Summary of Aerial Overview Surveys in the Southern Interior Forest Region - 2007

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2007 Overview of Forest Health in the Southern Interior Forest Region

Introduction

The 2007 Aerial Overview Surveys were carried out between July 15 and August 23, 2007. A total of 343.6 hours of fixed-wing flying were required for 100% coverage of the Region. As in past years, three separate survey crews conducted the surveys for the Southern Interior Region which included the Quesnel, Central Cariboo, Chilcotin, 100 Mile House, Kamloops, Cascades, Okanagan Shuswap, Headwaters, Columbia, Arrow Boundary, Kootenay Lake, and Rocky Mountain Districts.

Surveys were carried out using the standardised Provincial Aerial Overview Survey protocols (http://ilmbwww.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 continued to use the expanded categories, which now include trace (less than 1% current mortality) and very severe (greater than 50% current mortality) (see Table 1).

Overall, weather conditions and visibility were satisfactory. Wildfire activity initially caused some difficulties with the surveys, especially in the Kootenay and south Okanagan areas. Some additional delays were experienced in parts of the Cariboo, due to poor weather late in the surveys.

The most damaging pest in the Southern Interior Region continued to be mountain pine beetle (5,379,219 ha); other pests causing large scale damage were western spruce budworm (804,304 ha), western balsam bark beetle (434,126 ha), Douglas-fir beetle (78,528 ha), and spruce beetle (35,769 ha).

Table 1. Severity ratings used in the aerial overview surveys.

Mortality 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	11-29%	Moderate	thin foliage, top third of many trees severely defoliated, some completely stripped
Severe	30-49%	Severe	bare branch tips and completely defoliated tops, most trees sustaining >50% total defoliation
Very Severe	50% +		

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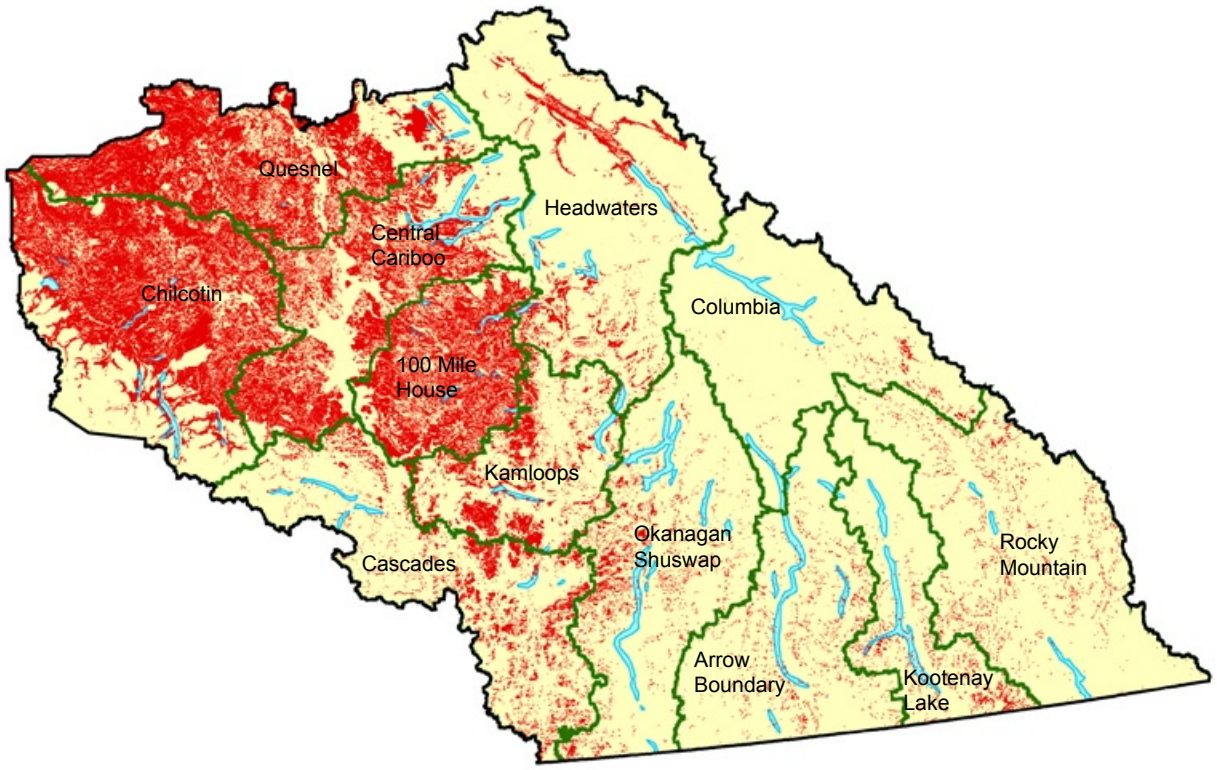


Figure 1. Mountain pine beetle infestations in the Southern Interior Forest Region in 2007.

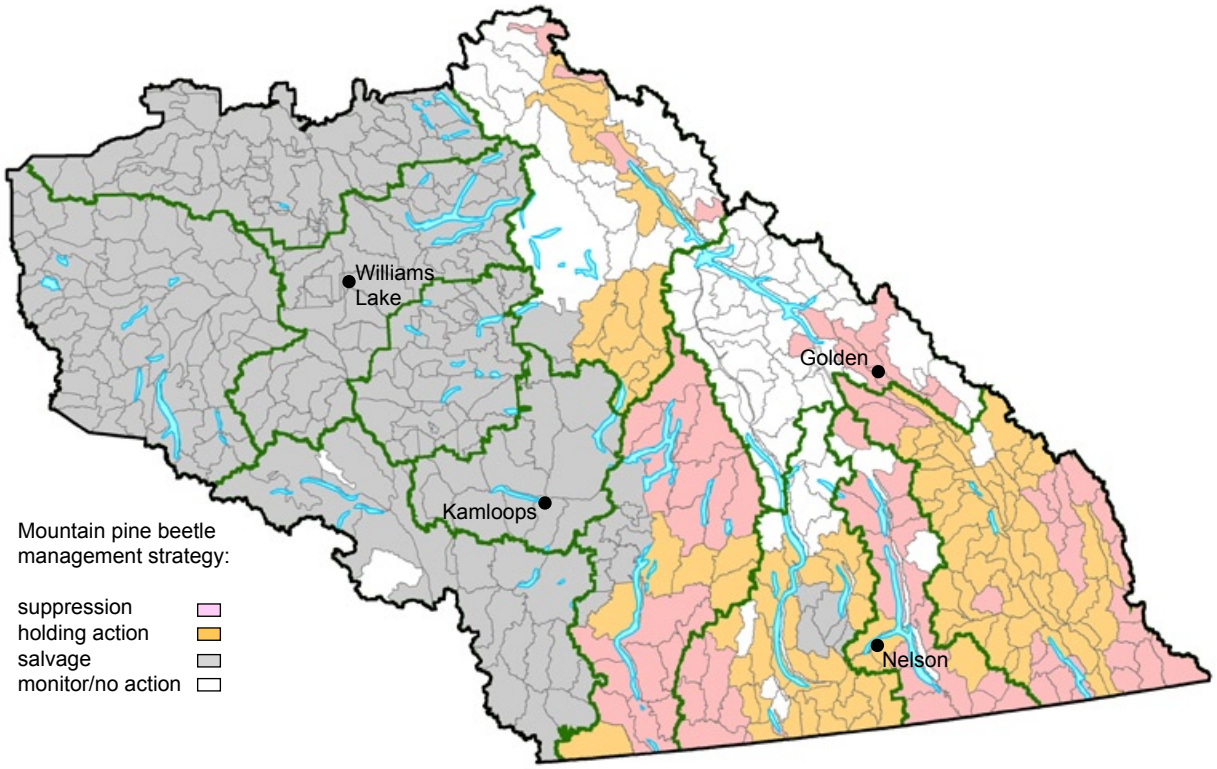


Figure 2. Beetle Management Unit (BMU) boundaries, and associated mountain pine beetle strategies, as of December 2007.

Table 2. Area summaries for forest health factors mapped during the 2007 aerial overview surveys.

Forest District and Damaging Agent	Area of Infestation (ha)					
	Trace	Light	Moderate	Severe	Very Severe	Total
Mountain Pine Beetle						
Chilcotin	79,993.9	307,647.2	820,663.2	271,492.3	11,658.1	1,491,454.7
Quesnel	362,740.8	266,473.7	420,775.2	119,118.7	14,197.7	1,183,306.1
Central Cariboo	398,619.8	91,224.5	157,501.5	97,977.1	98,367.5	843,690.4
100 Mile House	238,051.2	151,904.5	188,373.5	69,733.8	77,073.1	725,136.1
Cascades	30,911.1	147,324.9	108,083.3	29,242.1	4,498.3	320,059.7
Kamloops	14,746.8	101,238.0	95,319.4	66,070.2	25,833.5	303,207.8
Headwaters	99,128.3	59,894.0	55,004.1	16,377.7	2,826.2	233,230.2
Okanagan Shuswap	18,653.4	78,177.1	40,998.3	11,843.1	3,680.5	153,352.2
Rocky Mountain	2,584.9	17,887.1	14,691.9	7,657.2	2,328.5	45,149.5
Arrow Boundary	2,339.7	16,538.5	15,275.7	6,179.3	809.5	41,142.7
Kootenay Lake	327.6	8,168.2	6,943.4	6,299.8	246.9	21,985.9
Columbia	1,501.1	6,761.3	7,804.0	1,202.0	235.5	17,503.8
Total	**1,249,598.6**	**1,253,239.0**	**1,931,433.2**	**703,193.2**	**241,755.0**	**5,379,219.1**
Douglas-fir Beetle						
Central Cariboo	37,933.0	5,890.5	3,870.5	65.9	0.0	47,759.9
Chilcotin	3,669.6	4,856.2	1,866.5	122.5	0.0	10,514.8
100 Mile House	7,276.2	2,350.5	47.6	0.0	0.0	9,674.3
Quesnel	6,470.0	426.9	480.6	183.5	0.0	7,561.0
Rocky Mountain	43.1	401.3	730.6	731.3	0.0	1,906.4
Arrow Boundary	71.3	253.4	63.3	0.0	0.0	388.0
Kamloops	0.0	98.9	126.7	18.1	0.0	243.7
Headwaters	202.8	2.5	0.0	0.0	0.0	205.3
Columbia	0.0	71.5	57.8	0.0	0.0	129.3
Okanagan Shuswap	0.0	37.4	22.0	0.0	0.0	59.4
Kootenay Lake	45.3	0.0	0.0	0.0	0.0	45.3
Cascades	0.0	9.5	6.2	24.8	0.0	40.5
Total	**55,711.1**	**14,398.8**	**7,271.8**	**1,146.2**	**0.0**	**78,527.9**
Spruce Beetle						
Central Cariboo	7,431.2	2,939.7	1,019.7	3,000.7	19.4	14,410.8
100 Mile House	6,037.3	1,934.8	206.8	464.4	0.0	8,643.4
Okanagan Shuswap	52.6	1,135.8	3,582.5	1,102.6	0.0	5,873.5
Kamloops	0.0	239.0	1,029.1	452.6	0.0	1,720.6
Cascades	91.8	702.9	772.2	77.3	11.7	1,655.9
Quesnel	243.7	1,098.4	38.4	219.8	0.0	1,600.3
Rocky Mountain	0.0	0.0	984.1	107.3	0.0	1,091.4
Headwaters	320.1	160.6	75.8	2.2	0.0	558.6
Chilcotin	3.8	175.8	0.0	0.0	0.0	179.6
Columbia	0.0	28.3	0.0	0.0	0.0	28.3
Kootenay Lake	0.0	6.2	0.0	0.0	0.0	6.2
Total	**14,180.4**	**8,421.5**	**7,708.6**	**5,426.9**	**31.1**	**35,768.5**
Western Balsam Bark Beetle						
Quesnel	100,998.9	3,469.2	12.8	0.0	0.0	104,481.0
Headwaters	73,382.9	16,506.4	265.8	85.6	0.0	90,240.7
Okanagan Shuswap	52,042.2	19,685.9	261.9	2.2	0.0	71,992.2
Central Cariboo	64,993.1	3,633.6	165.8	98.8	0.0	68,891.2
100 Mile House	15,842.9	3,389.7	0.0	0.0	0.0	19,232.5
Cascades	12,747.6	3,396.2	172.4	0.0	0.0	16,316.3
Chilcotin	9,077.8	6,632.9	157.7	0.0	0.0	15,868.4
Rocky Mountain	10,840.2	1,410.0	686.5	136.3	0.0	13,073.1
Arrow Boundary	10,112.2	1,767.5	537.4	138.4	0.0	12,555.4
Columbia	8,551.1	1,065.6	197.7	0.0	0.0	9,814.4
Kootenay Lake	5,340.1	506.7	520.9	0.0	0.0	6,367.7
Kamloops	3,158.0	1,912.9	222.3	0.0	0.0	5,293.2
Total	**367,087.1**	**63,376.4**	**3,201.2**	**461.3**	**0.0**	**434,126.0**

Table 2 continued. Area summaries for forest health factors mapped during the 2007 aerial overview surveys.

