2005. Most mortality was along the southern end of Revelstoke Lake, in Mount Revelstoke National Park, and in the vicinity of Revelstoke. 25 small spot infestations were also mapped, killing an additional 45 trees.

Spruce Beetle

Spruce beetle mortality expanded in the Sullivan River and Cummins Park areas, and totalled 168 ha, up from only 13 ha in 2004.

Western Hemlock Looper

Western hemlock looper populations began decreasing significantly in 2003 - 2004, and this trend continued in 2005. Defoliation was only mapped on 1,441 ha, down from 3,408 ha. Most remaining activity was scattered along Lake Revelstoke and Upper Arrow Lake. Trap catches throughout the District were very low this year, (Table 11) indicating that populations have now mostly subsided to pre-outbreak levels. No defoliation is expected in 2006. Mortality due to repeated looper defoliation over the past three years was recorded on 4,410 ha, in the Lake Revelstoke, Upper Arrow Lake, Akolkolex River, and Illecillewaet River areas.

Western Blackheaded Budworm

Populations appear to have declined sharply, and defoliation was only recorded on 7 hectares in 2005, just east of Rogers Pass in Glacier National Park, down from over 900 hectares in 2004.

Other forest health factors observed were satin moth (46 ha, just south of Revelstoke), an unspecified defoliator in the Albert Creek and Rogers Pass areas (378 ha), 39 ha of unspecified young stand mortality in the Wallis Creek area, windthrow (97 ha), and landslide damage (100 ha).

Rocky Mountain Forest District

Mountain Pine Beetle

Mortality due to mountain pine beetle continued to increase. Total area affected was up by over 3-fold in 2005, to 96,983 ha, up from 29,384 ha in 2004, and 8,500 ha in 2003. Nearly all of this increase was in the light (1-10%) and moderate (10-30%) categories; the amount of infestation classed as severe (30-50%) remained nearly unchanged at only 5,243 ha. The number of spot infestations increased slightly, to 603 (4,120 trees). 8,590 hectares of the mapped area was within Kootenay National Park, and 1,890 hectares were within 9 different provincial parks.

Mountain pine beetle is now present in nearly all areas of the District with susceptible host. The greatest expansions were seen in the Elk River, Dewar Creek- Redding Creek, Bobbie Burns Creek – Steamboat Mountain, Invermere, Radium, Kootenay National Park, and Wigwam River areas.

Overwintering mortality surveys from March of 2005, indicated that populations in the area are vigorous, with an average population R-value of 8.5. Larval mortality in the District averaged only 68% - the highest mortality rate in the Southern Interior Region, but still historically a very low value. However, due to cool, moist weather during the late 2005 larval development and flight periods, green:red expansion ratios were lower than the past few years. Attack patterns in many parts of the District appear to have been more dispersed than usual. Ratios averaged 2.4:1 in the District in 2005, down from 5:1 in 2004.

Western Balsam Bark Beetle

Mortality due to western balsam bark beetle was mapped on 21,871 ha in 2005; nearly all of this was in the light (1-10% mortality) category. Mortality was seen in most high-elevation areas, with the most significant damage in the northern (Spillamcheen River and Vowell Creek), southwestern (St. Mary's River, Redding Creek, and Purcell Wilderness Conservancy), and central (Wild Horse River, upper Bull River) areas of the District.

Douglas-Fir Beetle

Douglas-fir beetle remains active in the District, with mortality observed on 1,781 ha, up from 515 ha in 2004. Increased activity was observed in the Whiteswan Lake – Premier Lake area, and in the Hellroaring Creek area. The scattered spot infestations that were seen in the south-central portion of the District in 2004, decreased substantially this year, resulting in the decline in the number of spot infestations (from 188 in 2004, to only 83 in 2005). As well, infestation levels in Kootenay National Park fell slightly, from 95 hectares in 2004, to 53 hectares in 2005.

Spruce Beetle

No significant mortality was observed during the overview surveys in 2005.

Western Pine Beetle

Western pine beetle mortality was observed in the Fort Steele area, and totalled 47 ha. Three small spot infestations were also seen in the general area.

Other forest health factors observed included forest tent caterpillar (113 ha in the Fort Steele area), satin moth (25 ha near Fairmont Hot Springs), larch needle cast (77 ha), pine needle cast (46 ha in the upper Moyie River), windthrow (105 ha, scattered), and wildfire (66 ha). As well, an unspecified foliar disease was observed affecting 106 hectares in upper Mather Creek, an unspecified defoliator was mapped on 74 ha in the Lodgepole Creek area, and unspecified mortality was recorded on 3 plantations (213 ha) in the White River area.

Kootenay Lake Forest District

Mountain Pine Beetle

Mountain pine beetle populations have continued to expand rapidly, and affected area has increased nearly 4-fold from 2004 levels, to 42,020 ha. Area affected has now increased almost 17-fold from just 2 years ago. The increasing average polygon size (up to 53.4 ha from 48 ha in 2003 and 33 ha in 2003) and decreasing number of spot infestations (from 537 in 2004 to 122 in 2005) demonstrates how smaller areas of mortality have, in many areas, expanded and coalesced into larger, more continuous areas of attack, especially in areas where the beetle has been present for more than 1-2 years.

Mountain pine beetle, Kootenay Lake Forest District.

Increased mortality was seen in most areas of the District, with the greatest increases being in the west-central area around Nelson. Significant expansions were also seen in the southern areas of the District, and a large number of new and expanding infestations were observed in the central portion of the District, between Ainsworth and Duncan Lake. Significant increases were seen in a number of provincial parks, where area increased from 2,070 hectares in 2004, to 7,650 hectares in 2005.

Overwintering mortality rates over the winter of 2004-2005, indicated a very low larval mortality of 45%, and a very high population R-value of 10.5. These numbers predicted further large population expansions during 2005; however, cool, wet weather during the spring and early summer, resulted in a late and uncoordinated beetle flight during 2005, in much of the District. In some of the key suppression areas, very low levels of new green attack have been observed. In much of the rest of the District, green:red ratios of 2-3:1 were more common. This still indicates that populations expanded in the District in 2005, but at a slower rate than in the past few years.

Western Balsam Bark Beetle

Mortality was mapped on 8,880 hectares, and was scattered throughout most parts of the District. Most mortality was classified as light (1-10%).

Douglas-Fir Beetle

Douglas-fir beetle mortality remained at a low level in 2005, at 136.6 hectares, and 21 spot infestations of 5 or less trees.

Fir Engraver Beetle

Fir engraver beetle activity continues to cause scattered mortality in grand fir, on just under 300 ha in 2005. This is a slight increase from 2004 levels of 108 ha. Most mortality was in the Corn Creek – Boundary Creek area, and along the west side of Duncan Lake, near Maude Creek.

Spruce Beetle

Several small, scattered pockets of mortality were mapped, totalling 93 ha, in the Corn Creek, East Creek, and Steven Creek areas.

Western Blackheaded Budworm

No defoliation or mortality resulting from repeated defoliation was observed this year.

Larch Needle Cast

Larch needle cast caused light defoliation on 595 hectares. Activity was scattered in several areas of the district.

Pine Needle Cast

Pine needle cast 260 hectares of moderate defoliation approximately 10 km northeast of Yahk.

Other forest health factors observed included 8 hectares of satin moth (west of Retallack along highway 31A), 114 ha of an unspecified foliar disease, 25 ha of an unspecified defoliator, 68 ha affected by landslide activity, 6 ha of windthrow, and 47 ha of wildfire.

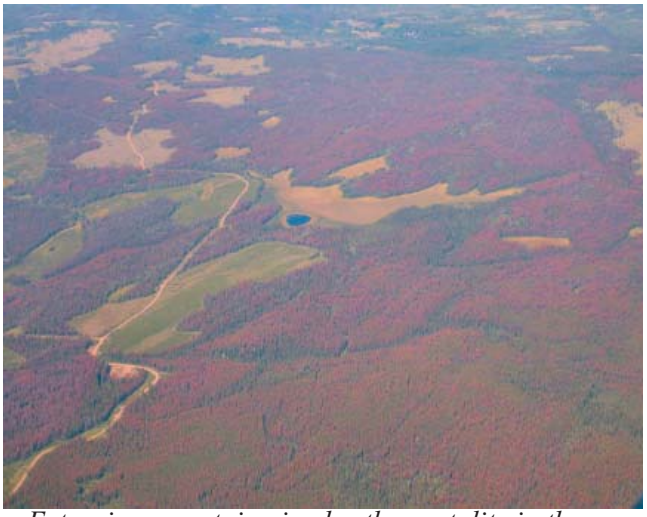
Kamloops Area Summary

The Kamloops portion of the 2005 Aerial Overview Survey was conducted between July 14 – July 28, 2004. The surveys required 58.0 hours of flight time, over 13 days of flying. Flights were based out of the Kamloops and Penticton airports, and covered the Kamloops, Okanagan Shuswap, and Cascades Forest Districts, and the portion of Headwaters District within the Kamloops TSA (the former Clearwater Forest District). Flying conditions were generally good on most days; intermittent poor weather caused a few delays and shortened flight days. Surveys were a co-operative effort between Ministry of Forests (Kevin Buxton, Regional Forest Health Technician) and contract personnel (Janice Hodge, JCH Forest Pest Management).

Kamloops Forest District

Mountain Pine Beetle

Mountain pine beetle populations continue to expand rapidly. Significant levels of mortality were mapped on 290,312 hectares in 2005, up almost 2.5 fold from 2004 levels of 117,000 hectares. The number of spot infestations has increased as well, from 410 (5,090 trees) in 2004, to 537 (5,840 trees) in 2005. Increases in both area affected and severity of attack were seen in almost all parts of the District. Area affected increased exponentially in many areas, including the Arrowstone Plateau, the Bonaparte Plateau – Taweel Lake area, and the Tunkwa Lake – Logan Lake area, where nearly all stands have now been attacked to some level. In other areas, most notably the upper Deadman River and upper Criss Creek, cumulative mortality is reaching high levels, and many stands are now composed mostly of grey attacked trees. Other areas areas experiencing major expansion are the upper Scuitto Creek – Monte Hills, Rocke Lake – Dardanelles Lake, Lac Le Jeune, McConnell Hill, upper Hat Creek, Medicine Creek – McLean Lake, Glossy Mountain, Chu Chua, and Dunn Lake areas. As well, pine stands throughout the interior wet belt transition in the Barriere River – Adams Lake areas are experiencing significant and increasing levels of mortality. Attack in parks has more than doubled, to 21,585 hectares, in 22 separate provincial parks.



Extensive mountain pine beetle mortality in the Criss Creek area, Kamloops Forest District.

Infestations in most of the above mentioned areas are continuing to expand and coalesce into large areas of continuous attack, as illustrated by the continued increase in average polygon size, which has more than doubled from 2004 levels to 106 hectares.

Ponderosa pine stands are experiencing significant levels of mountain pine beetle attack – 2,430 hectares of the total area, and 252 of the total 533 spot infestations, are in ponderosa pine. This mortality was scattered throughout the low elevation drybelt areas of the District, and is predominantly the result of close proximity to large beetle populations in lodgepole pine; as well, several areas that had sustained drought mortality in 2003-2004, are experiencing increased levels of attack. In many of these areas, mountain pine beetle is mixed with western pine beetle, and with other secondary insects. Green attack levels in many ponderosa pine stands are high.