Forest District and Damaging Agent	Area of Infestation (ha)				
	Light	Moderate	Severe	Very Severe	Total
Western Spruce Budworm					
Central Cariboo	198,402.2	23,769.6	973.1	0.0	223,144.9
Cascades	152,319.0	43,514.9	1,056.2	0.0	196,890.1
100 Mile House	149,045.1	15,127.9	1,820.9	0.0	165,993.9
Kamloops	118,068.9	8,029.7	63.6	0.0	126,162.2
Chilcotin	55,241.4	6,106.5	512.7	0.0	61,860.6
Okanagan Shuswap	27,472.7	2,106.6	50.9	0.0	29,630.2
Headwaters	622.7	0.0	0.0	0.0	622.7
Total	**701,172.1**	**98,655.2**	**4,477.4**	**0.0**	**804,304.6**
Two-Year Cycle Budworm					
Quesnel	4,593.9	0.0	0.0	0.0	4,593.9
Headwaters	3,093.6	0.0	0.0	0.0	3,093.6
Total	**7,687.5**	**0.0**	**0.0**	**0.0**	**7,687.5**
Larch Needle Blight					
Rocky Mountain	4,953.1	1,610.8	1,468.1	0.0	8,032.0
Kootenay Lake	3,672.4	34.4	0.0	0.0	3,706.8
Arrow Boundary	944.6	856.0	0.0	0.0	1,800.6
Total	**9,570.1**	**2,501.3**	**1,468.1**	**0.0**	**13,539.5**
Birch Leafminer					
Columbia	0.0	13.9	0.0	0.0	13.9
Total	**0.0**	**13.9**	**0.0**	**0.0**	**13.9**
Douglas-fir Tussock Moth					
Kamloops	10.8	47.8	29.2	0.0	87.8
Total	**10.8**	**47.8**	**29.2**	**0.0**	**87.8**
Western Blackheaded Budworm					
Arrow Boundary	39.9	548.1	0.0	0.0	588.0
Total	**39.9**	**548.1**	**0.0**	**0.0**	**588.0**
Satin Moth					
Chilcotin	29.5	0.0	0.0	0.0	29.5
Cascades	0.0	4.6	0.0	0.0	4.6
Total	**29.5**	**4.6**	**0.0**	**0.0**	**34.2**
Dothistroma					
Headwaters	0.0	8.2	0.0	0.0	8.2
Total	**0.0**	**8.2**	**0.0**	**0.0**	**8.2**
Windthrow					
Quesnel	0.0	0.0	361.7	36.2	397.8
Rocky Mountain	0.0	303.6	0.0	0.0	303.6
Kootenay Lake	0.0	102.2	121.0	0.0	223.2
Central Cariboo	0.0	0.0	89.7	9.5	99.1
Columbia	0.0	61.8	0.0	0.0	61.8
100 Mile House	0.0	0.0	52.4	0.0	52.4
Okanagan Shuswap	0.0	0.0	3.4	4.3	7.7
Total	**0.0**	**467.6**	**628.1**	**49.9**	**1,145.6**

Regional Overview

Mountain Pine Beetle, *Dendroctonus ponderosae*

Total red attack remained nearly unchanged in 2007, at 5.38 million hectares, compared to 5.13 million hectares in 2006. In many areas of the Region, mountain pine beetle populations have either reached their peak, or are in the declining phase. This is especially evident in much of the Quesnel District, where red attack levels have dropped sharply, mainly due to host depletion. This is also occurring in parts of the Central Cariboo and 100 Mile House Districts. Many stands in these areas now have a very high component of standing grey pine. The area of severe and very severe attack has also declined in most of the Kootenays, although this is more of a factor of local population dynamics, than host depletion. Region-wide, the proportion of attack that was classified as severe or very severe, fell from 24.1% to 17.6%.

A total of 71,400 trees were killed in just under 5,429 small spot infestations, which is similar to 2006 totals of 72,000 trees in 5,672 spot infestations (Table 3). Three-quarters of these spot infestations were in the Kootenays, where most infestations remained relatively broken up and scattered. This pattern of mortality still indicates dispersing populations from larger outbreak areas.

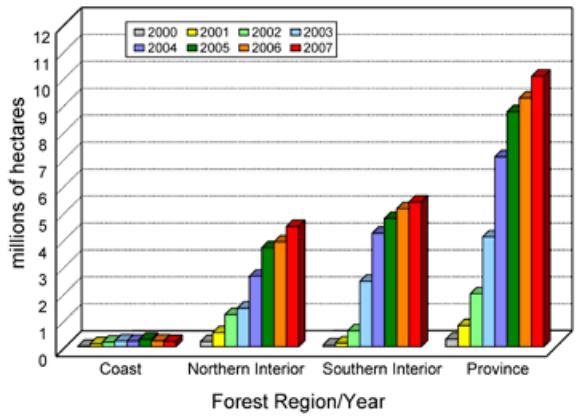


Figure 3. Area affected by mountain pine beetle from 2000 - 2007 in British Columbia, by Forest Region.

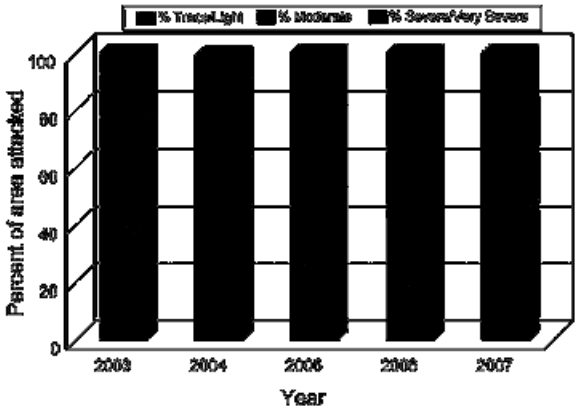


Figure 4. Proportion of mountain pine beetle infested area by infestation severity level, from 2003 - 2007, in the Southern Interior Forest Region.

Table 3. Area infested, number of polygons, average polygon size, and number of trees killed in spot infestations, for mountain pine beetle in the Southern Interior Forest Region, 2001-2007.

Year	Area Infested (ha)	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	4,220,499	41,057	101.9	4,932	63,410
2005	4,853,830	49,381	95.6	3,839	35,033
2006	5,125,879	59,971	85.5	5,672	71,803
2007	5,379,219	59,373	90.6	5,429	71,409

Each fall, after the completion of the aerial overview surveys, Beetle Mangement Unit (BMU) strategies are re-assessed. In 2007, nearly one million hectares of the Southern Interior Region's landbase was downgraded to "Salvage" (which now accounts for nearly half of the Region's landbase). The entire Quesnel, Central Cariboo, Chilcotin, 100 Mile House, Kamloops, and Cascades Districts are now designated as Salvage (with the exception of a few "No Action/Monitor" areas in the Cascades District). Several additional BMU's in the Headwaters, Okanagan Shuswap, and Arrow Boundary Districts either remain as Salvage, or have been downgraded from Holding Action to Salvage. Table 4 lists the area of each District which falls under the different mountain pine beetle strategies.

Table 4. Beetle management unit mountain pine beetle strategy designations in the Southern Interior Forest Region as of December 2007, 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	0	14 (1,313,664)	0	14 (1,313,664)
Cascades	0	0	20 (2,127,168)	2 (129,003)	22 (2,256,171)
Okanagan Shuswap	21 (1,546,330)	6 (551,224)	7 (351,614)	0	34 (2,449,168)
Headwaters	4 (134,652)	17 (934,793)	0	18 (1,804,000)	41 (2,873,445)
Columbia	9 (301,244)	0	0	42 (1,843,055)	51 (2,144,299)
Arrow Boundary	7 (334,868)	28 (1,068,051)	5 (174,541)	10 (419,063)	50 (1,996,524)
Kootenay Lake	17 (844,661)	4 (196,674)	0	6 (199,522)	27 (1,240,857)
Rocky Mountain	24 (953,688)	52 (1,805,386)	0	1 (41,458)	77 (2,800,531)
Total	**82 (4,115,443)**	**107 (4,556,128)**	**280 (12,213,961)**	**79 (4,436,101)**	**548 (25,762,318)**

Severe mortality in lodgepole pine near Elbow Lake, north of Kamloops.

Aggressive harvesting continues in affected pine types throughout the Southern Interior Region. Within Districts where there are still Suppression Units, such as Okanagan Shuswap, Kootenay Lake and others (Table 4), detailed surveys, fall and burn and targeted harvesting is being conducted as per District Forest Health Strategies. Suppression activities have accelerated in the Arrow-Boundary-Kootenay area of the south due to lower levels of green attack detected after the 2006 and 2007 beetle flights. However, the MPB "wave" may have hit portions of the Boundary as some fairly large areas of green attack, associated with few or no red attack, have been located in ground surveys conducted this winter. The green:red ratio in the southeast portion of the Region remains fairly low (Table 5) and the main threat remains from airborne dispersal of beetles from more distant areas of severe attack.

Table 5. Green:red mountain pine beetle ratios for the Southern Interior Forest Region, 2007.

Forest District	Average Green:Red Ratio	Range
Okanagan Shuswap	2.0	1 - 4
Headwaters (Morkill)	0.7	0.4 - 0.9
Headwaters (Holmes)	8.0	0.6 - 8.0
Columbia	2.0	1 - 5
Rocky Mountain	1.3	0.4 - 4.2
Kootenay Lake	1.5	<1 - 3
Arrow Boundary	1.0	<1 - 2

The incidence and severity of MPB attack in young pine stands (20-55 years) continued to increase within the core outbreak areas in the Cariboo and more southern areas of the Region. 2007 marked the third year of stand specific aerial surveys of young pine and the results are summarized on pages 37 - 47 of this report. An effort was made in the 2007 overview surveys to map this mortality in young pine stands, and as a result approximately 117,065 hectares of affected young pine was mapped. This total is not directly comparable to the stand specific surveys and gives a much more "broad-brush" approximation of impact.

Severe mountain pine beetle attack in a series of 23 - 25 year old lodgepole pine plantations in the Georges Creek area, Kamloops District.

Affected area within provincial parks has increased, and now totals over 345,000 hectares in 164 separate parks. (Table 6). This is an increase from 294,837 hectares in 2006, and 241,030 hectares in 2005. Forty five individual provincial parks sustained at least 1,000 hectares of red attack in 2007. Over 30% of all attack in parks was within the Chilcotin District. The most affected park continued to be Itcha Ilgachuz Park, in the Quesnel and Chilcotin Districts, where red attack was mapped on over 61,500 hectares. Several other provincial parks sustained at least 10,000 hectares of mapped red attack: Ts'yl-Os, Wells Gray, Big Creek, Bowron Lake, Mount Robson, Churn Creek, Kluskoil Lake, Cariboo Mountains, Marble Range, and Cathedral Park. Infestations in the National Parks (Yoho, Kootenay, Glacier, and Mount Revelstoke) have increased slightly to 12,501 hectares, most of which was within Yoho and Kootenay National Parks.

Many provincial parks and forest recreation sites are now removing dead trees from camping and day-use areas due to safety concerns, and developing long-term strategies to address forest health issues.

Table 6. Area (hectares) of mountain pine beetle in provincial parks in the Southern Interior Region in 2007. Numbers in brackets refer to additional areas within National Parks*.

Forest District	Total Number of Parks	Number of Parks with MPB	Area of MPB in Parks (ha)	Total Park Area (ha)
Chilcotin	13	11	109,538	390,766
Headwaters	40	14	52,027	848,744
Quesnel	18	15	48,236	202,497
Central Cariboo	11	7	42,933	195,766
100 Mile House	29	18	30,105	48,342
Kamloops	49	29	27,726	66,498
Okanagan Shuswap	110	20	13,551	186,990
Cascades	35	9	9,434	200,814
Kootenay Lake	23	8	5,532	215,975
Arrow Boundary	33	7	4,475	169,813
Rocky Mountain	35	5	1,649 (2,079)	272,461 (41,517)
Columbia	21	1	52 (10,422)	50,929 (387,783)
Total	**305**	**164**	**345,258 (12,501)**	**2,849,595 (429,300)**

*National Parks - Yoho, Kootenay Lake, Glacier, and Mount Revelstoke.
**Several parks cross over District boundaries, hence these totals are lower than would be indicated by the data in this table.

Lac Le Jeune Provincial Park campground area, following removal of lodgepole pine killed by mountain pine beetle, May 2007.

Other species of pine continued to be killed by mountain pine beetle in many areas. Ponderosa pine mortality increased throughout the South Thompson River valley, from Chase, through to Kamloops, Kamloops Lake, and Ashcroft. Mortality also increased throughout the Scottie Creek, Hat Creek, Clinton, Westwold, Merritt, Nicola Lake, Stump Lake, Aspen Grove, Chapperon Lake, and north Okanagan areas. Scattered pockets of ponderosa pine mortality were seen throughout the Fraser River, Nicola River, Spences Bridge, and Princeton areas. In total, 83,325 hectares of the total area mapped as mounain pine beetle was in ponderosa pine.