Overwintering mortality surveys conducted in the spring of 2005 indicated a very low average larval mortality of 29%, and the associated population R-value was 22.6. These values were the most extreme in the Region, and indicate that mountain pine beetle populations are ex-

Mountain pine beetle-killed ponderosa pine.

panding at an extremely high rate in the District. Large increases in infested area, and in tree mortality rates, are expected to be observed in 2006.

Western Balsam Bark Beetle

Western balsam bark beetle mortality was mapped on 7,757 hectares in 2005, all of which was classified as trace and light. Most activity was in the northeast portion of the District, in the Nikwikwaia Creek, Blomley Creek, Chu Chua Creek, and Sun Peaks areas. Mortality was likely underestimated in the Bonaparte Plateau area in 2005, as subalpine fir is often found mixed with lodgepole pine, and the high levels of mountain pine beetle mortality often mask the lower level, scattered mortality of western balsam bark beetle.

Western Hemlock Looper

Western hemlock looper populations have now fallen to pre-outbreak levels in all areas in the District, and no defoliation occured in 2005. Cumulative mortality was mapped on just under 100 hectares, in the Inks Lake, Goose Lake, and Duffy Lake areas. Mortality levels averaged 60-80%, and volume losses in the area are estimated at approximately 15,000 - 20,000 m^3. Most of this mortality was a result of the first 1-2 years of defoliation in a given location, and was often where false hemlock looper populations were also high. The additive effect of both defoliators caused very severe defoliation in these locations.

Western Spruce Budworm

Western spruce budworm populations continue to fluctuate in the western portion of the District. Defoliation was mapped on 6,725 hectares in 2005, up from 4,600 ha in 2004. Populations fell in most areas where activity was noted in 2004, and increased in the Hat Creek, McLean Lake, and Two Springs Creek areas. Trace levels of defoliation (below the threshold of visibility from aerial surveys) continue to be observed during ground reconnaissance, in a wide range of areas along the North Thompson and Thompson River valleys, and in the Roche Lake – Campbell Creek area. No predictive egg mass sampling was conducted in the District in 2005.

Birch Leaf Miner

Populations increased in the Louis Creek area, and defoliation was recorded on just under 1,500 hectares. This is an increase from 2004 levels of 672 hectares.

Douglas-fir Beetle

Overall, Douglas-fir beetle activity has decreased, with scattered spot infestations (11 spots, 100 trees) seen in only a few areas, near Adams Lake, Durand Creek, and Venables Lake. An additional 73 hectares of severe mortality was observed in the Vidette Lake area.

Spruce Beetle

Spruce beetle activity was observed in the upper Wentworth Creek area, and in the Sun Peaks – Fadear Creek area. Affected area totalled 321 hectares.

Hemlock looper-caused mortality in Douglas-fir near Inks Lake, Kamloops Forest District.

Douglas-fir Tussock Moth

Douglas-fir tussock moth defoliated 19 hectares in the Scheidam Lake area, northeast of Kamloops. Defoliation was a mix of light, moderate, and severe. Populations had been predicted to remain low, as 2004 trap catches indicated a continued downwards trend. No attempt was made to assess the population on the ground, due to access difficulties (private land).

Other

Other forest health factors observed included small, scattered wildfires (48 hectares). During routine field activities, regional forest health personnel observed significant levels of mortality in several immature stands located within the 2003 McLure wildfire perimeter. Investigation indicated that most of the mortality was a result of the activity of secondary insects, such as *Dendroctonus valens*, which had built up in surrounding fire-killed stands.

Cascades Forest District

Mountain Pine Beetle

Mountain pine beetle mortality continues to increase exponentially, and area affected has increased by over 3-fold for the second year in a row, from 9,070 ha in 2003, to 33,570 ha in 2004, to 103,388 hectares in 2005. The proportion of trace (< 1% attack) has doubled, to 14 % of the total area, while the proportion of very severe (> 50% attack) has fallen to less than 1% of the total area. The number of spot infestations has doubled, from 469 (6,365 trees) in 2004, to 927 (9,830 trees). This indicates that the amount of scattered light attack is increasing sharply, while harvesting efforts have been successful at addressing some of the areas of highest mortality.

The largest increases are in the northern and northeastern parts of the Merritt TSA, in the Clapperton Creek – Steffens Creek, Glimpse Lake, Rush Creek, upper Quilchena Creek, and Pennask Lake areas; and in the northeast part of the Lillooet TSA, along the west side of the Fraser River, from Slok Creek north to the district boundary. Significant increases were also seen in the Murray Creek, Twall Creek, Sleetsis Creek, Inkikuh Creek, Shuhun Creek, Gillon Creek, Pavilion Lake, and Siwash Creek areas. In particular, the French Bar Creek and Siwash Creek areas have experienced a huge increase in the number of small, scattered polygon and spot infestations; the combination of limited access and abundant pure, mature lodepole pine stands in the French Bar - Watson Bar area makes this area a particular challenge for suppression activities.

Mountain pine beetle is also causing widespread ponderosa pine mortality in several areas, in the Merritt, Lemoto Creek, Midday Creek, upper Otter Creek, McCullough Creek, and Chapperon Lake areas. A total of 1,811 hectares and 25 spot infestations (250 trees) of the total mountain pine beetle infested area were in ponderosa pine. As in the Kamloops District, much of the attack in ponderosa pine was mixed with western pine beetle.

Mountain pine beetle mortality in Manning Park.

Western Balsam Bark Beetle

Western balsam bark beetle was mapped on 13,644 ha in 2005, nearly all of which was classed as either trace or light. Affected stands are scattered throughout high elevation areas along the western edge of the District, as well as in the Siwash Creek – Paradise Lake, and Sussex Lakes areas.

Overwintering mortality surveys completed during March 2005 indicated that larval mortality was low (53%) and population R-values were high (13.7) during the winter of 2004-2005. As well, 2005 green:red ratios were high. Values as high as 30:1 to 50:1 were reported from lower elevations (under 1,500 metres) in the Merritt TSA, indicating massive influx of beetles from neighbouring stands. Ratios at higher elevations averaged 2:1. In the Lillooet TSA, green:red ratios averaged 5:1. It is expected that overall attacked area, as well as severity of attack, will increase in significantly in 2006.

Spruce Beetle

Total area affected by spruce beetle remained similar to 2004 levels, at 3,112 hectares of mainly light and moderate mortality. Decreases in the Tommy Creek area were largely offset by increases in Truax Creek, Williams Creek, Cadwallader Creek, and the Rex Peak area. Significant, continuing mortality was also observed in the Keary Creek, Bob Creek, Lost Valley Creek, and Downton Creek areas. Several small, scattered areas of mortality were also mapped in the upper Coldwater River, upper Tulameen River, and Pasayten River areas.

Douglas-fir Beetle

Douglas-fir beetle activity has declined in many areas, and was mapped on only 90 hectares (down from 425 hectares in 2004). 54 spot infestations killed an additional 435 trees. Most mortality continues to occur in the dry, low elevation stands in the Thomson River and Fraser River areas.

Mountain pine beetle mortality in the French Bar Creek area, Cascades District.

Western Spruce Budworm

Populations expanded in 2005, and defoliation was mapped on 92,291 hectares, up nearly 35% from 2004 levels of 68,845 hectares. Increases were seen in several areas – the Yalakom River, Big Bar, Carpenter Lake, Tyaughton Lake, and Pavilion Lake areas; as well, populations continue to expand into areas with no previously recorded defoliation, in the Otter Creek – Allison Lake and Tulameen River areas, and along the southern side of the Similkameen River as far east as Hedley. Budworm has also spread up the Coldwater River as far as the Coquihalla Lakes area, where it is defoliating both Douglas-fir and subalpine fir. Defoliation levels dropped off in the Downton Lake, Anderson Lake, Skuhun Creek, Promontory Hills, Swakum Mountain, Nicola Lake, and Douglas Lake areas. A total of 2,387 hectares of high-priority Douglas-fir stands were aerially treated with *B.t.k.* in June. Results did not fully meet expectations, as a period of cold, rainy weather occurred just after spray application. However, predictive egg mass sampling indicated that populations had been reduced to some degree within the spray area. In general, in the Merritt TSA, egg mass sampling shows that budworm populations are spreading in geographical extent, while they are at the same time decreasing in density. In the Lillooet TSA, populations are remaining high, and moderate or severe defoliation is predicted for 2006, at nearly 80% of all sampling sites.

Moderate western spruce budworm defoliation in the Kingsvale Creek area, Cascades District.

Wildfire

Approximately 4,527 hectares were burned in 2005, nearly all of which was in a single wildfire, located in the Sleetsis Creek area. This wildfire impacted mostly dry ponderosa pine, Douglas-fir, and lodgepole pine stands, and burned approximately 430 hectares of mountain pine beetle infested stands. A second moderately sized wildfire burned approximately 140 hectares of low elevation mixed Douglas-fir and ponderosa pine near Merritt.

Other insect damage noted during the surveys included 117 hectares of satin moth defoliation in the Murray Lake areas.

Mountain Pine Beetle

Mountain pine beetle infestations expanded by approximately 80%, to 78,673 hectares. The number of spot infestations decreased, from 854 in 2004, to 636 (5,570 trees). The most significant expansions were in the Ptarmigan Hills, Bolean Creek, Shorts Creek, Fowler Creek, Spanish Lake, and upper Salmon River areas; large increases in small, scattered infestations were seen throughout the southwest and northern portions of the District. Lesser but still significant increases were seen in the Aberdeen Plateau, Harris Creek, Ferry Creek, and Monashee Pass areas. Average polygon size has remained stable at 50 hectares (52 hectares in 2004), while the number of polygons has nearly doubled, from 854 in 2004 to 1,573 in 2005. Attack in provincial parks totalled 3,170 hectares.

Mountain pine beetle has also been causing scattered mortality in ponderosa pine, mainly in the Chase Creek – Harper Ranch, Glenemma, and Naramata areas. A total of 295.5 hectares and 8 spot infestations (40 trees) of the total mountain pine beetle infested areas were in ponderosa pine.

Overwintering mortality estimates from the spring of 2005, indicated low larval mortality rates (47 %), and high population R-values (14.1). These indicated a vigorous, expanding population. However, during the summer, periods of cool weather appeared to disrupt the beetle flight, and as a result, green:red ratios were lower than in past years. In the eastern areas of the District, green:red ratios averaged approximately 1:1, while in the western areas of the District (where the weather was warmer and drier), ratios averaged approximately 3:1. It is expected that increased area of red attack will be observed in 2006, especially in the western areas of the District.

Western Balsam Bark Beetle

Mortality was observed on 77,084 hectares, nearly 75% of which was classified as trace (< 1% attack). The most significant infestations continue to be in the Buck Hills – Greystokes area, where over 20,000 hectares of mortality were mapped. Other areas of significant mortality were in the Hunters Range, Tahaetkun Mountain, Whiterock Mountain, and Pukeashun Mountain areas, with smaller areas scattered throughout high elevation forests of the northern 2/3 of the District.

Spruce Beetle

Spruce beetle mortality was visible on 233 hectares, down significantly from 2004 levels of 1,550 hectares. Most of this decline was seen in the Snowy Mountain area, where little activity was detected. A few other small pockets of mortality were observed, in the Cathedral Park, Headwater Lakes, Queest Mountain, and Celista Mountain areas.

Douglas-fir Beetle

Douglas-fir beetle mortality declined significantly, and was only mapped on 183 hectares, with an additional 900 trees killed in 124 spot infestations. Activity increased in the form of many small, scattered spot infestations and small polygons, in most areas in the southern part of the District, especially the Mission Creek, Shuttleworth Creek, Mt. Kobau, Keremeos Creek, and Darke Creek areas. Scattered mortality was seen in the northern part of the District, in the Sugar Lake, Mabel Lake, Salmon Arm, Sicamous, and upper Scotch Creek areas.

Light, scattered mountain pine beetle attack in the Okanagan Shuswap District. Note high ratio of new attack (faders) to older attack (dull red).

Western Spruce Budworm

Light defoliation was only observed in one small area (74 hectares) at Winters Creek, east of Hedley. Defoliation is expected to increase in this area in 2006, as budworm populations have been expanding eastwards along the Similkameen River valley, towards the District boundary. No egg mass sampling was conducted in the District in 2005.

Western Hemlock Looper

No defoliation occurred in 2005. Cumulative mortality was mapped on just over 500 hectares, mainly in the Perry River valley. Scattered pockets of mortality were also mapped in the Sugar Lake, Mabel Lake, Larch Hills, Cooke Creek, and Queest Mountain areas. Mortality levels ranged from 10% to 40%, and volume losses are estimated at approximately 20,000 - 30,000 m^3. Most of this mortality was a result of the first 1-2 years of defoliation in a given location.

Western spruce budworm defoliation near Princeton.

Douglas-fir Tussock Moth

Douglas-fir tussock moth defoliated 36.4 hectares of private land in the BX Creek area, just east of Vernon. A nearby 6-trap monitoring site was the only site in the Region that caught a significant number of moths in 2004, and an average of 79 moths per trap was caught in 2005. Despite these increasing trap catches, ground reconnaissance of the area revealed that populations in the area had crashed, due to NPV virus infection. Defoliation is not anticipated in 2006.

Wildfire

A large wildfire in the Camp McKinney Road area east of Oliver burned 525 hectares of low elevation grassland and ponderosa pine – Douglas-fir forest. Several other small, scattered wildfires increased the total area burned in the District to 589 hectares. Additionally, secondary insect activity caused severe mortality on 370 hectares in lodgepole pine stands within the perimeter of the 2003 Okanagan Mountain Park fire.

Other forest health factors mapped included 21.9 hectares of western pine beetle (near the 2003 Anarchist fire, and in Sutherland Hills Regional Park in Kelowna), 32 hectares of satin moth defoliation in the Mt. Kobau and Shuttleworth Creek areas, 14 hectares of pine needle cast near Noisy Creek, and 19 hectares of windthrow near Vaseaux Creek.

Douglas-fir tussock moth defoliation near Vernon, showing characteristic "top down" feeding pattern.

Headwaters Forest District

Mountain Pine Beetle

Mountain pine beetle infestations continue to expand, increasing from 30,920 ha in 2004, to 99,051 hectares in 2005. The number of spot infestations increased nearly 4-fold as well, to 492 (5,289 trees). Mountain pine beetle is spreading to all areas of the District with any significant lodgepole pine component, with the highest levels of attack being seen in the Clearwater – TFL 18, and Thompson River corridor areas. Specific areas experiencing high levels of mortality, and/or rapidly expanding populations, include the Russell Creek, Joseph Creek, Mahood Lake, TFL 18, and southern Wells Gray Park areas in the south; and the Tete Jaune Cache – Cedarside, Red Pass, Dunster-McBride, Albreda, and Yellowhead Mountain areas in the north. Many other areas have experienced a sharp increase in the level of small, scattered infestations and spots, especially in the Adams Lake, Adams River, Cayenne Creek, Raft River, and Tete Jaune Cache/Cedarside areas. Area mapped in provincial parks totalled 20,845 hectares, most of which was in Wells Gray Park, and Mount Robson Park.

The average polygon size has decreased somewhat, to 51.5 hectares, and the total number of polygons has increased, from 322 in 2004, to 1,923 in 2005. This indicates that the mountain pine beetle is rapidly spreading into many new stands, often in the form of small, scattered infestations. Overwintering mortality surveys from the spring of 2005 indicated a vigorous population at the time, with an average larval mortality of only 46.5%, and a high average population R-value of 10.9. Subsequent green:red expansion ratios were variable throughout the District. In the Renshaw-Upper Morkill Special Management Unit, ratios averaged 0.75:1, which indicates a slightly decreasing population. In the Hugh Allan Special Management Unit, ratios averaged 2.7:1, which indicates an increasing, but still manageable, population. Ratios in the southern areas of the district were high, mainly due to influx of beetles from neighbouring areas, averaging 9:1, and ranging as high as 24:1.

Western Balsam Bark Beetle

Western balsam bark beetle mortality levels remained nearly unchanged, at 77,084 hectares. Over 70% of the area mapped was classified as Trace. Activity levels dropped off in the upper Fraser River River, Raush River, Holmes River, McKate River, and Horsey Creek areas, while increased mortality was seen throughout the central and southern parts of the District, scattered in relatively smaller, scattered high elevation areas. Large areas of trace and light mortality continued to be observed in the Milk River-Goat River, Cariboo River, and Cushing Creek areas, which account for over half of the affected stands in the District.

Spruce Beetle

Spruce beetle activity increased significantly, and was mapped on 9,990 hectares in the District, up from just over 3,000 hectares in 2004. The majority of the affected area was in the Canoe River area, and in the Kinbasket Lake area, near Dawson Creek and Windfall Creek. Other areas where mortality was observed included Raush River, Albreda, the upper Azure River, Flourmill Creek, Clearwater Lake, and the upper Goat River. Smaller, more scattered infestations were mapped in the Cayenne Creek, Holmes River, Kiwa Creek, Chalco Creek, and Forget Me Not Creek areas. The highest rates of mortality were in the Kinbasket Lake – Dawson Creek area, where much of the affected area was classified as moderate and severe. Over half of all affected area in the District was classified as trace, including all of the large infestations in the Canoe River area.

Douglas-fir Beetle

Douglas-fir beetle activity remains low, with trace mortality mapped on 212 hectares, in the upper North Thompson River, Albreda River, and West Twin Creek areas. The infestations in the southern portion of Wells Gray Park have now declined, and only a few spot infestations were seen in that area. A few spot infestations were also observed in the Dawson Creek/Kinbasket Lake area.

Two-Year Cycle Budworm

Just under 2,000 hectares of defoliation was observed in 2005, in the Forget-Me-Not Creek area. 2005 was an "off" year in the feeding cycle, in most areas of the District; in general, populations have been decreasing over the last several years.

Western Hemlock Looper

Defoliation was observed in several western hemlock stands north of McBride, and along the west side of Kinbasket Lake – Canoe Reach. Access difficulties precluded any ground checks to verify the defoliator agent. Possible candidates include western hemlock looper, hemlock sawfly, saddleback looper, grey forest looper, and western blackheaded budworm. Recent western hemlock looper population trends in the Region indicate that other species may be the causal agent, such as hemlock sawfly (which had a recorded outbreaks in the Bowron River – McBride area in 1975-1977), or saddleback looper (which had a recorded outbreaks in the Blue River area in 1951-1953) (see http://www.pfc.forestry.ca/entomology/defoliators/ for more information on historical defoliator trends in B.C.).

Wildfire

326 hectares were burned in wildfires in 2005, mostly in 4 fires in the Lempriere Creek, Hugh Allen Creek, Canvas Creek, and Mud Lake areas.

Mountain pine beetle mortality.

Cariboo Area Summary

The Cariboo portion of the aerial overview survey was conducted between July 12 and September 7, 2005. The surveys required a total of 184.5 hours of flight time over 32 days of flying. Flying conditions were generally much improved over 2003 and 2004, when smoke and haze caused visibility issues, and flight delays. Surveys were conducted by contract personnel (Joe Cortese, Alta Vista Management; Don Wright, Timber Wright Contracting; Mikko Sapponen, TMS Timber; and Bob Erickson).

Quesnel Forest District

Mountain Pine Beetle

Total area affected by mountain pine beetle has fallen very slightly, from a high in 2004 of 1,359,000 hectares, to 1,289,022 hectares in 2005. However, the total number of trees killed has risen significantly, due mainly to increasing severity levels in much of the infested area - the area experiencing severe and very severe mortality has risen, from 265,000 hectares in 2004, to 589,830 hectares in 2005 – over 45% of all affected area in the District. Much of the area that was classified as moderate in 2004 is now experiencing severe mortality levels. The number of spot infestations recorded was insignificant, at 18 (only 275 trees).

Mountain pine beetle mortality in the Blackwater River area, Quesnel District.

The overall extent of the infestation has changed little from the 2004 situation, and beetle populations are now present in most pine stands in the District. The majority of the land area of the District west of the Fraser River, is now experiencing moderate, severe, or very severe mortality rates, with the most significant increases in mortality levels being seen in the Kluskus Lakes, Coglistoko River, Baezeko River, Nazko River, and Tzenzaicut Lake areas. Large increases in mortality rates were also seen east of the Fraser River, especially in the Umiti Creek, Nyland Lake, Victoria Creek, Lightning Creek, and Barkerville – Bowron Lakes areas. Attacked area in parks totalled 58,442 hectares, most of which was within Bowron Lake, Itcha Ilgachuz, and Kluskoil Lakes Parks.

Overwintering mortality sampling from the spring of 2005 indicated a low larval mortality of 54%, and a high R-value of 8.7. As well, green:red ratios averaged 11:1 in the District in 2005. These values all indicate beetle populations that are still very vigorous, and still expanding. It is expected that affected area will remain high for another year, and then begin to decline significantly as stands in many parts of the District become depleted of mature pine.

Western Balsam Bark Beetle

Western balsam bark beetle remained active in the eastern portion of the district, mainly in the Willow River, Little Swift River, Jack of Clubs Creek, and Cariboo Mountain areas. Total area affected remained almost unchanged, at 70,741 hectares.

Spruce Beetle

Spruce beetle was mapped on only 2,613 hectares in 2005, down from 22,500 hectares in 2004. A little over half of the area was classified as sustaining only light or trace mortality. Most of the visible mortality was confined to the Swift River and Kimball Creek – Connection Creek areas.

Two-Year Cycle Budworm

No defoliation was observed in 2005. As populations in different areas in the District appear to be non-synchronous, with the result that defoliation has been visible each year over the past several years, this lack of visible defoliation this year may be an indication that population levels are declining.

Wildfire

Approximately 617 hectares of wildfire occurred in the District in 2005; most of this area was in a single fire of 600 hectares, near Batnuni Lake.

Windthrow

Windthrow was mapped on 503 hectares, most of which was in several small scattered areas in the Willow River and Porter Creek areas. Scattered windthrow has been occurring in this general area for several years, and has been of concern due to active spruce beetle populations. Most of this windthrow has been occurring in high elevation spruce and mixed spruce stands.

Other forest health factors mapped were 74 ha of light western spruce budworm defoliation in the Soap Lake area.