Whitebark pine was also killed by mountian pine beetle in several high-elevation areas totalling 14,181 hectares. Scatterd areas of mortality were observed throughout the Kootenays, in the Rockies, Purcells, and southern Selkirks, west of Lytton in the Lilloet Range, and scattered in the Cariboo Mountains and Quesnel Lake areas. Ongoing whitebark pine decline and mortality, caused by both mountain pine beetle and white pine blister rust, has been a cause of concern due to it's importance as a food and cover source for several bird and mammal species in high elevation ecosystems.

Ponderosa pine killed by mountain pine beetle, Veasy Lake area, Kamloops District..

Douglas-fir Beetle, *Dendroctonus pseudotsugae*

Douglas-fir beetle was mapped on 78,528 hectares, up from 55,815 hectares in 2006. Most of the attacked area was in the Central Cariboo District (61% of the affected area); large areas of attack were also seen in the Chilcotin (10,515 hectares), 100 Mile House (9,675 hectares), Quesnel (7,560 hectares), and Rocky Mountain (1,906 hectares) Districts. While most of the area was classified as trace, more severe levels of mortality were mapped in the Chilcotin and and Fraser River corridors, in Kootenay National Park, and in the Grasmere area. Another 20,200 trees were killed in 1,425 spot infestations, which were most prevalent in the Cariboo and Kootenay areas (Table 7).

In the Cariboo, and particularly the Chilcotin, much of the Douglas-fir beetle population increase is due to stress from ongoing western spruce budworm defoliation. Overall damage was worst in Old Growth Management Areas (OGMA's) and mule deer winter ranges, where beetle management has been restricted to protect biodiversity and wildlife vales.

Table 7. Number of spot infestations of Douglas-fir beetle in the Southern Interior Forest Region, by District, 2007.

District	# spot infestations	# trees
Central Cariboo	542	8,326
100 Mile House	226	2,399
Arrow Boundary	144	1,712
Rocky Mountain	123	2,055
Chilcotin	88	1,763
Quesnel	88	1,381
Okanagan Shuswap	87	885
Kamloops	60	765
Cascades	45	640
Columbia	11	115
Headwaters	6	130
Kootenay Lake	5	30
Total	**1,425**	**20,200**

Spruce Beetle, *Dendroctonus rufipennis*

Spruce beetle infestations were mapped on 35,769 hectares, down significantly from 2006 levels of 82,318 hectares. However, most of the decreases were seen in the trace and light categories, while the severe category increased by nearly 6-fold, to 5,426 hectares. Because of this, the total number of trees killed in 2007 remained similar to the number killed in 2006. Most of the decreases were seen in the Central Cariboo, 100 Mile House, and Quesnel Districts; area afffected increased by 5-fold in both the Okanagan Shuswap (to 5,874 hectares) and Rocky Mountain (to 1,092 hectares) Districts. Significant mortality was also mapped in the Kamloops (1,720 hectares) and Cascades (1,656 hectares) Districts.

Western Balsam Bark Beetle, *Dryocoetes confusus*

Western balsam bark beetle mortality increased from 283,478 hectares in 2006, to 434,126 hectares in 2007. Most of this increase was due to a very large increase in the amount of trace attack mapped in the Quesnel, Headwaters, and Central Cariboo Districts. These three Districts, together with the Okanagan Shuswap, contain over three-quarters of all the mortality mapped in the Region. Additional scattered attack occurred throughout high elevation areas in the rest of the Region. In many areas, especially the Cariboo and the Kamloops District, western balsam beetle mortality remains difficult to see, due to widespread, often severe, mountain pine beetle attack in lodgepole pine within, or in close proximity to, the same stands.

Western Spruce Budworm, *Choristoneura occidentalis*

Overall affected area totalled 804,305 hectares, which was an increase of 48,000 hectares over 2006 levels of 755,916 hectares. This is very close to the peak area seen during the 1980's outbreak, when defoliation was mapped on just over 820,000 hectares. However, there was a general decline in the levels of moderate and severe defoliation, in all Districts. This was due to several factors, including an aggressive ongoing aerial spray program, and widespread early L2 larval mortality early in the spring. Decreased area of defoliation was seen in the Central Cariboo and Cascades Districts, while defoliation expanded significantly in the Kamloops, 100 Mile House, and Okanagan Shuswap Districts. Defoliation was also visible in a few small areas in the south of the Headwaters District, for the first time since 1989.

Egg mass sampling was conducted during the fall of 2007 at 472 sites in the Region (Table 8). On average, the highest populations in 2008 are expected to be in the Kamloops, Cascades, and 100 Mile House Districts, especially in the Savona, Six Mile, Ashcroft, Paul Lake, Heffley Creek, Monte Creek, Westwold, Eightythree Lake, Goose Lake, Chasm, Loon Lake, Williams Lake, Gaspard Creek, and Alexis Creek areas. Defoliation severity should decline in the Chilcotin and Central Cariboo Districts. Nearly 98% of all sampling sites in the Region were positive for eggmasses, indicating that defoliation will occur over a wide area again in 2008.

Table 8. Summary of Southern Interior Forest Region fall 2007 western spruce budworm egg mass sampling results, showing predicted 2008 defoliation.

	Number of sites in each defoliation category					
District	**Nil**	**Light**	**Moderate**	**Severe**	**Total number of sites**	**Average # egg masses/10m² foliage***
Kamloops	0	36	65	16	117	83.6
Cascades	2	50	59	7	118	63.6
100 Mile House	4	54	41	3	102	56.9
Okanagan Shuswap	1	22	20	2	45	55.2
Chilcotin	2	10	9	0	21	43.4
Central Cariboo	2	52	15	0	69	34.1
RSI total	**11**	**224**	**209**	**28**	**472**	**61.1**

*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

2007 Western Spruce Budworm Spray Program

From 1987-1989, the Ministry of Forests conducted operational trials with *B.t.k.* to determine its best operational use against the western spruce budworm. In 1990, the first operational program was conducted, with 4,000 ha treated with *B.t.k.* in the old Vernon District. Since that time the program has expanded to meet the increasing necessity to protect our interior Douglas-fir forests from budworm damage. The 2007 western spruce budworm *B.t.k.* spray program was the largest to date in the province (Figure 5).

Just over 57,000 hectares, in 33 separate spray blocks, were treated with Foray 48B (*Bacillus thuringiensis* var. *kurstaki*, or *B.t.k.*) between June 15 and June 23, 2007. The *B.t.k.* was applied at a rate of 2.4 litres/ha using a combination of rotary (315BLama and Hiller UH12ET) and fixed-wing aircraft (two AT802 Air tractors). A total of 20,731 ha in 11 spray blocks and 36,274 ha in 22 spray blocks were treated in the Kamloops/Merritt area and 100 Mile House, Central Cariboo and Chilcotin areas, respectively. Western Aerial Applications Ltd. operated the rotary wing aircraft equipped with Simplex spray systems and the Provincial Airtanker Centre in Kamloops oversaw the aerial application with the two air tractors, equipped with T-jet spray systems, on a cost-recovery basis.

All aircraft used in the Southern Interior Region spray program are equipped with GPS spray guidance systems, thus eliminating the need for block boundary marking on the ground. The GPS system simplifies block layout and spray monitoring and reduces the number of ground personnel required. This system also enables spray operations to be switched to different spray blocks quickly and efficiently.

The estimated cost per hectare of the 2007 program (*B.t.k.* and spray aircraft only) was $24.32/ha for the rotary wing program in Kamloops and $21.82 for the fixed-wing program in the Cariboo. Other costs not included in this per hectare estimate include: staff time; support helicopter for spray operations and block set-up; trucking costs of moving *B.t.k.* to staging sites; statutory advertising; contractor costs (egg mass sampling and spray monitoring); and, various miscellaneous supplies.

Our Interior Douglas-fir forests are becoming increasingly vulnerable to insect and disease damage. Impacts of changing climate, deteriorating stands conditions, loss of species diversity (e.g. pine component lost to mountain pine beetle) and expansion of pest ranges, such as the budworm, is challenging our ability to manage these forests. As the budworm outbreak continues, trees and stands become more susceptible to other mortality factors such as the Douglas-fir beetle. The spray program for budworm is just one part of many management tactics to maintain and increase resiliency in these Interior Douglas-fir forests. Results from fall egg mass sampling indicate continued high defoliation and expansion of the budworm in 2008 confirming the need for a larger, targeted spray program this summer.

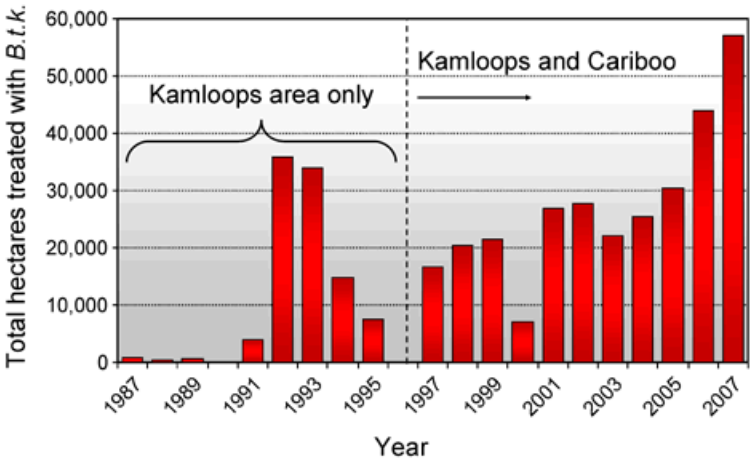


Figure 5. Area treated with *B.t.k.* (in hectares) in the Southern Interior Region, from 1987 - 2007.

Western Hemlock Looper, *Lambdina fiscellaria lugubrosa*

Pheromone trap catches at 27 permanent trapping sites were all low (Table 9), and 3-tree larval beatings conducted at these sites yielded very few larvae. Populations are expected to remain at low levels in 2008. No defoliation was observed in the Region.

Table 9. Average number of western hemlock looper moths caught per 6-trap cluster from 2002 - 2007 in the Southern Interior Forest Region.

			Average Trap Catches					
Site	District	Location	2002	2003	2004	2005	2006	2007
1	Headwaters	Serpentine Creek	156	77	3.5	11.7	2.2	14.0
2	Headwaters	Thunder River	172	69	10.8	8.8	3.0	44.0
3	Headwaters	Mud Lake	505	71	13.2	7.0	4.0	14.2
4	Headwaters	Murtle Lake Road	433	150	8.5	11.3	12.0	21.2
5	Headwaters	Finn Creek	271	29	1.7	7.0	3.8	6.2
	District Average		**291**	**79**	**7.5**	**9.2**	**5.0**	**19.9**
7	Okanagan Shuswap	Scotch Creek	954	567	4.5	0.8	2.8	6.2
8	Okanagan Shuswap	Yard Creek	273	780	0.2	0.7	11.7	3.5
9	Okanagan Shuswap	Crazy Creek	315	1,110	4.2	4.5	0.5	6.7
10	Okanagan Shuswap	Perry River North	1,294	1,471	75	8.2	6.0	18.0
11	Okanagan Shuswap	Three Valley Gap	374	238	25.5	21.3	4.5	9.2
12	Okanagan Shuswap	Perry River South	1,084	958	30	6.0	3.7	9.2
13	Okanagan Shuswap	Kingfisher Creek	1,203	203	8.7	24.8	3.3	5.3
14	Okanagan Shuswap	Noisy Creek	128	145	4.8	24.8	1.1	10.2
15	Okanagan Shuswap	Shuswap River E.R.	347	457	107.3	3.0	1.7	2.8
16	Okanagan Shuswap	Greenbush Lake	302	2,860	192.3	0.3	1.8	logged
17	Okanagan Shuswap	Adams River	189	no traps	1.3	9.7	3.2	13.2
	District Average		**588**	**806**	**38.4**	**8.1**	**3.7**	**8.4**
66	Columbia	Sutherland Falls	n/a	n/a	2.5	2.5	1.0	1.2
72	Columbia	Trout Lake	n/a	n/a	7.0	6.2	2.0	1.2
73	Columbia	Martha Creek	n/a	n/a	16.6	7.7	2.2	0.8
74	Columbia	Goldstream River	n/a	n/a	2.2	5.3	3.8	2.8
75	Columbia	Downie Creek	n/a	n/a	no traps	1.3	1.3	1.0
76	Columbia	Bigmouth Creek	n/a	n/a	2.3	8.5	13.4	0.7
78	Columbia	Carnes Creek	n/a	n/a	1.2	4.3	1.5	1.2
83	Columbia	Begbie Creek	n/a	n/a	9.2	12.7	2.5	1.2
84	Columbia	Pitt Creek Rec Site	n/a	n/a	1.8	1.0	2.6	1.8
85	Columbia	Redrock	n/a	n/a	1.8	22.7	17.3	7.5
87	Columbia	Jumping Creek	n/a	n/a	3.3	9.4	0.5	1.0
	District Average		**n/a**	**n/a**	**4.8**	**7.4**	**4.1**	**1.9**

Late instar western hemlock looper larva.

Douglas-fir Tussock Moth, *Orgyia pseudotsugata*

n late July 2007, several small pockets of severe defoliation covering about 88 hectares, were detected in the Campbell Creek area, east of Kamloops. These concentrations of Douglas-fir tussock moth were unexpected, as trap catches and 3-tree beatings results in the few years previous to 2007 had not indicated incipient outbreak populations. In 2007, 6-trap pheromone monitoring sites caught an average of 20.1 moths/ trap compared to 10.4 moths/trap in 2006. High moth catches occurred at the Monte Creek and Six-Mile sites (Table 10), but generally, trap catches have fluctuated greatly over the past few years. Single-trap pheromone monitoring sites caught very low numbers of moths throughout the trapping area (Table 12). 3-tree larval beatings collected a total of 67 tussock moth larvae, up from 5 larvae in 2006.

Severe Douglas-fir tussock moth defoliation near Kamloops.

Table 10. Average number of Douglas-fir tussock moths caught per 6-trap cluster from 2001 - 2007 in the Southern Interior Forest Region (Okanagan Shuswap, Cascades, and Kamloops Forest Districts).

		Average Trap Catches						
Site	**Location**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
1	McLure	1.3	0.2	6.3	3.3	0	9.8	33.3
2	Heffley Creek	13.8	6.7	76.3	5.5	38.0	14.8	34.2
3	Inks Lake	9.7	7.8	30.0	1.5	0.3	10.2	5.6
4	Six Mile	8.2	3.5	67.0	9.7	33.6	52.5	73.5
5	Battle Creek	17.2	10.7	67.7	5.6	1.2	14.0	34.8
6	Barnes Lake	39.2	10.3	52.2	6.7	1.5	34.5	21.3
7	Veasey Lake	56.7	16.3	83.0	2.7	0	13.8	22.2
8	Pavilion	17.7	1.0	9.7	0.3	0	1.5	15.7
9	Stump Lake	3.8	0	3.2	1.2	3.8	2.8	8.7
10	Monte Creek	5.5	3.5	10.7	13.8	40.2	18.3	80.5
11	Chase	14.2	28.0	36.3	11.2	9.3	0	0
12	Yankee Flats	0.7	1.7	1.0	0.3	2.0	0	0
13	Vernon	19.6	28.8	24.8	22.7	79.8	12.2	1.3
14	Wood Lake	6.8	0.3	1.1	6.7	11.0	0.3	1.0
15	Kelowna	6.2	0.5	fire	deleted	deleted	deleted	deleted
16	Summerland	16.8	1.5	0	0	4.5	1.0	0.3
17	Kaleden	5.7	1.2	0.3	0.3	18.6	11.6	29.0
18	Blue Lake	4.2	2.7	9.2	8.4	39.8	8.3	1.3
19	Stemwinder Park	49.3	2.5	1.2	1.0	29.5	1.5	17.8
20	Ashnola River	46.7	1.2	0.5	0	14.3	0	12.3
21	Spences Bridge	19.7	0.7	21.3	1.5	0	1.5	10.2
	Regional Average	**6.0**	**17.3**	**25.1**	**5.1**	**16.4**	**10.4**	**20.2**

Ground surveys, coupled with sequential egg mass surveys, were conducted in the fall of 2007 to determine the location and magnitude of tussock moth populations in the Kamloops area. Surveys were located in sites exhibiting higher moth trap-catches, sites with prior ground or air observations, and sites of historic tussock moth outbreaks. Viable egg masses were found in several locations. Several sites surveyed had egg mass concentrations indicating severe defoliation levels in 2008. Some of the more severe epicentres are located in the Six Mile, Beaton Road, Robbins Range, Barnhartvale, Heffley Creek and Palmer-Forsythe Road areas (Table 11). A spray program using the nuclear polyhedrosis virus (Virtuss®) will be conducted in 2008 to collapse the population in these sites.

Table 11. Results of Douglas-fir tussock moth sequential sampling ground surveys in the Kamloops area, fall 2007.

Location	Average Elevation (m)	Number of Sites	Avg. #Egg Masses/tree	Predicted 2008 Defoliation
Barnes Lake	756	1	0.3	Nil to Light
Barnhartvale	539	3	0.2 - 4.3	Light to Severe
Battle Creek	669	1	0.2	Nil to Light
Beaton Road	602	6	0.4 - 24.5	Light to Severe
Carquille/Veasey Lk.	726	1	0.0	NIL
Heffley Creek	662	3	0.4 - 3.1	Light to Severe
McLure	563	1	0.0	Nil
Palmer-Forsyth	659	2	0.4 - 0.5	Light
Robbins Range	531	4	0.4 - 13.3	Light to Severe
Six Mile	591	5	0.7 - 3.7	Light to Severe

Table 12. Average number of Douglas-fir tussock moths caught per trap (single trap per site) from 1994 - 2007.

	Forest District					
	Kamloops	Okanagan Shuswap			Cascades	
Year		Salmon Arm	Vernon	Penticton	Merritt	Lillooet
	(±30 traps[1])	(9 traps)	(±46 traps)	(27-30 traps)	(±30 traps)	(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
2006	3.7	0	1.6	0.3	2.1	0.4
2007	1.2	N/T	N/T	1.3	2.0	2.3

[1]: in 2004, Kamloops changed from 100 sites to 30 sites.
[2]: NT= no traps placed

Two-Year Cycle Budworm, *Choristoneura occidentalis*

Light defoliation was mapped on 7,688 hectares in 2007, in the Quesnel and Headwaters Districts. This was an "off" year in the feeding cycle of this insect in most of the Region. Widespread defoliation is expected to be visible in 2008, as the larvae enter their second year of development.

Western Blackheaded Budworm, *Acleris gloverana*

Western blackheaded budworm defoliation was mapped on 588 hectares, in the Arrow Boundary District. This is a decrease from 2006, when just over 1,300 hectares were mapped in the Kootenays.

Larch Needle Blight, *Hypodermella laricis*

Larch needle blight damage declined throughout the Kootenays, and was mapped on only 13,540 hectares. Most of the damage was light, with some stands sustaining moderate and severe defoliation. Most of the damage was scattered in the central and southern Purcell Mountains. Most western larch stands affected in 2006 did not show any apparent long term impacts. In almost all cases the stands appeared to be fully recovered. However, in many areas, alpine larch did not recover as well, and mortality has occurred in many areas, especially between Kootenay Lake and Kimberly, in particular St. Mary's and Buhl River areas.

Gypsy Moth, *Lymantria dispar*

There were no positive pheromone trap catches in the Region in 2007.

Wildfire

In most areas of the Region, fire activity was low in 2007. The exception was in the Kootenays, where several large wildfires burned nearly 19,000 hectares of the total 22,800 hectares burned. These wildfires also caused some delays and difficulties for aerial overview survey crews in the area.

Windthrow

Windthrow damage was observed on 1,146 ha, mostly in the eastern Quesnel, Rocky Mountain, and southeast Kootenay Lake Districts. There continues to be concern in the eastern Cariboo that windthrow may be contributing to the maintenance and buildup of local spruce beetle populations.

Other

Aspen serpentine leaf miner (*Phyllocnistis populiella*) was widespread in the Cariboo, with severe defoliation noted in virtually all aspen stands east of Highway 97 extending to the Cariboo Mountains. West of the Fraser River, defoliation was light but very widespread. This defoliation was noted during the overview surveys and during ground reconnaissance; however, as this insect has not been historically mapped in the Cariboo, it was not captured spatially. Nearly all aspen stands in the Cariboo-Chilcotin sustained some level of defoliation in 2007.

Aspen serpentine leaf miner.

Dothistroma needle blight was observed in the Headwaters District by the Regional Pathologists during a reconaissance flight in June 2007. The most affected areas were in the Castle Creek, Holmes River, and Kinbasket Lake areas. Although none of these infection centers were picked up by the aerial overview surveys, a small (8 hectare) area moderately defoliated by Dothistroma near Blue River was captured by the surveys. Please refer to the Special Projects, Pathology Update section of this report for more details.

Other forest health factors observed during the aerial overview surveys included 34 hectares of satin moth, 14 hectares of birch leaf miner, 23 hectares of landslide damage, and 15 hectares of flooding mortality.

Nelson Area Summary

The Nelson portion of the Southern Interior Aerial Overview Survey was conducted between July 15 and August 9, 2007, and required 105.9 hours of flight time over 20 days. The surveys covered the Arrow Boundary, Columbia, Kootenay Lake, and Rocky Mountain Forest Districts, as well as all National Parks. Smoke, haze, and thunderstorm activity early in the surveys caused some delays and problems with visibility; conditions improved after these initial delays, allowing the remainder of the surveys to proceed successfully. Surveys were conducted by contract personnel (Neal Emery and Adam O'Grady of Nazca Consulting) and utilized a Cessna 336 aircraft.

Arrow Boundary Forest District

Mountain Pine Beetle

Infested area continued to decline for the second year in a row. Red attack was mapped on 41,143 hectares, down from 70,528 hectares in 2006, and just over 100,000 hectares in 2005. The most marked decrease was in the most severe attack categories - only 17% of the total mapped area was classified as severe or very severe, whereas in 2006, this accounted for 45% of all infested areas. The number of spot infestations has increased slightly, from 851 (13,795 trees) in 2006 to 915 (15,290 trees) in 2007. Decreased levels and area of red attack was seen in many areas, especially the Granby River, Burrell Creek, Inonalklin Creek, Slocan Valley, Castlegar, and Ladybird Creek areas. Despite the continued decline in overall infestation area, mortality is still widespread and beetle populations remain very active throughout the District.

Just over 1,000 hectares of whitebark pine mortality was observed, scattered through high elevation areas in the eastern half of the District.

Douglas-fir Beetle

Douglas-fir beetle activity has also continued to decline, and was mapped on 388 hectares. This is a decrease from just over 600 hectares in 2005. There was a significant decline in red attack levels in the Beaverdell and Edgewood areas; however, widespread mortality was seen in the Greenwood area. The number of spot infestations has also declined, from 229 (2,830 trees) in 2006 to 144 (1,710 trees) in 2007.

Western Balsam Bark Beetle

Populations continue to be active throughout the District. Mortality was mapped on 12,555 hectares, most of which was classified as Trace (< 1% current attack). The majority of the attack was in high elevation stands scattered throughout the District, with the highest levels of attack being in the Upper Kettle-Granby River areas.

Western Blackheaded Budworm

Light to moderate defoliation was observed on 588 hectares in the Koch Creek, Sheep Creek, and Trail areas.

Larch Needle Blight

Larch needle blight damage was down significantly this year. Light to moderate defoliation was visible on only 1,800 hectares, mostly in the Granby River, Big Sheep Creek, and Greasybill Creek areas. Some mortality was noted in alpine larch that had been heavily defoliated in 2006, but most lower elevation western larch stands affected in 2006 appeared healthy in 2007.

Blackstain root disease in lodgepole pine, Arrow Boundary District.

Other

Black stain root disease and *Ips* beetle were periodically found during mountain pine beetle ground surveys in March 2007 in the south western portion of the boundary portion of the District, but this was not recorded by the overview surveys. Other forest health factors observed included 6,500 hectares burned in wildfires (the largest of which were in the Pend D'Oreille, Springer Creek, and Nevertouch Lake areas), and 11 hectares of slide damage.

Columbia Forest District

Mountain Pine Beetle

The total infested area has continued to decline, from 20,677 hectares in 2006, to 17,503 hectares in 2007. As well, the amount of severe and very severe infestations has fallen from over 6,700 hectares, to just 1,438 hectares. This general decline in infested area was most evident in the Kootenay River and Golden areas. Relatively large areas of mortality were still seen in the lower Yoho National Park and Kootenay Crossing areas, while whitebark pine mortality increased significantly in the Golden, Beaver River, and lower Columbia Reach areas.

Mountain pine beetle infestation near Golden, in the Columbia District.

Western Balsam Bark Beetle

Mortality was mapped on 9,815 hectares, which is more than double 2006 levels, but similar to the levels seen in 2005. Nearly all of the area was classified as trace or light, and were scattered throughout the District.

Douglas-fir Beetle

Douglas-fir beetle was mapped on only 129 hectares, down from 445 hectares in 2006. Only 11 small spot infestations (115 trees) were mapped. Most of the beetle activity continued to be along the Vermillion River in Kootenay National Park.

Spruce Beetle

Spruce beetle mortality was at a low level, and was observed on only 28 hectares. No mortality was visible in the Cummins River area, where mortality was observed in 2006.

Other

Other forest health factors recorded were 14 ha of birch leafminer, 3,180 hectares of wildfire, 62 hectares of windthrow, and 4 hectares of flooding.