Central Cariboo Forest District

Mountain Pine Beetle

Infestations now exist in nearly all susceptible stands in the District, and total affected area remained nearly unchanged, at 700,171 hectares. The severity of attack is increasing somewhat, as the proportion of stands experiencing moderate or greater mortality rates has increased from 36.5% in 2004, to 46.7% in 2005. The most significant areas of increasing mortality were east and north of Williams Lake, in the Borland Creek, Miner Lake, Moffat Creek, Black Creek, Quesnel Forks, Cariboo River, Pine Valley, and Tyee Lake areas. Both increased mortality rates and increases in attacked area were also widespread in the Big Creek area, in the southwest part of the District. The number of spot infestations remains very low, at only 33 (390 trees). Total area of attack in provincial parks has tripled, from 8,020 hectares in 2004, to 24,110 hectares in 2005. As in the Quesnel District, average polygon size and total number of polygons has remained relatively constant from 2004, which indicates that the pattern of infestation continues to be characterised by large, continuous areas of attack. It is expected that the overall area of infestation will remain high for the next 1-2 years, and then begin to decline, as available host is depleted in many areas.

Grey attacked lodgepole pine stand, Central Cariboo District.

Overwintering mortality estimates conducted during the spring of 2005 indicated an average larval mortality of only 51%, and a population R-value of 7.5. While these figures are less extreme than the last few years, they still indicate that the population was very vigorous at the time. Green:red ratios after the 2005 beetle flight averaged 5.5:1, which indicates that the population continued to expand this year.

Western Balsam Bark Beetle

Infestation area has declined for the third year in a row, from just over 30,700 hectares in 2004, to 25,209 hectares in 2005. As well, mortality rates are dropping, and 77% of all infested area is now classified as trace. Most of the decline was seen in the upper Horsefly River, Mitchell Lake, and Spanish Lake areas. All activity continues to be in the northeast portion of the District.

Douglas-fir Beetle

Infested area has increased slightly from 2004 levels, to 20,361 hectares. As well, the proportion of infested area classed as severe has risen substantially; however, over 77% of all infested area was still classified as trace (less than 1% mortality). An additional 109 spot infestations were mapped (1,156 trees). Decreased mortality was seen in the Farwell Canyon, Gaspard Creek, Dog Creek, and Sword Creek areas, while infested area and mortality rates increased in the Williams Lake, 141 Mile, and Soda Creek – Meldrum Creek areas.

Spruce Beetle

Spruce beetle was mapped on 10,608 hectares in the Central Cariboo District in 2005. This is a decrease of over 60% from 2004 levels of 28,290 hectares. The drop is most likely due to a combination of host depletion in infested stands, along with active harvesting of many infested stands, especially around Bosk Lake and the east end of Horsefly Lake. This coupled with poor colour fading, masking of spruce beetle mortality by overlapping mountain pine beetle mortality, and possibly the two-year life cycle of spruce beetle, contributed to the drop in area mapped.

Most activity continues to be near Horsefly Mountain, Sawley Creek, Bill Miner Creek, and in several scattered areas near the east end of Quesnel Lake.

Western Spruce Budworm

Defoliation was mapped on 193,234 hectares. This is a 30% decrease from 2004 levels of 276,300 hectares; however, the proportion of the total area that was moderately and severely defoliated has increased slightly from 16% to 22%. Defoliated area dropped in the Alkali Creek, Dog Creek, Chimney Creek, Churn Creek, and Little Gaspard Creek areas. Severity levels decreased in the Farwell Creek, Williams Lake, and Mcleese Lake areas, while severity increased in the Drummond Lake, South Riske Creek, and Withrow Creek areas. Approximately 15,820 hectares of high-priority Douglas-fir stands were aerially treated with *B.t.k.* in late June (Table 10). Population decreases were seen in all areas sprayed. Approximately 10,000 hectares of high priority Douglas-fir stands may require treatment with *B.t.k.* in 2006, based on results of predictive eggmass sampling carried out in the fall of 2005.

Two-Year Cycle Budworm

As 2005 was an "off" year in the feeding cycle of this insect in the District, no defoliation was recorded. The current infestation in the eastern portion of the District appears to be declining, based on the trends observed in defoliation levels over the last several years.

Windthrow

Scattered windthrow was observed throughout the eastern portion of the District, with the most significant amounts of damage in the Moffatt Lakes area. Total area affected was 464 hectares. Although spruce beetle populations in most areas of the District appear to be declining, there is still cause for concern, as repeated windthrow events may contribute to population build-ups.

Other forest health factors included 99.6 ha of wildfire, and 38.6 ha of drought damage in the Gavin Lake area.

Chilcotin Forest District

Mountain Pine Beetle

Mountain pine beetle infestations continued to spread and intensify in the Chilcotin District. Total area affected increased from 1,138,300 hectares in 2004, to 1,309,463 hectares in 2005. As well, the area of moderate or greater mortality has increased by over 2.5 fold, to nearly 510,000 hectares – this accounts for just under 40% of all attack in the District. Most of the northern third of the District has experienced widespread increases in mortality rates, and significant expansions were seen along the entire southern leading edge of attack. Light and trace infestation is now as far south as Taseko Lake, Nemiah valley, Chilco Lake, and Tatlayoko Lake. Spot infestations and scattered small pockets of trace mortality were observed throughout the valleys of the Chilcotin and Coast Ranges. Over 45% of the entire land base of the District is now experiencing some level of infestation. The average polygon size in the District has remained high, at 136 hectares, while the number of spot infestations continues to drop, to only 208 (1,315 trees).

Mountain pine beetle-killed pine stands east of the Itcha Mountains, July 2005, Chilcotin District. Note variable colour change between different size/ age classes.

Attack in provincial parks totalled 70,505 hectares, most of which was in Itcha Ilgachuz Park. Large areas of infestation were also mapped in Tweedsmuir, Nazko Lake, Nuntsi, and White Pelican Parks.

Overwintering mortality results from March 2005, indicated a very low larval mortality rate of 33%, and a very high population R-value of 17.2. This vigorous population experienced a strong flight in 2005, and green:red ratios averaged 8:1 in the District. This will translate to increases in overall area attacked, and to very large increases in attack severity rates, in many areas of the District.

Western Balsam Bark Beetle

Western balsam bark beetle infestations continue to expand in the District, and were mapped on 21,703 hectares. This is an increase from 14,054 hectares in 2004, and 10,465 hectares in 2003. All mortality was located in the Chilcotin and Coast Ranges in the southern and southwestern portion of the District.

Douglas-fir Beetle

Populations have expanded significantly along the Chilcotin River, and the many small spot infestations mapped in the area in 2004 have coalesced into larger, more continuous polygons. Infestations along the south side of the Chilcotin east of Hanceville have declined. Total area mapped increased by over 4-fold, from 3,040 hectares in 2004, to 13,224 hectares in 2005. Just over 7,980 hectares were classified as Trace, and as such represent a very diffuse, scattered pattern of attack. The most severe infestations were in the Lees Corner area, where 2,550 hectares of severe mortality was mapped.

Spruce Beetle

Spruce beetle activity remained minor in 2005, with mortality mapped on 305 hectares in the Chilko Lake area, and in a few scattered areas in the Mosley Creek area.

Western Spruce Budworm

Populations continued to expand in the District, and defoliation was mapped on 57,892 hectares, up from 28,536 hectares in 2004. As well, over 60% of the defoliation was classified as moderate or severe. Defoliation was observed as far west as Redstone, and expanded into the Towyden Lake area. The most severely impacted stands are in the Hanceville, Lees Corner, and Haines Creek areas. In late June, 4,470 hectares of high-priority stands were aerially treated with *B.t.k.* Predictive egg-mass sampling completed in the fall of 2005, indicates that populations continued to build and expand in the District. Approximately 18,600 hectares of high-priority forest will require aerial treatment with *B.t.k.* in 2006.

Satin Moth

Satin moth populations have declined sharply, and defoliation was only recorded on 140 hectares, in the Chilko Lake and Tatlayoko Lake areas.

Western Hemlock Looper

No defoliation was recorded in 2005. Populations in the Mosley Creek – Homathko River areas appear to have collapsed; no defoliation is expected in 2006.

Redbelt

Redbelt damage occurred again during the spring of 2005, and was mapped on 2,314 hectares in the Elkin Creek – Big Onion Lake, and Charlotte Lake areas. As in past years, most of the damage occurred between 1,300 and 1,600 metres in elevation.

Other forest health factors mapped were 171 ha of severe flooding mortality scattered through the southwest areas of the District, and 12 hectares of small spot size wildfires scattered through the northern half of the District.

100 Mile House Forest District

Mountain Pine Beetle

Infestations are now present in nearly all areas of the District, and as a result the overall area of infestation remained nearly unchanged, at 623,560 hectares, following four consecutive years of 6 – 7-fold increases. As predicted, mortality rates increased sharply in nearly all areas, and the proportion of attack that was classified as moderate, severe, or very severe, has risen to nearly 43% (from just over 10% in 2004). Most of the extensive areas of Trace mortality in 2004 are now experiencing higher mortality rates. The highest mortality levels were seen in the southeast, southwest, and western portions of the District. The number of spot infestations continued to decline sharply – only 34 spot infestations were mapped. Attack in provincial parks has more than doubled, from 10,120 hectares in 2004, to 24,275 hectares in 2005.

Overwintering mortality surveys completed during the spring of 2005 indicated that larval mortality rates were low (47%) and population R-values were high (9.9). This, combined with the subsequent coordinated beetle flight, resulted in a high green:red expansion ratio of 7.5:1. It is expected that further increases in tree mortality rates will be seen next year, in most areas of the District.

Douglas-fir Beetle

The main centers of Douglas-fir beetle activity continue to be the Big Bar – Canoe Creek, Loon Lake – Bonaparte River, and Canim Lake areas. Total area affected continued to fall, from 2004 levels of 4,974 hectares, to 3,049 hectares; severity levels have also declined, and 80% of all mortality was classified as trace. Additionally, the number of spot infestations has fallen, from 187 (1,920 trees) in 2004, to just 22 (200 trees) in 2005.

Spruce beetle mortality.

Spruce Beetle

Spruce beetle infestations continued to decline slightly, from 17,252 hectares in 2004, to 13,724 hectares in 2005. Most mortality was in the northeast corner of the District, in the Spanish Creek and Hendrix Creek areas; a few scattered outbreaks were also observed in the Lorin Lake – Bowers Lake area.

Western Balsam Bark Beetle

Infested area has dropped, from 26,722 hectares in 2004, to 15,446 hectares in 2005. Additionally, most mortality was classified as trace. Decreases in area mapped were seen in the Bowers Lake – Jim Creek, and Hendrix Mountain areas; in the vicinity of Boss Creek and Big Timothy Mountain, overall area increased, while mortality rates decreased.

Western Spruce Budworm

Populations declined in many areas of the District, with a corresponding drop in defoliated area. Overall affected area fell by more than half, from 234,656 hectares in 2004, to 108,119 hectares in 2005. The majority of the defoliation was classified as light. The most significant declines were in the Exeter, Gustafson Lake, Cunningham Lake, and Canoe Creek areas. The most severe defoliation was in the Clinton, Loon Lake, and Big Bar areas. 7,740 hectares were aerially treated with *B.t.k.* in late June to reduce damage to high value Douglas-fir stands. Population reductions were seen in treated areas. Predictive eggmass sampling indicates that populations should remain fairly static through next year; approximately 4,500 hectares of high-priority stands may require treatment with *B.t.k.* in 2006.

Birch Leaf Miner

1,169 hectares were lightly defoliated by birch leaf miner in the Lang Lake area.

Windthrow

Windthrow occurred on 1,373 hectares, mostly in one large area north of Lang Lake. A few other scattered patches of windthrow were mapped in the Bosc Lake and Windy Mountain areas.