Rocky Mountain Forest District

Mountain Pine Beetle

The total area mapped remained nearly unchanged, at 45,150 hectares. Red attack levels have continued to drop significantly in the upper Elk River area, while significant increases were seen in the Cross River area. There was a significant drop in the area classified as very severe, to 2,328 hectares (5 % of the total area mapped). The number of spot infestations has remained relatively unchanged, at 1,448 (22,790 trees). In general, red attack is still widespread throughout the District.

Whitebark pine mortality accounted for 4,095 hectares of the total area mapped. The majority of this mortality was in the Spillamcheen River, Bobbie Burns Creek, Lussier River, and Redding Creek areas.

Douglas-Fir Beetle

Douglas-fir beetle populations remain active, especially in Kootenay National Park. Scattered mortality was also mapped in the Grasmere, Bloom Creek, and Flathead areas, as well as throughout the east-central portion of the District. Mortality was mapped on a total of 1,906 hectares (77% of which was classified as moderate or severe), with a further 2,055 trees killed in 123 spot infestations.

Douglas-fir beetle in Kishinena Creek, Rocky Mountain District.

Western Balsam Bark Beetle

Western balsam bark beetle mortality levels have more than doubled from 2006 levels, to 13,073 hectares. Populations are widespread and scattered over many areas of the District, especially in the Redding Creek, upper Bull River, Skookumchuk River, and Top Of The World Park areas.

Spruce Beetle

Spruce beetle has expanded significantly in the Fenwick Creek area, and by a lesser degree in the Flathead area. Mortality was mapped on a total of 1,091 hectares, most of which was classified as moderate.

Larch Needle Blight

Larch needle blight damage has declined significantly, and was recorded on 8,032 hectares. Defoliation was scattered through the District, especially in the Yahk River, Skookumchuck Creek, and Purcell Wilderness Conservancy area. As in other affected districts, western larch stands appear to have recovered from the 2006 defoliation, whereas is some areas, alpine larch has suffered some mortality.

Mortality in alpine larch from larch needle blight defoliation, Rocky Mountain District.

Other

Other forest health factors observed included 304 hectares of windthrow damage, 6 hectares of flooding damage, and 4,200 hectares of wildfire.

Kootenay Lake Forest District

Mountain Pine Beetle

Total area continued to decline, and was down to 21,986 hectares, from 2006 levels of 30,837 hectares. The area classified as very severe fell from 5,000 hectares in 2006, to just 245 hectares. The number of spot infestations has remained high, at 680 (10,930 trees). The most significant declines were seen in the north of the District, and in the Little Moyie River/Yahk area. Infestations were still generally widespread throughout the south of the District.

Scattered mountain pine beetle mortality in a Suppression BMU near Hawkins Creek, Kootenay Lake District.

Western Balsam Bark Beetle

Mortality was mapped on 6,367 hectares, up from 4,986 hectares in 2006. Damage is still widespread but very scattered, throughout the high elevation areas of the District. Most of the area was classified as Trace.

Douglas-Fir Beetle

Douglas-fir beetle damage was low in 2007. Damage was down from 263 hectares in 2006, to 45 hectares of trace mortality in 2007. At the same time, the number of spot infestations has declined to just 5, from 42 in 2006.

Larch Needle Blight

Larch needle blight damage declined from 21,250 hectares in 2006, to 3,707 hectares in 2007. The activity was mainly in the Creston and Hawkins Creek areas, and most damage was classified as light. A few alpine larch stands suffered mortaltiy as a result of the 2006 defoliation.

Windthrow

In mid July of 2007 there was a severe weather event that moved from Creston north through Cranbrook causing significant windthrow damage, especially around Creston, the Goat River system, Kid Creek and Cranbrook. A total of 223 hectares were affected.

Other

An unknown defoliator on hemlock was observed on a 10-hectare area at Blazed Creek, however time contraints did not permit any field-checking of the causal agent. It is likely that the defoliating agent is either grey spruce looper, or western blackheaded budworm.

Other forest health factors mapped during the overview surveys included 6 hectares of spruce beetle 5,308 hectares of wildfire.

Unknown hemlock defoliation at Blazed Creek, Kootenay Lake District.

Kamloops Area Summary

The Kamloops portion of the aerial overview surveys were conducted between July 24 - August 2, 2007, and required 54.8 hours of flight time over 9 days of flying. Surveys covered the Kamloops, Okanagan, Merritt, and Lillooet Timber Supply Areas. Although poor weather conditions and smoke initially resulted in delays, conditions for the surveys were generally clear and cloud-free, with very good visibility. Surveys were completed before poor weather patterns developed in August. All surveys were conducted by both Ministry of Forests (Kevin Buxton, Forest Health Specialist), and contract personnel (Janice Hodge, JCH Forest Pest Management) and utilized a Cessna 206 aircraft.

Kamloops Forest District

Mountain Pine Beetle

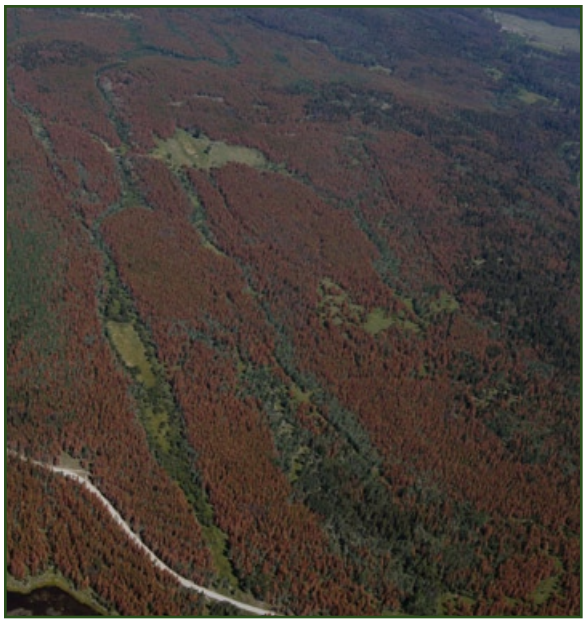
Red attack was mapped on 303,208 hectares, down slightly from a 2006 high of 320,700 hectares. Infestation continue to be active in nearly all areas of the District. Much of the area continued to experience high levels of red attack, with over 60% of all area classified as moderate or greater. Several areas that have experienced several years of mortality near Criss Creek, lower Deadman River, and Red Plateau are now primarily grey, with only scattered light current red attack visible. The number of spot infestations continued to drop, from 196 (2,350 trees), to just 82 (1,150 trees). Increased levels of red attack were seen in many areas, especially in the Highland Valley/Glossy Mountain, Chuwhels Mountain, Lac le Jeune, Fadear Creek, Barriere River, and Willowgrouse Lake areas.

Severe mortality in lodgepole pine near Elbow Lake, north of Kamloops.

High levels of red attack were observed in younger lodgepole pine stands (primarily plantations aged 20-40 years) in many areas, especially in the Watching Creek, Wentworth Creek, Jamieson Creek, Mayson Lake, Community Lake, Barriere River, Georges Creek, Paxton Valley, and Dardanelles Lake areas.

Mountain pine beetle was observed attacking mature, large diameter spruce in several locations. Brood production appears to have been generally low, although the attacked trees are usually killed. This is indicative of high beetle population pressure and declining host availability, and does not signal that spruce has become a suitable host for mountain pine beetle.

Mountain pine beetle continued to cause high and increasing levels of mortality in ponderosa pine throughout low elevation areas in the District. 50,419 hectares, or 17% of the total mountain pine beetle area, were in ponderosa pine, and many stands have now sustained very high levels of cumulative mortality. A portion of this mortality has also been due to western pine beetle activity, especially in the Kamloops, Heffley Creek, and Pritchard areas. Significant green attack was observed in many areas of the District this summer.



Severe mountain pine beetle - caused mortality in a young pine stand in the Dardanelles Lake area, Kamloops Forest District.

Spruce Beetle

Spruce beetle mortality was mapped on 1,721 hectares, down slightly from 1,955 hectares in 2006. Salvage harvesting of many affected stands in the Cahilty Creek area contributed to this reduction; however, populations are still very active in this area, as well as in the upper Wentworth Creek area. A small area of ongoing mortality was also noted in the upper Hat Creek area.

Western Balsam Bark Beetle

Western balsam bark beetle mortality was mapped on 5,293 hectares, down from 2006 levels of 7,100 hectares. Most of the red attack was in the Chu Chua Creek, Harper Creek, and Adams Lake areas. Little mortality was observed on the Bonaparte Plateau, but this is likely due to the masking of the relatively low-level balsam bark beetle attack as compared to the extremely high rates of mountain pine beetle mortality in the same stands.

Douglas-fir Beetle

Douglas-fir beetle was observed on 244 hectares, and a further 55 spot infestations killed 720 trees. Most mortality was along the south side of Paul Lake; other significant mortality was seen in the Heffley Lake, Louis Creek, Hat Creek, and Oregon Jack Creek areas. As Douglas-fir beetle killed trees often fade late in the year of attack or very early in the spring following attack, they are often under-represented by the aerial overview survey.

Western Spruce Budworm

Populations have continued to expand across the District, and defoliation was mapped on 126,162 hectares, up 75% from 2006 levels of 71,600 hectares. The largest expansions were in the Duffy Lake - 6-Mile, Inks Lake, Long Lake, and Robbins Range areas; widespread defoliation also appeared throughout the Paul Lake, Heffley Creek, Louis Creek, Fadear Creek, Barriere River, and Little Fort areas. Almost all of the defoliation was light, with some moderate defoliation in the Louis Creek, Deadman River, and Cache Creek areas. Despite a spray program conducted in the Criss Creek, Barnes Creek, and Scutto Lake areas in June of 2007 (for details see page 12 of this report), budworm populations are expected to increase and spread in 2008, throughout most of the District.

Douglas-fir Tussock Moth

Douglas-fir tussock moth populations increased to damaging levels in the Campbell Range area east of Kamloops, and severe defoliation was observed on 88 hectares. Egg mass sampling carried out during the fall of 2007 located several other population epicenters in the District, in the Six Mile, Beaton Road, Robbins Range, Barnhartvale, Heffley Creek, and Palmer-Forsythe Road areas. Treatment of selected areas with nuclear polyhedrosis virus (Virtuss®) in May of 2008 may be considered.

Douglas-fir tussock moth larva.

Other

226 hectares were burned in several small, scattered wildifres.

Wildfire in a stand of ponderosa pine recently killed by mountain pine beetle in the Peterson Creek area near Kamloops.

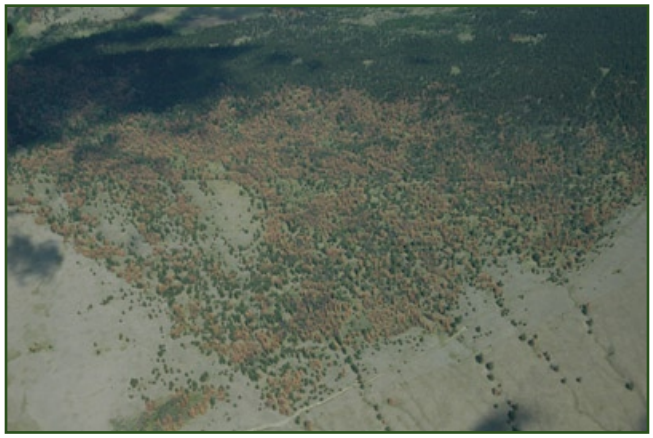
Cascades Forest District

Mountain Pine Beetle

Affected area has continued to increase substantially, with red attack mapped on 320,060 hectares, a 63% increase over 2006 totals. The average polygon size has remained relatively high, at 68 hectares. The number of spot infestations declined, from 668 (7,511 trees) in 2006 to 437 (4,790 trees) in 2007. Increased red attack was seen in nearly all areas of the Merritt TSA, especially in the Pimainus Creek, Gordon Lake, Shackan Creek, Prospect Creek, Coldwater River, Kingsvale, Otter Creek, Quilchena Creek, Siwash Creek, Nicola River, Swakum Mountain, and Surrey Lake areas. The Lillooet TSA also experienced widespread increases in red attack, especially in the French Bar Creek, Watson Bar Creek, and Yalakom River areas; smaller, scattered, but widespread pockets of red attack were also seen throughout the Relay Creek, Tyaughton Creek, Gun Creek, Hurley River, and Anderson Lake areas.

Red attack in young lodgepole pine stands was seen in the Glimpse Lake, Contant Lake, Rey Creek, Spius Creek, and Ketchan Lake areas.

Mountain pine beetle attack in ponderosa pine also increased, and was mapped on 14,068 hectares of the total reported area. Attack was seen throughout many low elevation areas of the District, with the most heavily impacted areas being near Chapperon Lake, Nicola Lake, Midday Creek, and Aspen Grove. Whitebark pine mortality was mapped on 2,527 hectares in the Stein River, Texas Creek, and Kwoiek Creek drainages.



Ponderosa pine attacked by mountain pine beetle near Chapperon Lake, Cascades Forest District.

Spruce Beetle

Spruce beetle mortality was mapped on 1,656 hectares in the District. Most of the affected atands continue to be in the Lillooet TSA, scattered throughout the Carpenter Lake, Anderson Lake, Cadwallader Creek, and Cayoosh Creek areas. A few areas of mortality were also seen in the Merritt TSA, in the Lawless Creek, Asp Creek, and Flat Top Mountain areas.

Western Balsam Bark Beetle

Western balsam bark beetle affected area increased slightly, from 14,132 hectares in 2006, to 16,316 hectares in 2007. The most widespread mortality was in the Siwash Creek, McNulty Creek, and Lodestone Mountain areas.

Douglas-fir Beetle

Douglas-fir beetle attack was mapped on 41 hectares, down from 118 hectares in 2006. The number of spot infestations increased, from 19 (175 trees) in 2006, to 45 (640 trees) in 2007. Attack was scattered in small isolated pockets, although a few larger areas of red attack continued to be seen in the Big Bar and Watson Bar areas.

Western Spruce Budworm

Many af the lower elevation, hot, dry sites experienced significant larval mortality during the early spring larval dispersal period, and subsequently experienced reduced defoliation levels. At the same time, populations expanded in many higher elevation mixed species stands (spruce, pine, and Douglas-fir). Defoliated area declined slightly, from 240,034 hectares in 2006, to 196,890 hectares in 2007, but populations are still generally high and widespread throughout most of the District. Populations are expected to remain high throughout much of teh District in 2008

A spray program was conducted on June 22, 2007 in the Pothole Creek area to control budworm populations, and to protect stands from further damage. Area sprayed totalled just over 2,800 hectares.

Other

Other forest health factors included 5 hectares of satin moth and 414 hectares of wildfire.

Western spruce budworm defoliation in the Yalakom River area, Cascades Forest District.

Okanagan Shuswap Forest District

Mountain Pine Beetle

Infested area continued to increase, up from 118,943 hectares in 2006, to 153,352 hectares in 2007. 40% of all mapped areas continued to be classified as moderate or greater severity. Red attack increased throughout the west central portion of the District, in the Equesis Creek, Nicola River, Powers Creek, Trout Creek, and Trepanier Creek areas; an increase in the number of smaller, scattered infestations was also seen in much of the southern portion of the District. Mortality continued to be widespread throughout most of TFL 49, the Aberdeen Plateau, the Shuswap, north Okanagan, and the east-central part of the District.

High levels of red attack were seen in young pine plantations in the Weyman Creek, Paxton Valley, Charcoal Creek, Bolean Creek, and Gleneden areas.

Fall and burn site, Ellison Provincial Park, Okanagan Shuswap Forest District.

Ponderosa pine mortality resulting from mountain pine beetle attack also increased substantially , and was mapped on 8,568 hectares mainly in the Monte Lake, Westwold, Silver Creek, Whiteman Creek, and Fintry areas. In March of 2007, the Ministry of Forests, in-cooperation with B.C. Parks, completed single tree removal of more than 500 mountain pine beetle - attacked Py trees in Ellison Provincial Park. The primary objectives of the work was for beetle population control, fuel reduction, and to address safety concerns.

The Ministry of Forests is also working cooperatively with the Ministry of Tourism to address bark beetle issues in many of the District's priority recreation sites. Both fall and buck, and/or fall and burn recommendations are being carried out by the District's fall and burn contractor who is also working on non-recreation fall and burn areas.

Douglas-fir Beetle

Douglas-fir beetle infestations continue to be scattered through the District, mostly in smaller isolated pockets. Higher levels of mortality were seen in the Mission Creek, Shuttleworth Creek, Darke Creek, Ashnola River, and Humamilt Lake areas. Affected area totalled 59 hectares, with a further 885 treees killed in 87 spot infestations.

Severe mountain pine beetle - caused mortality at Bryden Lake, Okanagan Shuswap Forest District.

Spruce beetle attack in Cathedral Park, Okanagan Shuswap Forest District.

Spruce Beetle

Spruce beetle mortaility increased substantially in the Cathedral Park, Snowy Protected Area, and Trapper Lake areas. Smaller areas were also seen in the North Queest Mountain, Celista Mountain, and Seymour River areas. Mortality was mapped on 5,874 hectares, up over 5-fold from 2006 levels of 1,020 hectares.

Western Balsam Bark Beetle

Western balsam bark beetle is still common in the District, and was mapped on 71,992 hectares. The most widespread areas of mortality were in the Greystokes - Buck Hills area; other large areas of mortality were in the Hunters Range, Park Mountain, Winnifred Creek, Headwaters Lakes, Greyback Lake, Tahaetkun Mountain, and Pukeashun Mountain areas. Most of these areas have been experiencing on-going mortality for several years.

Western Spruce Budworm

Budworm populations continued to expand in the District. Defoliation was visible in all areas where it was observed in 2006, and as well appeared in several new areas - Equesis Creek, Whiteman Creek, Trout Creek, Orofino Mountain, and Mount Kobau. Affected area totalled 29,630 hectares. Populations are expected to increase in most of these areas in 2008.

Western Hemlock Looper

No defoliation was seen, and both moth trapping and larval 3-tree beating results indicate that populations are low. No defoliation is expected in 2008.

Other

Minor damage was caused by 200 hectares of wildfire, and by 7 hectares of scattered windthrow. Incidence of cedar flagging increased in the District this year, however this was only picked up by ground reconaissance by the District Forest Health staff, and was not captured by the overview surveys.

Cedar flagging in the Bobbie Burns area, Okanagan Shuswap Forest District.

Headwaters Forest District

Mountain Pine Beetle

Mountain pine beetle continues to expand in the District, with overall affected area up from 157,648 hectares in 2006, to 233,230 hectares in 2007. In the Robson Valley TSA of the Headwaters Forest District, populations have expanded throughout most of the areas along the Fraser River, from McBride south to Mount Robson Park, and in the Raush River, Cedarside, and Canoe Reach areas. The highest levels of red attack were along the Fraser River near Dunster, McKate Creek, and McBride, and also in the Raush River and Castle Creek areas. In areas along the Alberta border, such as the Hugh Allen River, Renshaw Creek, Morkill River and Holmes River drainages and Mount Robson Provincial Park, the beetle is showing only moderate increases, and in many cases area and severity of red attack has declined. Control efforts appear to be working effectively to inhibit population expansion into Alberta. In the south, increases in both overall area affected and severity of red attack were widespread, especially in the TFL #18, Raft River, Mad River, Reg Christie Creek, Adams Lake, Cayenne Creek, and Stevens Lakes areas. Large areas of red attack are still being seen throughout southern Wells Gray Park and in and around Clearwater. Red attack was seen in several pine plantations near and in TFL #18. Attack patterns in the south tend to be more scattered but of a higher severity level than in the north - half of the affected area was classified as moderate or higher red attack; in the Robson TSA, only 15% of affected area was classified as moderate or higher.

Red attack was observed in young pine plantations in the Mann Creek and Coldscaur Lake areas on T.F.L. #18, and in the Axel Creek area.

Western Balsam Bark Beetle

A general increase in trace level red attack in the northern areas of the District, especially in the drainages east of the Fraser River, Mount Robson Park, Canoe Reach, resulted in an overall increase in affected area, from 50,588 hectares in 2006, to 90,240 hectares in 2007. Nearly all of the mortality in the District was classified as Trace or Light. Although scattered mortality is still widespread in the south, an overall decline was seen, especially in the Murtle Lake, Avaola, Adams River, and Cayenne Creek areas.

Spruce Beetle

Spruce beetle populations continue to decline in the District. Mortality was seen in the Dawson Creek,Cedarside, and Gollen Creek areas, totalling 559 hectares. No new mortality was seen in the Wells Gray Park area, where several years of attack have resulted in high levels of standing dead spruce.

Douglas-fir Beetle

Douglas-fir beetle remains at a low level in the District. 205 hectares of trace attack were mapped in the Dawson Creek drainage, and occasional small spot infestations were mapped in the Mahood Lake and Dunn Peak Park areas.

Two-Year Cycle Budworm

Despite 2007 being an "off" year in this insect's feeding cycle, light defoliation was mapped on 3,094 hectares, in scattered pockets throughout Wells Gray Park, and in the upper Raft River and Thunder River drainages.

Western Spruce Budworm

Just over 620 hectares of light defoliation was visible in the Blackpool and Mount MacLennan areas. This is the first time that defoliation from the budworm has been mapped in the District since 1989.

Western Hemlock Looper

Moth catches at the 6 permanent 6-trap pheremone baiting sites in the District were low, catching an average of 20 moths/trap. No defoliation was seen.

Dothistroma Needle Blight

Dothistroma needle blight (*Dothistroma septosporum*) was observed causing damage to a small (8.2 hectare) lodgepole pine plantation approximately 25 kilometers south of Blue River. A reconnaissance flight conducted by Regional Pathologists in June of 2007 identified several sites where lodgepole pine was being damaged, in the Holmes River, Castle Creek, Kinbasket Lake, and North Thompson River areas. Little of this damage has been observed during the aerial overview surveys, as it is very difficult to identify from the elevation at which the surveys are conducted.

Other

1,549 hectares of wildfire was recorded in the District in 2007, including a 465 hectare fire on TFL #18 and a 375 hectare wildfire in the Goat River area. Fir-fireweed rust (*Pucciniastrum epilobii*) was prevalent on subalpine fir in a few plantations on TFL #18. This rust affects current year's growth and commonly affects true firs when the alternate host (fireweed) is in close proximity.

Fir-fireweed rust, Headwaters Forest District.

Cariboo Area Summary

The Cariboo portion of the aerial overview surveys began on July 18 and finished August 23. Two contract crews surveyed the area encompassed by the Quesnel, Central Cariboo, 100 Mile House and Chilcotin Forest Districts as well as the Robson Valley TSA portion of the Headwaters Forest District. A total of 182.9 hours of aircraft time was expended to map this area, which included a portion of the Mid-Coast Forest District in the Coastal Forest Region. Approximately 12 hours was spent flying portions of the Coastal Region. Due to the relatively early start, crews were able to complete most of the surveys before the onset of poor weather conditions in August. Surveys were conducted by contract personnel (Joe Cortese, Don Wright, Mikko Sapponen, and Bob Erickson) and utilized Cessna 180, 185, and 206 aircraft.

Quesnel Forest District

Mountain Pine Beetle

Overall infested area in the District has remained nearly unchanged since 2005, at 1,183,306 hectares. Red attack levels have declined sharply in most areas, however, as host material has become depleted. The proportion of the total area classified as severe or very severe has fallen from 46% in 2005, and 28% in 2006, to just 11% in 2007. Despite the generally declining population levels continuous unbroken red atack was still recorded over most of the central and western areas of the District, and widespread areas of severe red attack were mapped in the upper Chilcotin and Baezaeko River drainages, and in the Toil Mountain area. Moderate red attack is widespread across the entire western half of the District. All of the 363,000 hectares of trace attack, occurred in stands which had been nearly depleted of host material during previous years.Younger age class pine is being impacted severely in many areas, and mortality in plantations or other pine stands under 40 years of age was observed throughout the central and eastern areas of the District. Area affected totalled just over 40,000 hectares; 35% of this was classified as severe or very severe.

Extensive grey attack, Quesnel Forest District.

Extensive red attack in a 40-year old lodgepole pine stand, Quesnel Forest District.

Spruce Beetle

Spruce beetle was mapped on 1,600 hectares in the District, mostly in the Benson Lake area. This is down sharply from over 28,000 hectares in 2006. However, ground surveys indicate that spruce beetle is much more extensive than detected from the air. Scattered windthrow has been occurring for several years throughout the eastern part of the District, and has contributed to the buildup of spruce beetle populations.

Douglas-fir Beetle

A significant increase in trace and scattered spot infestations of Douglas-fir beetle was noted in the Fraser River corridor, particularly in the Charleston area, and in the area between Kersley and Marguerite. No mortality was noted in previously infested areas in the Victoria Creek, Black Stuart Mountain, and Wells areas. A total of 7,7561 hectares of mostly trace attack and 88 spot infestations (1,380 trees) were mapped.

Western Balsam Bark Beetle

Trace infestations increased significantly, especially in the Willow River, Beaver Pass, Swift River, Little Swift River, and Wells areas. Total area affected increased by 2.5-fold, from 40,650 hectares in 2006, to 104,481 hectares in 2007.

Two-year Cycle Budworm

Light defoliation was mapped on 4,593 hectares near Wells. This low level of defoliation was expected, as 2007 was an "off" year in the feeding cycle of this insect. However, low levels of defoliation were detectable on the ground in many spruce/subalpine fir stands in the eastern Cariboo. Higher levels of defoliation are expected in 2008, as the second year larvae inflict more damage.

Other

Scatterd areas of windthrow in the Swift River area (totalling 398 hectares), and 292 hectares of wildfire, were also recorded.