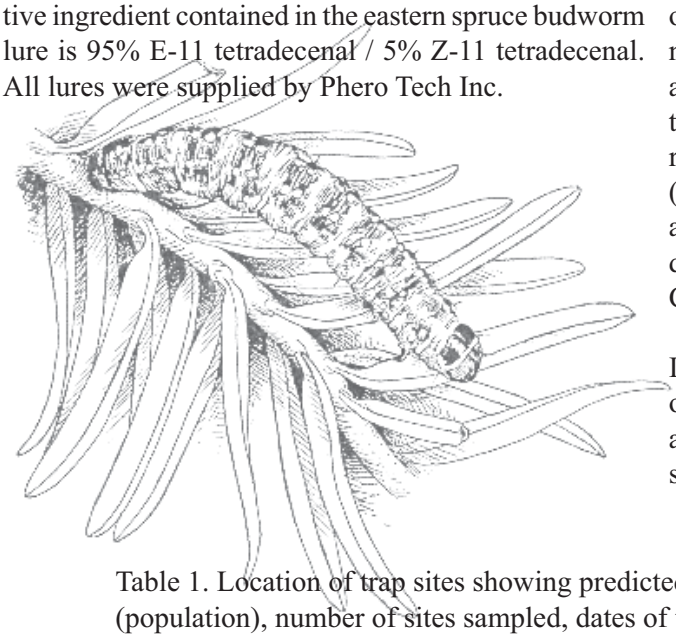
Other forest health factors included 144 hectares of wildfire, most of which was in a 110 hectare area near Timothy Mountain.

Windthrow, 100 Mile House District.

Western Spruce Budworm Trapping Trial

The objective of this study was to test the predictive capability of trapping moths in pheromone baited traps (milk carton traps) compared to the standard method of annual fall egg mass sampling. Egg mass sampling is the current method of prediction for budworm populations in areas which may require treatment, whether through direct control or silvicultural manipulation. However, the process is time consuming and laborious. Trapping moths is a much less labour intensive technique and if it could be used to predict where egg mass sampling should occur, then more sites could be monitored, yet less egg mass sampling would need to be done.

Based on last year's (2004) results, only the high dosage (330 nanograms) eastern spruce budworm lure was tested in 2005. Sites were selected through visual assessments during the aerial overview survey in 2004. Three areas were chosen as having low levels of defoliation and four areas as high (Table 1). In the spring of 2005, 6 trap clusters were placed at up to 5 sites (Table 1) within each of the chosen areas, for a total of 30 sites. The active ingredient contained in the eastern spruce budworm lure is 95% E-11 tetradecenal / 5% Z-11 tetradecenal. All lures were supplied by Phero Tech Inc.



At the end of the summer, egg mass sampling was conducted at the 6-trap cluster sites, at the same time as the traps were collected. 15 overstory Douglas-fir were selected at each trapping site and a 45 cm branch tip from the north and south aspect, taken at mid-crown, was clipped and evaluated for the presence of western spruce budworm egg masses. The number of egg masses was then expressed as an average per 10 m^2 foliage for each site (Table 2) to give a prediction of defoliation in 2006. At some sites, animals had disturbed the traps, which were either missing or on the ground, and therefore could not be included in the analysis (Table 2). Up to 18% of the pheromone traps had been disturbed in some way.

The average trap catch at the Low sites was 65.5 moths / trap compared to 98.3 moths / trap at the High sites. When a t-test was performed on the lumped raw trap data comparing trap catches from the High and Low population areas, a significant difference emerged ($p<0.05$). However, if the sites were looked at individually, one observes that in some of the Low areas, fairly high numbers of moths were caught (Table 2). A correlation analysis was performed comparing the trap catches and the egg mass sampling results. There was a weak correlation between trap catches and egg mass predictions (Pearson Correlation Coefficient: 0.359), which does not appear linear. This correlation became stronger when the data was transformed using natural logarithms (Pearson Correlation Coefficient: 0.617).

It appears there is some relationship between the number of egg masses on branch samples and trap catches of adult moths. However, the sites selected through aerial surveys as High for defoliation in 2005, have egg mass

Table 1. Location of trap sites showing predicted level of budworm defoliation (population), number of sites sampled, dates of trap retrieval, and population sampling. All traps were placed mid-June 2005 prior to moth flight.

Location	Predicted WSB population	Number of sites sampled	Egg mass sampling & trap collection dates
Greenstone Mountain	Low	5	September 12
Six Mile	Low	5	September 12
Criss Creek	Low	5	September 13
Kentucky Alleyne	High	4	August 22 & 30
Lily Lake East	High	4	September 8
Comstock	High	3	August 22
Lily Lake West	High	4	August 30

Table 2. Average number of western spruce budworms caught per 6-trap cluster (baited with the eastern spruce budworm lure), and predicted defoliation levels for 2006, based on egg mass sampling at several locations in the Kamloops and Cascades Forest Districts (summer 2005).

Location and Site #	WSB population level	# traps/ site	Average trap catch	2005 Egg mass rating/10m²	2006 Defoliation prediction
Greenstone					
1	Low	6	71.2 ± 3.36	0	Nil
2	Low	6	56.2 ±3.35	0	Nil
3	Low	6	61.3 ± 3.84	0	Nil
4	Low	3	74.7 ± 7.31	0	Nil
5	Low	6	61.7 ± 3.02	0	Nil
Six Mile					
6	Low	5	68.4 ± 7.53	0	Nil
7	Low	6	109.2 ± 5.82	0	Nil
8	Low	6	100.7 ± 5.83	0	Nil
9	Low	5	74.2 ± 7.36	0	Nil
10	Low	4	92.5 ± 9.02	5.3	Low
Criss Creek					
11	Low	6	51.2 ± 3.54	0	Nil
12	Low	6	51.7 ± 5.96	0	Nil
13	Low	5	37.0 ± 3.51	0	Nil
14	Low	4	43.8 ± 2.43	0	Nil
15	Low	1	28.0 ± 0	0	Nil
Kentucky Allene					
1	High	6	87.8 ± 3.32	85.9	Moderate
2	High	6	90.7 ± 8.37	65.4	Moderate
3	High	6	75.2 ± 3.36	162.1	Severe
4	High	4	75.8 ± 4.42	24.9	Low
Lily Lake East					
5	High	5	96.2 ± 6.64	13.8	Low
6	High	6	84.2 ± 14.71	15.7	Low
7	High	6	109.8 ± 7.16	47.3	Low
8	High	6	105.5 ± 7.81	30.4	Low
Comstock					
9	High	6	110.5 ± 6.80	42.5	Low
10	High	5	124.2 ± 6.30	69.6	Moderate
11	High	6	102.3 ± 5.74	52.1	Moderate
Lily Lake West					
12	High	1	73.0 ± 0	23.9	Low
13	High	5	115.4 ± 8.13	31	Low
14	High	3	108.7 ± 17.25	47.1	Low
15	High	3	115.7 ± 18.34	5.3	Low

sample predictions of low and moderate with only one case of severe (Table 2) for 2006. In order to further fine-tune this defoliation prediction method, sites with egg mass sample predictions of severe for 2006 should be used in next year's trial, to more easily test the pheromone's ability to distinguish between population levels. The use of the six-trap cluster has substantially reduced variance in trap catch from 2004 when only 3 traps for each pheromone type were used. Therefore, the six-trap cluster technique should continue to be used. As well, six-traps per site is the standard number used for other defoliator species when monitoring population trends (e.g. Douglas-fir tussock moth, western hemlock looper). The eastern spruce budworm lure appears to have promise in the field of western spruce budworm population prediction.

Summary Of 2004-2005 Overwintering Mortality Estimates

Mountain Pine Beetle

Overwintering mortality sampling is conducted to provide an estimate of beetle population trends and brood success/survival. During March-April of 2005, extensive sampling was carried out in all Districts, at a total of 119 sites, to determine brood success and survival over the winter of 2004-2005. A standard methodology for sample collection and evaluation is used, and can be referenced in the report, "2004 Overview of Forest Health in the Southern Interior Forest Region", pg. 32: <http://www.for.gov.bc.ca/rsi/ForestHealth/overview_reports>.

Overall, total mortality during the life cycle must be 97% or greater to keep population levels static, and winter mortality is responsible for the majority of the annual brood mortality. Mortality due to winter effects must generally reach at least 70% to have any effect on population growth rates. Mountain pine beetle overwintering mortality rates were low overall, with all Districts averaging below 70% brood mortality; 8 of the 12 Districts averaged below 50% brood mortality. These numbers are very low when compared to historic averages.

R-values were very high in all Districts. 8 of 21 Districts had average R-values of at least 10.0, and all had R-values greater than 7.5. R-values greater than 10.0 are considered to be extremely high, while any value over 4 indicates a growing population.

Table 1. Percent mortality of mountain pine beetle progeny during the winter of 2004-2005, with associated R-values.

District	# sites	# trees	# samples	% mortality	R-value
Quesnel	6	60	120	54.2	8.66
Central Cariboo	10	100	200	50.7	7.48
Chilcotin	12	120	240	32.7	17.17
100 Mile House	10	100	200	46.6	9.88
Headwaters	15	150	300	46.5	10.9
Kamloops	10	99	198	28.9	22.6
Cascades	11	109	218	53.1	13.7
Okanagan Shuswap	11	92	184	47.3	14.1
Arrow Boundary	10	94	188	48.7	11.3
Columbia (Golden)	4	36	72	57.9	12.6
Kootenay Lake	11	94	188	45	10.5
Rocky Mountain	10	99	198	67.8	8.5
Totals/Averages	**120**	**1,153**	**2,306**	**47.01**	**12.56**

Wide variations in % brood mortality and R-values between different sites were seen in most districts; this indicates that winter conditions were very variable, and in some isolated areas, winter mortality was very high, while in other areas, it was very low. However, overall % mortality and R-value numbers indicate that most populations are growing at a high rate. This, combined with the generally high green:red expansion ratios seen in most areas, indicate that mountain pine beetle populations, infested area, and especially mortality rates, will continue to increase in 2006.

Douglas-fir Beetle

Limited sampling for Douglas-fir beetle was performed in the Chilcotin (6 sites), 100 Mile House (2 sites) and central Cariboo (2 sites) Districts. In general, overwintering mortality was low in the Chilcotin and Central Cariboo Districts (40.5% and 57.9% respectively), while it was fairly high in the 100 Mile House District (86.9%). R-values were moderate to low, with populations static to slightly decreasing in the 100 Mile House and Central Cariboo Districts (R-values of 1.8 and 2.4, respectively), and static to slightly increasing in the Chilcotin District (R-value of 4.17).

Status Of Mountain Pine Beetle Attack In Young Lodgepole Pine Stands In Central British Columbia

Introduction

Of the 14.9 million ha of pine in British Columbia, there are approximately 1.96 million ha of young pine (natural regeneration and managed plantations) between the ages of 20-55 years. More than 1.1 million ha are comprised of over 80% pine. Within this inventory of young pine, over 1 million ha are between the ages of 20-35 years (BCMOFR 2005). These stands represent future harvests, habitat and forest structure. Many of these young stands are currently being impacted by the mountain pine beetle (MPB), *Dendroctonus ponderosae*, and associated bark beetles such as *Ips pini*.

The Provincial Aerial Overview Surveys mapped approximately 8.7 million ha of red attacked mature lodgepole pine in 2005 (BCMOFR 2004,2005), which represents attack resulting from the 2004 beetle flight. It is estimated that the level of red attack will increase in 2006, which will represent attack resulting from the 2005 beetle flight. In 2004, observations were made of MPB attacking young second growth pine stands. As a result of these observations, and field reconnaissance, a project was initiated to determine the extent, severity and implications of this new threat.

Mountain pine beetle attack in an even-aged providence trial in the Robson Valley.

Young or small diameter pine has often been a "sink" for MPB during past outbreaks. A beetle "sink" can be defined as the phenomenon of MPB attacking trees in stands that are not thought of as susceptible due to age or size, and generally few, or no brood result from these attacks. The decline of the South Okanagan MPB outbreak (1984-1992) was in part due to the MPB being pushed into sub-optimal stands of very dense, small and often younger age pine (L. Maclauchlan, personal observations). Even if beetle production out of young stands is minimal, the local and landscape level conditions of this MPB outbreak are very different from past outbreak conditions. Beetle pressure, size and extent of the outbreak (>8.7 mill. ha) (Figure 1), and the mixing and dispersal of beetles over the landscape is unprecedented.

As little as 25% mortality (e.g. resulting in less than 700 stems per hectare live) (M. Madill, personal communication) could cause a stand to be classified as NSR (not satisfactorily restocked) and therefore may require rehabilitation measures. Given the MPB pressure and levels of attack observed in 2004 and 2005, many of our young stands could become NSR in the next few years. As with mature stand risk (Safranyik et al. 2004; Shore and Safranyik 1992; Safranyik and Linton 1985; Safranyik and Jahren 1970), risk to young stands is highly dependent upon the level of MPB activity in adjacent stands or proximity to an ongoing outbreak. Normally, lodgepole pine less than 60 years of age would not be considered at risk to MPB due to their age, diameter and other physical attributes (Shore and Safranyik 1992). However, many young stands in these putatively low susceptible age- and size-classes are currently under attack.

Recent drought conditions may have increased the vulnerability of young trees, however many trees in managed stands reach diameters that are acceptable to MPB and other beetles at an earlier age than trees in naturally regenerated, unmanaged, and more densely grown stands. Existing plantations are likely very different than naturally regenerated stands, which result from insect and fire mortality. Therefore, current attack in young stands may be a result of changing parameters of susceptibility and the tremendous pressure from the beetle thus creating these beetle "sinks".

The key objectives of this project are to:

-determine the current level and severity of MPB attack in young pine;
-determine the relative risk and damage to different age cohorts between 20 and 55 years;
-determine the future risk to young pine in the various locations and stages within the current outbreak parameters; and,
-determine if the MPB will propagate successfully within these younger pine.

The emphasis of this report will be on the extent and severity of mountain pine beetle damage throughout the core outbreak area in central British Columbia.

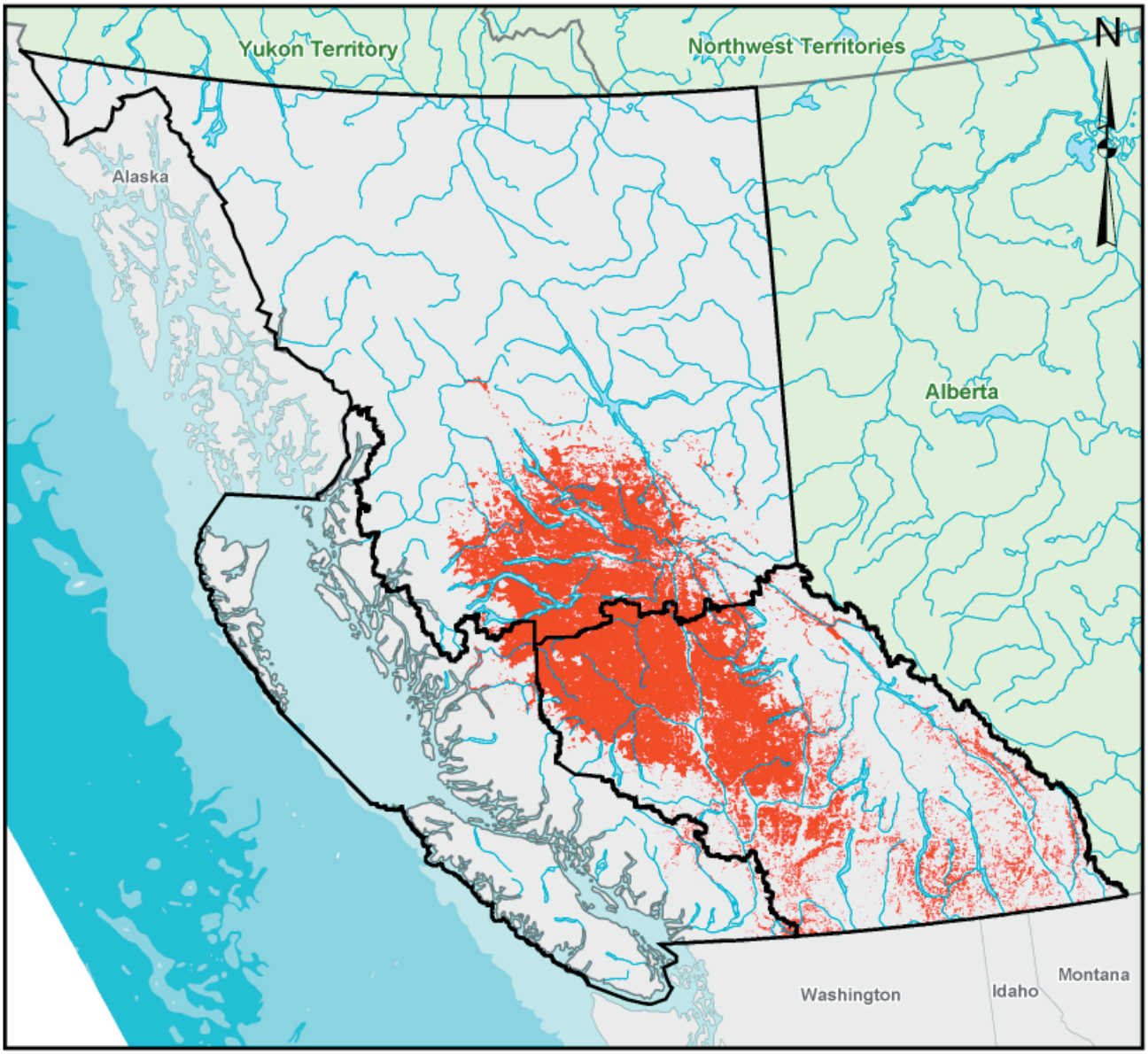


Figure 1. Map of B.C. with Forest Region boundaries, showing the extent of mountain pine beetle as mapped during the 2005 aerial overview survey.

Methods

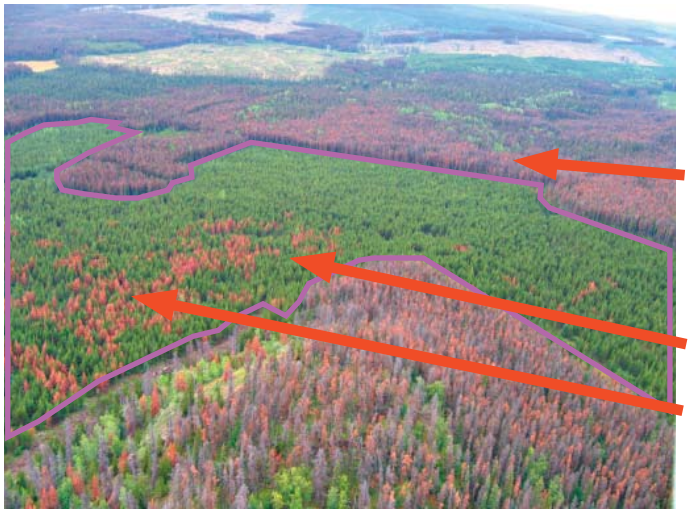
A 3-tiered approach was implemented to quantify and evaluate the incidence, impact and future risk to mountain pine beetle, Ips pini and other major forest health concerns in young lodgepole pine stands. The three levels of assessment included aerial surveys, ground surveys and 0.25 ha permanent sample plots to monitor long term impacts, brood production and success. Vegetation Resource Inventory (VRI) (BCMOFR 2005) provided the inventory data base for the Northern and Southern Interior Forest Regions of pine leading stands (20-55 years). For surveys conducted in 2005, the VRI data was stratified by 5-year age increments (20-25, 26-30, 31-35 and so on) (Table 1) for openings 5 hectares or greater with >80% lodgepole pine component.

Table 1. Total hectares of leading lodgepole pine (>80%) by 5-year age increments within nine forest districts comprising the study area.

	hectares of lodgepole pine by age category (years)					
District	**20-25**	**26-30**	**31-40**	**41-50**	**51-55**	**Total**
100 Mile House	21,925	12,177	13,723	8,715	1,863	58,403
Central Cariboo	26,168	12,017	24,130	31,901	5,633	99,849
Chilcotin	8,321	5,000	41,123	73,655	15,759	143,858
Kamloops	6,301	3,677	2,189	3,962	2,330	18,458
Nadina	26,715	16,129	14,849	8,419	8,292	74,404
Okanagan Shuswap	36,603	14,862	10,763	4,496	2,290	69,014
Prince George	23,762	12,060	24,184	18,032	2,506	80,544
Quesnel	28,162	14,002	15,759	25,067	13,776	96,766
Vanderhoof	21,314	14,836	23,281	10,782	10,056	80,269
Total	**199,271**	**104,761**	**169,999**	**185,029**	**62,505**	**721,565**

Aerial Surveys

The aerial survey enabled a far greater subset of potentially impacted stands to be assessed than ground surveys. The inherent limitation of aerial surveys was that it is only possible to record past attack levels. The data collected included: percent red and grey attack in polygons; the spatial pattern of attack (i.e. scattered, clumped, random); a "2006 risk" rating for the young stand based upon adjacent mature stands (i.e. low, moderate, high or negligible); and, an assessment of the outbreak in adjacent mature stand based on level of mortality and availability of mature host material (increasing, ongoing or declining). Photographs were taken of all polygons and adjacent mature stands.



Photograph of young stand as viewed during aerial survey, showing how attack levels are estimated and surrounding risk assessed.

Ground Surveys

Twenty three to thirty stands were surveyed in each District within the core area of the outbreak. Variable radius plots (5 or 10 based upon polygon size) were established in each stand and the following information was collected: dbh; height; number and species of stems (>10 cm unless attacked by Ips or MPB); presence of other major pests; and MPB attack information (year of attack, attack density, brood success).

Permanent Sample Plots

Fifteen 0.25 ha permanent sample plots were established throughout the study area. Plots were located to obtain a cross-section of tree age and size, level of attack, stand origin and management (harvested, fire regenerated, spaced, pruned), and adjacent beetle pressure and future risk.

In addition to the above surveys, brood success, production and the influence of climate is being studied. Young lodgepole pine attacked in 2005 will be reared in controlled temperature environmental chambers and in situ with a climate station monitoring environmental conditions.