Central Cariboo Forest District

Mountain Pine Beetle

Total red attack area has peaked in the District, and totalled 843,690 hectares, up slightly from 2006 levels of 815,000 hectares. Mortality rates increased substantially in the southwest end of the District, especially in newer areas of infestation, at mid to high elevations in the Black Dome Mountain, Churn Creek, Dash Creek, Big Creek, Groundhog Creek, and Bambrick Creek areas. Red attack rates declined to trace levels on nearly 400,000 hectares throughout the central portion of the District, where stands had been nearly depleted of host material during previous years. Despite this general decline, large areas of moderate or greater mortality were still mapped in the Little River, Moffatt Lakes, McKinley Creek, Tautri Lake, and Owen Lake areas. Attack remains nearly continuous over large areas of the District, but it is expected that overall area will begin to drop in 2008.

Mortality in young pine was evident throughout the central areas of the District, especially in areas where available host material has become limited and beetle populations are still high.

Western Balsam Bark Beetle

Total area affected by western balsam bark beetle more than doubled, from 29,000 hectares in 2006, to 68,891 hectares in 2007. Most of the expansions were in the Quesnel Lake and upper Horsefly River areas, and over 90% of all area was classified as trace.

Douglas-fir Beetle

Populations are very active throughout much of the District, and total affected area increased to 47,760 hectares in 2007, from 40,032 hectares in 2006. A large number of new spot infestations were mapped in many areas, including Beaver Creek, Big Lake, Horsefly, Meldrum Creek, and Sheep Creek. The number of spot infestations more than doubled, from 202 (2,460 trees) in 2006, to 542 (8,326 trees) in 2007. Mortality also expanded in the Farwell Creek and Dog Creek areas. There was a general decline along the Fraser River north of Sheep Creek, but significant levels of mortality were still mapped in the area. Decreased attack was also noted in the Williams Lake, Chimney Lake, and 140 Mile House areas.

Spruce Beetle

Overall infested area has decreased by 50%, from nearly 30,000 hectares in 2006, to 14,411 hectares in 2007. Most of the decrease in area was in the upper Horsefly River and Quesnel Lake areas. At the same time, infestations in the upper McKusky Creek expanded and nearly 2,200 hectares of severe mortality was mapped in this area. Some of the damage may be due to mountain pine beetle attacking spruce in mixed stands. Ground surveys have indicated that spruce beetle is much more extensive than detected from the air.

Western Spruce Budworm

Although budworm populations are still generally high and damage remained widespread, defoliation intensity and area has declined significantly in the Meldrum Creek, Riske Creek, and Chimney Lake areas. Defoliation expanded in the Empire Valley and Lone Cabin Creek areas. Only 11% (24,750 hectares) of the total mapped area of 224,145 hectares was classified as moderate or severe defoliation.

A spray program was conducted in June 2006 to control budworm populations in the Bald Mountain and Gaspard Creek areas; for details refer to page12 of this report. In 2007, the most severe areas of defoliation are expected to be in the Meldrum Creek, Riske Creek, Farwell Creek, Gaspard Creek, and Highway 20 corridor areas. Light defoliation is expected to occur throughout the Dog Creek, Alkali Creek, Chimney Lake, and Pine Valley areas.

Other

Other forest health factors observed in the District were 100 hectares of windthrow near Moffat Lake and Potato Mountain, and 680 hectares of wildfire.

Chilcotin Forest District

Mountain Pine Beetle

Infestations have continued to intensify in nearly all areas of the District, and nearly 75% of all attack was classified as moderate or greater. The beetle also expanded into previously uninfested or lightly infested areas in the Klinaklini River, Mosley Creek, Tatlayoko Lake, Homathko River, Chilko Lake, and Taseko Lake areas. The most severe infestations were in the Itcha Ilcatchuz Park, Satah Mountain, Towdystan, Palmer Lake, Stum Lake, and Tete Angela Creek areas. Total affected area was 1,491,455 hectares. Attack in young pine was noted mostly in the Mt. Alex Graham area.

Extensive mountain pine beetle red attack in the headwaters of Big Creek, Chilcotin Forest District.

Scattered red attack resulting from an influx from nearby heavily attacked areas, in the headwaters of the Klinaklini River, Chilcotin Forest District.

Western Balsam Bark Beetle

Infestations were mapped on 15,868 hectares, in scattered mountain drainages in the southwest portion of the District. Intensity of attack increased slightly, with 42% of all area classified as light.

Spruce Beetle

Spruce beetle continues to have little impact in the District, and was mapped on only 180 hectares, in the Colwell Creek, Mosley Creek, and Farrow Creek areas.

Grey attacked lodgepole pine in the Chilcotin Forest District.

Douglas-fir Beetle

Douglas-fir beetle mortality increased substantially in the District, with red attack being mapped on 10,515 hectares, up from just 2,631 hectares in 2006. An additional 88 spot infestations killed 1,700 trees. This increase was expected, as ground surveys in 2006 indicated that green attack levles were very high. Most of the beetle activity was along the Chilcotin River corridor, from the Central Cariboo boundary all the was west to Puntzi Lake, with the most severe infestations being in the Redstone - Alexis Creek area. Scattered mortality was also observed along the lower Taseko River, and in the Sapeye Lake and Tsuniah Lake areas. Chronic western spruce budorm defoliation has likely been a factor in the buildup of beetle populations.

Western Spruce Budworm

Defoliation continues to be widespread along the Chilcotin River corridor, and has now moved westwards all the way to Pyper Lake. Defoliation intensity was down in most areas, with almost 90% of all area being classified as light. Recovery in stands in previously defoliated areas has been notable, where successive years of *Btk* treatment have helped lower populations and prevent continued mortality and growth loss. Some moderate and severe defoliation was mapped in the Lees Corner and Alexis Creek areas. Total defoliated area was up slightly from 2006 levels, to 61,861 hectares.

Many stands in the area have been experiencing very high levels of defoliation for several years. Mortality is being observed in many areas, despite an aggressive direct control program, in which 21,560 hectares of high-priority stands were aerially treated with *B.t.k.* in June 2006 (for details refer to page 12 of this report). In 2007, moderate and severe defoliation is expected to occur in most areas along the Highway 20 corridor between Hanceville and Redstone.

Other

Satin moth lightly defoliated 30 hectares of aspen at the south end of Tatlayoko Lake, several small, scattered wildfires burned 53 hectares, and slide damage was mapped on 12 hectares in the Homathko River drainage.

100 Mile House Forest District

Mountain Pine Beetle

Overall infested area remained almost unchanged, at 725,136 hectares in 2007 versus 723,000 hectares in 2006. This demonstrates that mountain pine beetle is infesting virtually every pine stand in the District. However, the area of attack classified as moderate or higher fell from a high of 438,343 hectares in 2006, to 335,180 hectares in 2007, as severity levels began to drop throughout much of the northern and central areas of the District. This reduction in red attack levels is due to host depletion in areas previously sustaining high levels of attack. Severity levels increased substantially at higher elevations in the Deka Lake, Windy Mountain, and Hihium Lake areas, where many areas have progressed from trace or light in the previous year to severe or very severe this year. This rapid expansion at higher elevations is a clear example of the lack of climatic barriers to bark beetle populations as well as the powerful wave of immigration into these zones. Infestations continue to be severe throughout the Marble Range, Bonaparte Lake, Eagan Lake, and North Bonaparte areas..

Young pine suffered high levels of mortality throughout the District, especially in the Holden Lake, Murphy Lake, Boss Creek, Canimred Creek, and Campeau Creek areas.

Mortality in ponderosa pine, due to mountain pine beetle attack, increased throughout the Clinton, Bonaparte River, and Loon Lake areas, and was mapped on 16,760 hectares.

Douglas-fir Beetle

Douglas-fir beetle activity increased significantly, and was mapped on 9,774 hectares, up nearly 2.5-fold from 2006 levels of 4,112 hectares. The number of smaller spot infestations also increased dramatically, from just 26 (380 trees) to 226 (2,400 trees). Most activity was in the Fraser River, Big Bar Creek, Canoe Creek, Eagle Creek, Lac La Hache, Timothy Lake, Canim Lake, Clinton, Bonaparte Lake, and Young Lake areas.

Spruce Beetle

Mortality levels fell from 15,280 hectares in 2006, to 8,643 hectares in 2007. Most of the decline was in the Deception Creek, Spanish Creek, and McKinley Creek areas. The proportion of attack classifed as trace also increased to 70%. This reflects the fact that much of the infested area is suffering ongoing, chronic, low-level mortality.

Western Balsam Bark Beetle

All mortality continued to be confined to higher elevations in the northeast part of the District. Trace and Light attack was mapped on 19,233 hectares, up from 12,488 hectares in 2006. Most of the increases were in the Mt. Hendrix and Deception Creek areas.

Western Spruce Budworm

Budworm defoliation expanded by 30%, from 128,373 hectares in 2006, to 165,994 hectares in 2007. At the same time, the proportion of the total area classified as moderate or severe fell from 35%, to just 10%. This indicates that populations are expanding, but not yet intensifying. Egg mass sampling conducted in the fall of 2007 indicates that light to moderate defoliation can be expected again in 2008, in most areas.

Other

Two small windthrow patches near Big Timothy Mountain and Mount Hendrix covered 52 hectares, and wildfires burned 391 hectares, mostly in a large fire near Bowers Lake.

Special Projects/Updates

Summary Of 2005-2006 Bark Beetle Overwintering Mortality Estimates

Overwintering mortality sampling is conducted annually to provide an estimate of beetle population trends, and brood success and survival. A standard methodology for sample collection and evaluation is used, as referenced in the 2004 version of this report (available in .pdf format from <http://www.for.gov.bc.ca/rsi/ForestHealth/overview_reports/Overview_2004.html>). Two numbers are generated for each sample, the R-value and the % brood mortality. The R-value is a measure of the ratio of successful beetle progeny to initial attack rates, and is a good indicator of population trends. Any R-value greater that 4.0 indicates a generally increasing population. The % mortality is a direct measure of the brood mortality up until the time of sampling, which is usually conducted in March, after most winter mortality has occurred.

Mountain Pine Beetle

Mountain pine beetle brood mortality must reach annual levels of 97% in order for the population to decline significantly. Winter mortality usually accounts for the majority of annual brood mortality. Winter mortality rates below 70% have little effect on population growth rates. During March - May of 2007, extensive sampling for mountain pine beetle was conducted in all Districts, at a total of 159 sites. Of these, 27 sites were in young lodgepole pine stands (20-40 years of age).

Mountain pine beetle overwintering mortality rates were generally low in most areas, especially in the Merritt, Kamloops, and Clearwater areas. Mortality rates were above 60 % in most of the Kootenays (although still less than 70%), the Chilcotin, Quesnel, and young pine stands in some areas. R-values in mature pine were above 4.0 in all areas, except for most young pine stands. The most vigorous populations were in the Merritt TSA, which averaged 27% mortality, and an R-value of 13.8.

Due to intermittent cool, wet weather, the beetle flight period was delayed, and prolonged over several weeks in many areas of the Region in 2007. This resulted in increased adult mortality, and somewhat lower green attack rates. Late attack may have resulted in underdeveloped brood in some cases. However, in most areas, extremely high beetle populations would have made up for this, and the overall level of green attack was still very high. Updated spring 2008 overwintering mortality estimates will be available on the Southern Interior Region Forest Health webpage in April <http://www.for.gov.bc.ca/rsi/ForestHealth/MBB_updates.html>.

Douglas-fir Beetle

Sampling for Douglas-fir beetle was carried out in the Central Cariboo, Chilcotin, and 100 Mile House Districts (5 sites in each District). Larval mortality was quite high, and R-values were low in all areas (Table 2).

Table 1. Percent mortality of mountain pine beetle progeny during the winter of 2006-2007, with associated R-values.

District/TSA	# sites	# trees	% mortality	R-value
Quesnel - young pine only	5	50	86.7	1.7
Central Cariboo - mature pine	5	50	57.3	5.2
Central Cariboo - young pine	5	50	72.8	1.2
Chilcotin - mature pine	9	90	77.0	4.7
Chilcotin - young pine	3	30	97.9	0.3
100 Mile House - mature pine	10	100	52.5	6.1
100 Mile House - young pine	5	50	77.8	1.7
Headwaters (Robson Valley) - mature pine	9	90	59.7	6.5
Headwaters (Robson Valley) - young pine	1	10	78.5	1.2
Headwaters (Clearwater) - mature pine	14	140	41.4	9.1
Headwaters (Clearwater) - young pine	1	10	100.0	0.1
Arrow Boundary	7	66	65.5	7.5
Columbia	10	81	50.3	11.5
Kootenay Lake	5	51	62.3	9.8
Rocky Mountain	10	94	60.9	8.9
Lillooet TSA - mature pine	14	140	55.4	10.2
Lillooet TSA - young pine	1	10	48.7	6.3
Merritt TSA - mature pine	14	140	27.2	13.8
Merritt TSA - young pine	1	10	56.7	3.2
Kamloops - mature pine	11	110	43.7	8.1
Kamloops - young pine	4	40	64.3	2.3
Okanagan Shuswap - mature pine	13	153	49.0	4.6
Okanagan Shuswap - young pine	2	26	52.5	5.8
Totals/Averages	159	1,591	62.5	5.6

Table 2. Percent mortality of Douglas-fir beetle progeny during the winter of 2006-2007, with associated R-values.