Results and Discussion

The majority of aerial and ground surveys were conducted in the core, or older and more severe, parts of the MPB outbreak area including Prince George, Quesnel, Vanderhoof, Central Cariboo, 100 Mile House and Nadina Forest Districts. Small areas within the Chilcotin, Kamloops and Okanagan Shuswap areas were surveyed; however, attack in young pine in these three districts was still very sporadic. Therefore, the results discussed refer primarily to the former six districts. Of approximately 1.96 million ha of young pine between the ages of 20-55 years in B.C., 490,236 ha (25%) occur within these six districts (Table 1). Other districts in the south and to the north of the core outbreak area also have very large areas of young pine that could also be at risk in the coming years.

Aerial Survey Results

The total area of young pine aerially surveyed in each of the six districts ranged from 4% to 14%, averaging 9.7% coverage overall (Table 2). The total rotary wing flying time was 41 hours. A total of 1,164 polygons were surveyed and 49.2% had some level of 2004 MPB attack (red attack). Observed attack levels ranged from 0 to 95% red attack (Fig. 2) with over 50 polygons (4.3% of total) having greater than 50% red attack (Fig. 2). Once a representative number of polygons from each age class was surveyed on each mapsheet, the surveyors would move on to the next map unless there was extreme variation within an age. This gave a uniform coverage both by geographic area and age.

Table 2. Percent area surveyed (excluding Kamloops, Okanagan & Chilcotin)

	% area surveyed by air					
	20-25	**26-30**	**31-40**	**41-50**	**51-55**	**Total**
100 Mile House	9.6%	20.0%	21.0%	8.6%	4.4%	14.1%
Central Cariboo	6.7%	17.3%	8.6%	1.7%	16.8%	7.4%
Nadina	10.4%	8.9%	4.7%	0.7%	7.5%	7.5%
Prince George	3.5%	4.7%	5.1%	3.0%	10.0%	4.2%
Quesnel	6.8%	19.4%	21.3%	5.2%	4.7%	10.3%
Vanderhoof	11.0%	17.1%	13.4%	19.4%	7.8%	13.6%
Grand Total	**8.0%**	**16.1%**	**11.9%**	**5.3%**	**7.9%**	**9.7%**

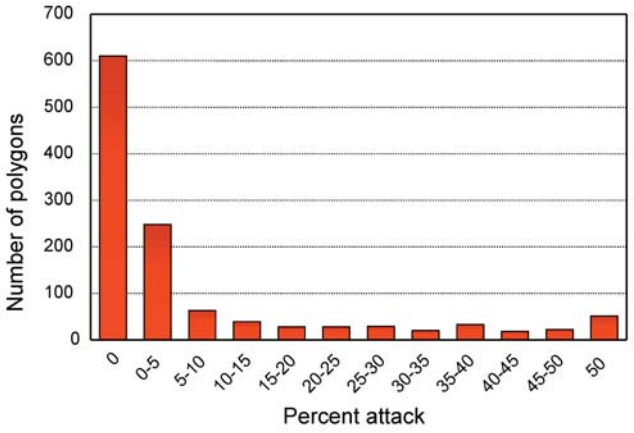


Figure 2. Summary of the frequency of polygons having different levels of mountain pine beetle attack (red and grey attack combined).

Summarizing all Districts flown, the highest frequency of MPB attack was observed in polygons over the age of 40 (Table 3). Polygons containing 31-40 year old lodgepole pine also had a high frequency of MPB attack, with 62.5% of polygons surveyed having some level of attack (Table 3). In the heavier and older areas of the MPB outbreak the beetles are not distinguishing these intermediate age classes from mature stands and that the majority of the40-year plus stands will have moderate to severe attack levels. Relatively little MPB attack occurred in young stands until 2004 (Figure 3) . However, stands over 40 years which presumably contained larger stems were the first to be attacked and to a much higher degree than younger ages (Fig. 3). On average, over 20% red attack and over 5% grey attack was observed in stands over 40 years which would represent greater than 25% mortality thus making the stands NSR (M. Madill, personal communication).

Table 3. Summary for all districts of the percent polygons, by age category, surveyed by air having MPB attack.

Age	No. of polygons surveyed	% polygons with MPB attack
20-25	320	28.40%
26-30	343	33.50%
31-40	285	62.50%
41-50	125	83.20%
51-55	90	93.30%
unknown	1	100.00%
total/average	**1164**	**49.20%**

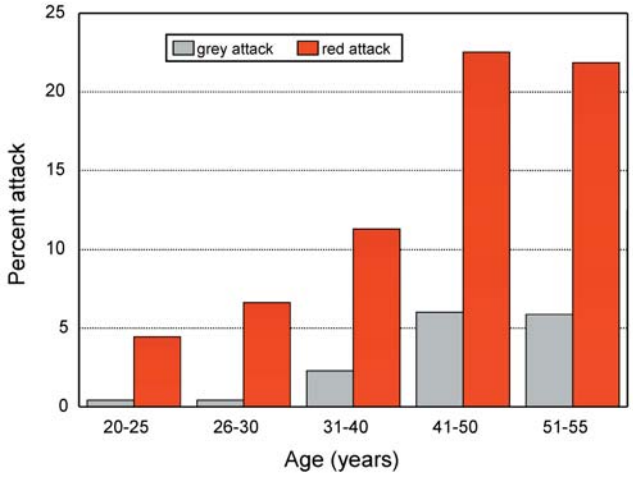


Figure 3. Summary of aerial surveys for all Districts showing the average percent grey attack (pre-2004 attack) and red attack (2004 attack) within young lodgepole pine polygons surveyed in 2005.

Table 4 summarizes, by district and age, the number of polygons with no MPB attack, with MPB attack, average percent attack within polygons and the overall percent polygons with MPB attack. As predicted, the districts with the highest occurrence of MPB attack in young stands, such as Quesnel, Prince George and Vanderhoof, were those in the more established areas of the outbreak (Table 4). The high frequency of attack seen in the Central Cariboo, 100 Mile House and Nadina (Table 4) are testament to the exponential increases in beetle populations over the past two years and rapidly diminishing mature host resource. In particular, 100 Mile House and Nadina Districts, having 38.4% and 31.4% of polygons surveyed showing presence of MPB attack respectively, are newer outbreak areas yet very high levels of young pine are under attack. This may be in part due to the long range movement and mixing of beetle populations out of the core area of the outbreak.

Cross section of a young pine, 24 years of age, attacked by mountain pine beetle in the Central Cariboo District, July 2005.

While conducting the aerial surveys, assessment of adjacent and future risk to the young stands were made. Adjacent risk was a prediction of the probability of the stand being attacked by MPB in 2006 and beyond, based upon adjacent stand parameters such as the level of harvest surrounding the stand, proximity to active MPB and availability of mature host (Table 5). Adjacent risk was not intended to predict the current level of green attack in the stand. The other assessment, future risk, although similar, was largely based upon the outbreak parameters of the geographic area and was defined as decreasing, increasing or static (Table 6). These assessments were conducted to assist in prioritizing stands most likely to be impacted by MPB for future surveys or rehabilitation.

The trends seen in Table 5 seem to verify our assumptions in that Prince George and Quesnel have the highest number of polygons with nil to low risk of attack in 2006. Only 22.5% and 14.1% in Quesnel and Prince George respectively are at high risk of attack in 2006. As figure 1 shows, the majority of mature pine has been infested in these two districts and the beetle has moved away from many of the locations where these young stands are located, thus reducing the future risk of attack. Therefore, within 2 years there should be less attack seen in young stands in the core of the outbreak, unless beetles move back into these areas. 100 Mile House and Nadina Districts show the opposite trend, with 37.9% and 55% of stands, respectively, at high risk to attack in 2006 and beyond (Table 5). In Quesnel, Prince George and Vanderhoof the majority of stands, 76.9%, 69.2% and 68.7% respectively, have decreasing future risk (Table 6). The Central Cariboo also shows a decreasing trend, with 60.4% of polygons assessed with decreasing risk. This could be largely due to rapid and severe infestation levels observed in the area over the past two years (BCMOF 2004, 2005).

Table 4. Summary by district and age of polygons aerially surveyed, showing the number of polygons with no MPB attack, with MPB attack, the average percent attack within polygons and the overall percent polygons with MPB attack.

	Number of Polygons		Average Attack (%)		% Polygons With
Age (years)	Unattacked	Attacked	Red	Grey	MPB attack
100 Mile House					
20-25	51	9	6.6	1.2	15.0%
26-30	62	8	1.8	0.0	11.4%
31-40	18	40	5.6	0.7	69.0%
41-50	1	23	12.0	4.1	95.8%
51-55	1	3	17.7	10.0	75.0%
total/average	**133**	**83**	**7.5**	**2.0**	**38.4%**
Quesnel					
20-25	17	26	3.3	1.6	60.5%
26-30	27	34	9.6	0.3	55.7%
31-40	7	45	13.2	5.7	86.5%
41-50	0	17	20.1	19.8	100.0%
51-55	1	16	23.1	15.9	94.1%
unknown	0	1	12.5	0.0	100.0%
total/average	**52**	**139**	**12.6**	**6.5**	**72.8%**
Prince George					
20-25	12	7	8.8	0.0	36.8%
26-30	17	9	7.7	0.0	34.6%
31-40	24	14	8.2	0.4	36.8%
41-50	3	21	44.2	2.0	87.5%
51-55	0	14	28.1	0.9	100.0%
total/average	**56**	**65**	**24.1**	**0.9**	**53.7%**
Central Cariboo/Chilcotin					
20-25	28	23	5.2	0.1	45.1%
26-30	16	37	16.9	2.7	69.8%
31-40	12	33	21.5	8.6	73.3%
41-50	7	12	30.0	13.9	63.2%
51-55	1	14	31.9	10.6	93.3%
total/average	**64**	**119**	**19.0**	**5.9**	**65.0%**
Vanderhoof					
20-25	52	15	3.3	0.0	22.4%
26-30	60	13	3.7	0.0	17.8%
31-40	33	38	11.4	0.7	53.5%
41-50	8	30	21.4	2.3	78.9%
51-55	2	19	18.0	3.8	90.5%
total/average	**155**	**115**	**13.2**	**1.4**	**42.6%**
Nadina					
20-25	65	9	3.0	0.0	12.2%
26-30	16	8	6.0	0.0	33.3%
31-40	12	8	19.0	0.0	40.0%
41-50	2	1	30.0	0.0	33.3%
51-55	1	18	34.3	0.0	94.7%
total/average	**96**	**44**	**19.9**	**0.0**	**31.4%**

Table 5. Summary of adjacent risk for all ages of polygon combined, by district, noting the percent of total surveyed in each district. Adjacent risk is the subjective probability of that polygon getting attacked in 2006 based on level of MPB in adjacent mature stands, harvesting activity and other parameters.

	% of Polygons with Adjacent Risk of:		
District	Nil	Low	High
100 Mile House	3.80%	58.30%	37.90%
Quesnel	13.30%	64.20%	22.50%
Prince George	64.10%	21.80%	14.10%
Central Cariboo/Chilcotin	8.00%	49.40%	42.60%
Vanderhoof	28.70%	28.70%	42.60%
Nadina	0.70%	44.30%	55.00%

Table 6. Summary of future risk for all ages of polygon combined, by district, noting the percent of total surveyed in each district. Future risk is based on observed and known outbreak parameters in the location of the young stand. Future risk is defined: Decreasing – most mature pine in area is grey or red (older outbreak); Increasing – building MPB with mature host remaining (newer outbreak); and, Static – moderate MPB with some mature host remaining (mid- to full-outbreak).

	% of Polygons With Future Risk Assessment of:		
District	Decreasing	Increasing	Static
100 Mile House	37.4%	32.5%	30.0%
Quesnel	76.9%	9.4%	13.7%
Prince George	69.2%	12.8%	17.9%
Central Cariboo /Chilcotin	60.4%	21.6%	18.0%
Vanderhoof	68.7%	16.9%	14.5%
Nadina	39.0%	14.7%	46.3%

Mountain pine beetle attack in a 42 year old pine plantation, Prince George District, July 2005.

Ground Surveys Results

164 polygons comprising 1,185 circular plots were ground surveyed in 2005 (Table 7). Attack levels in stands ground surveyed ranged from no attack to 98% of the stems attacked. This level of attack renders the stand NSR and therefore must be scheduled for reforestation. 48.2% of polygons had some level of MPB attack (Fig. 4) and over 23% had attack levels greater than 50% within the stands (Fig. 4). Approximately half of the stands surveyed had been spaced (Table 7) but there was no significant difference in level of MPB attack in spaced or unspaced stands (Table 8). The level of attack increased dramatically in 2005 as illustrated in Figure 5. The average percent of red attack (2004 attack) compared to green attack (2005 attack) increased from 1.2-fold in the Central Cariboo to over 21-fold in Vanderhoof. Quesnel experienced over a 7-fold increase in average attack levels in from 2004 to 2005 (Fig. 5).

Table 7. Summary attributes from the 2005 ground surveys in young pine stands, by district.

Attributes	Prince George	100 Mile House	Quesnel	Vanderhoof	Central Cariboo /Chilcotin	Nadina
Number of polygons	28	30	25	29	23	29
Number of plots	180	195	175	185	160	290
Average density (sph)	1,180	663	843	1,221	1,025	1,213
Number of spaced polygons	13	11	13	14	8	17
Average Pl dbh (cm)	15.7	12.9	13.8	13.9	13.4	15.3
Average age (years)	28.2	27.4	27.9	27.1	30.4	29.9
Average height (m)	13.7	8.7	9.9	12.0	10.4	11.9
Average % green attack	23.2	14.2	32.6	23.4	13.3	10.0
Average green attack dbh (cm)	16.7	15.5	15.1	15.1	15.8	20.0
Average % red attack	4.9	3.3	4.3	1.1	11.4	0.7
Average red attack dbh (cm)	20.6	19.4	20.7	22.5	16.8	16.7
Average % unattacked	71.9	82.7	63.1	75.5	75.3	89.3
Average unattacked dbh (cm)	14.8	12.1	12.5	13.0	12.9	14.7

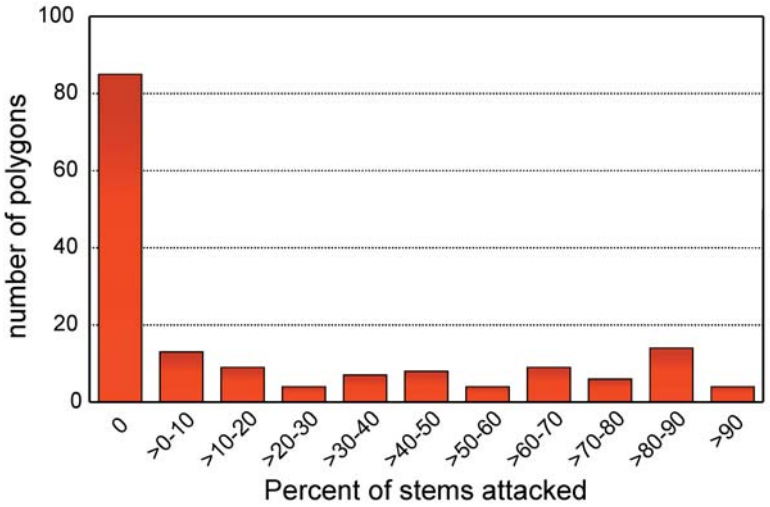


Figure 4. Frequency distribution showing the number of polygons ground surveyed falling into each attack category. Ground surveys from all Districts are included.

Another MPB attack trend that was evident is the classic "oldest and largest first" rule, although the largest trees were not always the oldest in young managed stands. Figure 6 clearly illustrates that the beetles chose the largest trees in the stands first. In many cases the trees remaining were 12 cm at dbh or less (Table 7, Figure 6). These smaller diameter trees are also vulnerable to attack by *Ips pini*, which has been increasing, particularly in the Central Cariboo and 100 Mile House Districts (personal observations). The average tree size under attack in 2005 was 15 cm, however trees as small as 10 cm dbh were attacked in certain stands.

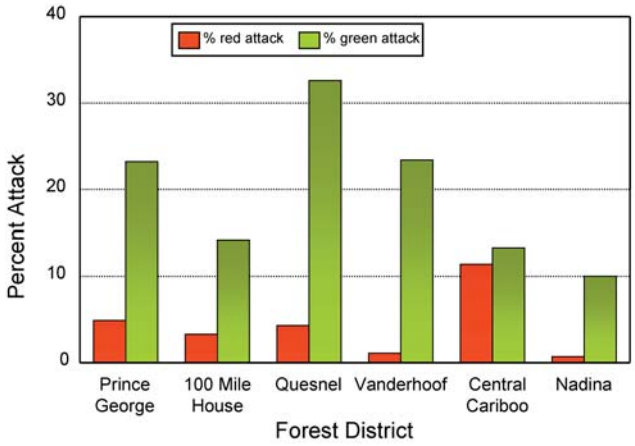


Figure 5. Average percent of red and green attack, representing 2004 and 2005 mountain pine beetle attack, respectively, recorded in ground surveys within six forest districts.

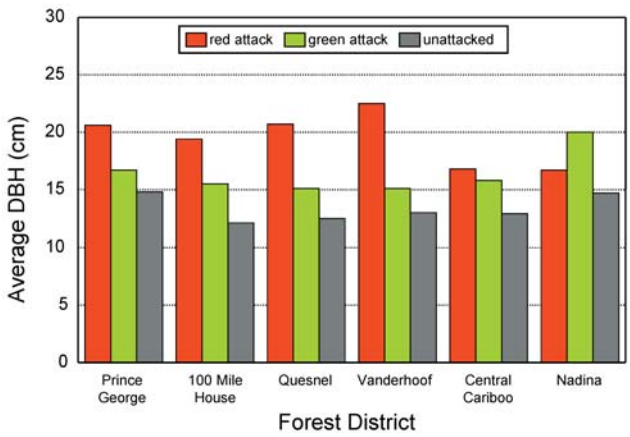


Figure 6. Average diameter (cm) of attacked and unattacked lodgepole pine in ground survey plots within the Prince George, 100 Mile House, Quesnel, Vanderhoof, Central Cariboo/Chilcotin, and Nadina Forest Districts.

Table 8. Comparison of the average percent pine stems remaining unattacked in all ground survey plots, by district and management (spaced versus unspaced).

Management History	Prince George	100 Mile House	Quesnel	Vanderhoof	Cariboo[1]	Nadina[2]
Not spaced	78.5	84.5	62.7	70.7	70.7	86.6
Spaced	64.3	77.5	63.5	80.6	86.0	89.4

[1] Three additional stands were spaced and pruned and none were yet attacked by MPB.

[2] Five stands were not identified as spaced or natural and had 67.6% stems unattacked.

Aerial survey estimates of red attack were well correlated with ground survey estimates of red attack in all districts. Figure 7 compares the aerial and ground observations from six polygons in the Central Cariboo that were surveyed by both air and ground methods. The adjacent risk rating assigned to each polygon revealed that the polygons rated as very low have minimal in-stand attack and will most likely continue to have low levels of attack. The polygons rated as having low risk will likely continue to sustain moderate levels of attack in 2006. Due to diminishing sources of beetles in surrounding stands and fewer, smaller live stems remaining in young stands already impacted by MPB (Figure 7), the risk will decrease within the core outbreak area in 2 years. The polygons rated as having high adjacent risk have moderate in-stand attack, ample remaining host trees and a high level of active beetle in surrounding mature stands (Figure 7). They remain at high risk for future attack by MPB.

Table 9 shows the location and parameters of the 15 permanent plots established in 2005. Attack in these plots ranged from no attack to 81% (Table 9). Location rather than density seems to be more important in terms of whether or not the stand will be attacked.

Table 9. List of 15 permanent plots established in 2005 noting stand age, density (sph), management (spaced, planted, naturally regenerated) and percent stems attacked by MPB.

Location	Age	Stems per ha	Treatment	% stems attacked
100 Mile House	20-25	1,316	spaced	0
Prince George	20-25	1,568	spaced	57
Central Cariboo	20-25	1,416	planted	71
100 Mile House	26-30	1,160	spaced	0
150 Mile House	26-30	1,224	spaced	0
Central Cariboo	26-30	1,200	planted	0
Vanderhoof	26-30	1,280	spaced	1
Quesnel	26-30	804	spaced	30
Central Cariboo	26-30	1,244	spaced	42
Central Cariboo	26-30	1,636	unspaced	42
Prince George	31-40	1,440	spaced	1
Quesnel	31-40	880	spaced	63
100 Mile House	41-50	1,428	nat. regen.	81
100 Mile House	51-55	872	nat. regen.	42
Prince George	51-55	1,420	spaced	64

Work on determining if the mountain pine beetle will successfully develop and expand within young pine is still ongoing. However, preliminary data show that due to extremely high attack densities in young pine, ranging from 117 galleries/m^2 to >300 galleries/m^2, very little emergence has been observed. Raffa and Berryman (1983) determined that reproductive success of the MPB decreases at attack densities greater than 80 galleries/m^2. Larger diameter tree are yielding some brood success and this may increase as MPB dispersal into these stands decrease and attack densities approach normal levels.

This report summarizes the results from the first year in a multi-year project. We plan to expand the evaluation in 2006 to include more southern and northern areas of the province. Numerous collaborative projects have been initiated to facilitate this work. There are also ongoing research trials that will determine the likelihood of brood success in young lodgepole pine and the effects of climate on their success.

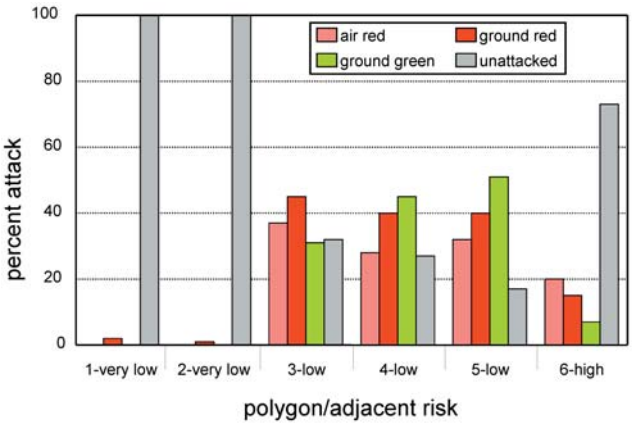


Figure 7. Comparison of aerial and ground observations from six polygons in the Central Cariboo District that were surveyed by both air and ground. Ground and air percent of red attack is shown along with percent of green attack and unattacked pine collected in ground surveys. The adjacent risk rating assigned to each polygon is shown on the x-axis.

Photograph of young stand in the Central Cariboo Forest District with moderate levels of attack within and surrounding the stand.

Mountain pine beetle density in young pine is above the optimum for brood success, so very little emergence has been observed from these young stands.

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