District or TSA	# sites	# trees	% larval mortality	R-value
Central Cariboo	5	50	98.9%	2.5
Chilcotin	5	50	96.9%	3.4
100 Mile House	5	50	88.9%	2.3
Totals/Averages	**15**	**150**	**94.90%**	**2.7**

2007 REPORT ON THE IMPACTS OF MOUNTAIN PINE BEETLE IN YOUNG PINE

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The assessment of mountain pine beetle impacts to young pine continued in 2007. As predicted, the extent and severity of attack was more rapid and intense in the south as host resources became increasingly scarce. In 2007, polygon-specific aerial surveys were completed in ten Districts (2,211 polygons surveyed) including: Central Cariboo; Chilcotin; 100 Mile House; Quesnel; Nadina; Fort St. James; Headwaters; Kamloops; Cascades; and, Okanagan Shuswap. Other work included ground surveys in 7 Districts (264 polygons surveyed) and re-assessment of 24 permanent sample plots. Old spacing trials established in 1988-1995 to study the influence of density on pest incidence and impacts were evaluated in 2007. In addition to these surveys, 100 hectares of young pine was treated with verbenone flakes to protect trees from attack by mountain pine beetle. Since the initiation of this project in 2005, 5,073 separate polygons have been aerially surveyed - 4,295 have been surveyed once, 700 have been surveyed in 2 years, and 78 have been surveyed in all 3 years, for a total of nearly 6,000 separate aerial surveys completed. Figure 1 illustrates the the typical progress of attack in a young stand, from 2005 - 2007.

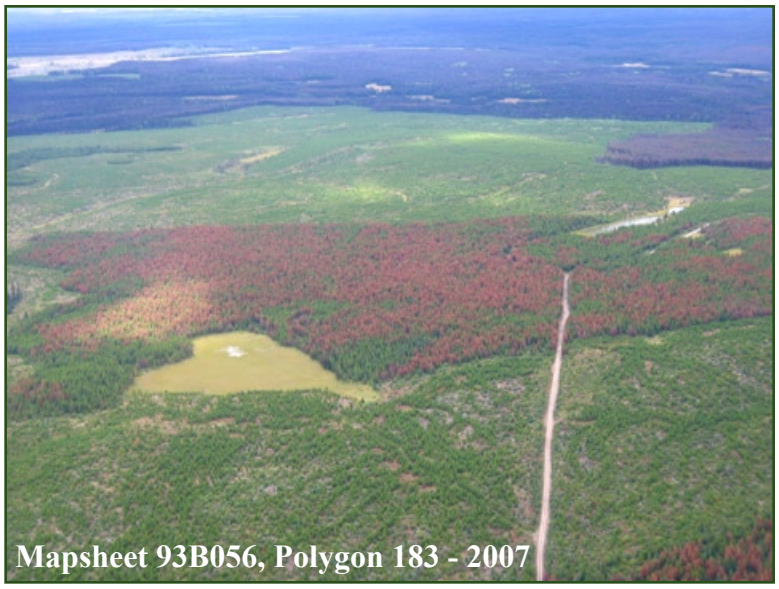

Figure 1. Photographs of young stands placed chronologically top to bottom to show progress of MPB attack from 2006-2007 (Quesnel Forest District).

Aerial and Ground Surveys

Since this project began in 2005, the number of young pine stands surveyed by air showing greater than 50% MPB attack (red and grey attack combined) increased substantially (Figure 2). In the 2007 aerial assessment over 83% of stands surveyed had some level of MPB attack, up from 49% in 2005. This represents 11% coverage of the target population (leading pine age 20-55 years) by area. In 2005, 4.3% of stands had >50% red attack whereas in 2007, 16.8% had >50% red attack and 25.2% of stands had >50% total attack (red and grey attack). The 2007 aerial assessments showed the highest in-stand attack and percent stands affected in the Kamloops, 100 Mile House and Quesnel Districts with an average of 47%, 42 % and 39% total MPB attack, respectively (Table 1). In Kamloops District, 39% of candidate stands were surveyed, by area (7,125 ha surveyed of a potential 18,500 ha) and 45% of these had >50% mortality (Figure 3).

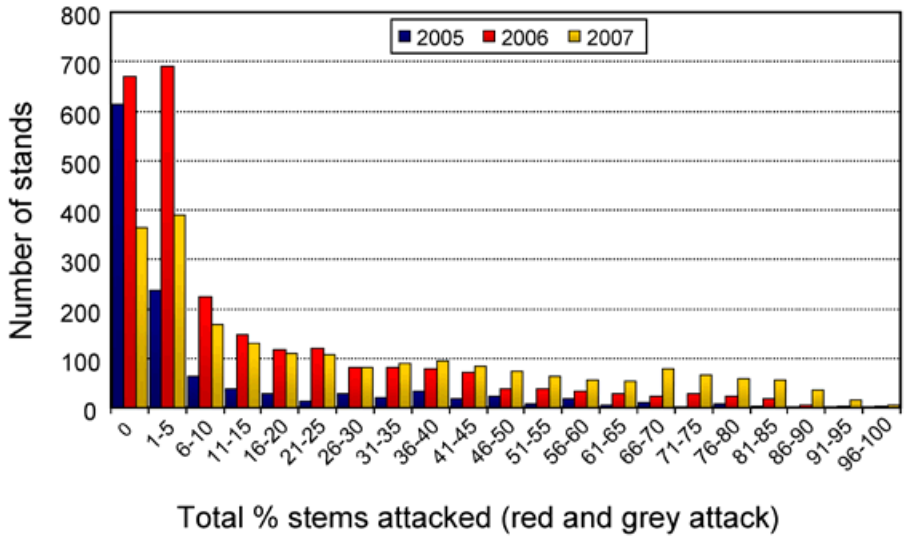

Figure 2. Number of aerially surveyed stands falling into each attack category in each of the three years surveyed, 2005-2007.

Table 1. Summary of 2007 aerial surveys of young pine stands, by District, showing number stands surveyed, average red attack and total attack (red and grey attack), and the percent stands affected of those surveyed.

Forest District	Hectares surveyed	# stands surveyed	Average of stands surveyed		
			% red attack	% total attack	% of stands affected
Central Cariboo	9,249	247	16.3%	29.1%	89.1%
Chilcotin	7,264	214	16.3%	29.1%	81.8%
Cascades	7,422	237	17.0%	19.6%	62.8%
Headwaters	2,558	93	7.0%	7.8%	68.8%
Fort St. James	2,857	172	10.9%	12.6%	61.6%
Kamloops	7,122	320	44.0%	47.4%	95.9%
100 Mile House	12,502	307	34.1%	42.2%	96.1%
Nadina	8,869	197	10.2%	14.5%	68.0%
Okanagan Shuswap	4,851	181	14.4%	15.5%	72.9%
Quesnel	10,324	220	29.2%	39.1%	95.9%

In the Kamloops District, the 2006 beetle movement from surrounding infestations was significant and as a result very high levels of tree mortality resulted in all age groups of young pine stands assessed. Over 90% of stands aerially assessed in 2007, in all age categories had some level of visible MPB attack (Table 2). Ground surveys in 40 stands showed MPB attack ranging from no attack to 92.9% green attack, with an average of 11.9% green attack (Table 3). In comparison, 2007 ground surveys in 100 Mile House District showed a range of zero to 100% green attack with an average of 34.4% green attack (Table 3). High levels of attack are predicted to continue in young stands within more southern Districts for at least another 2 years. Once MPB populations subside in surrounding mature stands and that host resource is depleted, the attack levels in young stands will also decline.

Attack in young stands is predominantly due to movement of beetles from surrounding mature stands. Beetle production from mass attacked young pine is low, therefore in years when there is no influx of beetles from the general outbreak population, only low levels of scattered attack is noticed in previously attacked stands. This low level MPB attack can most likely be attributed to within-stand beetle production. In stands with 5% red attack or less, tree mortality is not necessarily attributed to MPB (Figure 3) and may be due to other insects or diseases such as *Hylobius* or *Ips*.

In the Okanagan Shuswap District, the 2007 aerial surveys were only conducted in the core outbreak area of the district because the mature pine in the south and east portions of the Okanagan have not yet been as significantly impacted by the MPB. In comparison to Kamloops, far fewer stands 20-30 years had been affected by MPB. Many stands in this age range in the Okanagan fell into the 1-5% mortality range therefore suggesting some or all of the mortality noted could be due to factors other than MPB. Older stands in the Okanagan (40-55 year range), in close proximity to major outbreak areas had noticeably higher levels of MPB attack (Table 1). The overall impact to young stands in the Okanagan is predicted to be less severe than in Kamloops.

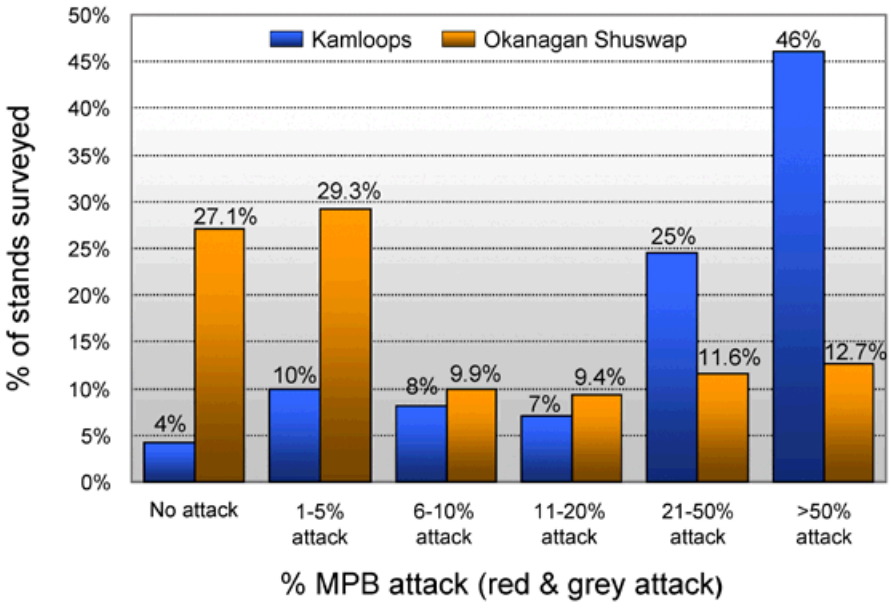

Figure 3. Results of 2007 aerial surveys in Kamloops and Okanagan Shuswap Districts showing total attack levels (grey + red attack) in stands surveyed, by attack increments. A total of 310 stands were surveyed in Kamloops and 181 stands in Okanagan Shuswap.

Table 2. Stands aerially surveyed in the Kamloops and Okanagan Shuswap Districts in 2007 showing number stands with and without MPB attack and average within stand attack (red and grey attack combined).

Age	# stands with no MPB	# stands with MPB attack	% stands with MPB attack	Avg. % attack in attacked stands
Kamloops District				
20-25	11	143	92.9%	37.9%
26-30	1	77	98.7%	58.2%
31-40	1	38	97.4%	63.6%
41-50	0	12	100.0%	46.8%
51-55	0	24	100.0%	53.4%
Okanagan Shuswap District				
20-25	22	60	73.2%	18.5%
26-30	17	39	69.6%	22.6%
31-40	6	22	78.6%	20.2%
41-50	3	7	70.0%	38.1%
51-55	0	3	100.0%	36.7%

Table 3. Summary statistics from ground surveys conducted in 7 Districts in 2007. For each district the average and maximum is shown for total MPB attack (old and new attack), diameter at breast height (DBH), percent 2007 and 2006 attack and percent old attack (attacked prior to 2006).

Forest District		Average DBH of Pl (cm)	Total % attack	% 2007 (green) attack	% 2006 (red) attack	% old (grey) attack
100 Mile House	Average	12.2	53.5%	34.4%	18.7%	0.5%
40 stands	Maximum	15.0	100.0%	100.0%	77.5%	4.5%
Vanderhoof	Average	14.4	48.3%	6.7%	22.2%	19.4%
22 stands	Maximum	19.6	87.2%	58.1%	76.1%	64.7%
Nadina	Average	15.4	17.4%	3.9%	10.2%	3.3%
40 stands	Maximum	20.8	86.3%	51.2%	57.7%	55.6%
Cascades	Average	13.8	7.1%	5.1%	2.3%	0.0%
40 stands	Maximum	16.4	68.2%	73.9%	36.0%	0.0%
Kamloops	Average	14.0	34.7%	11.9%	22.0%	0.1%
40 stands	Maximum	17.9	95.2%	92.9%	67.5%	4.8%
Okanagan Shuswap	Average	15.2	13.3%	3.8%	4.9%	4.7%
40 stands	Maximum	20.8	93.0%	56.3%	80.6%	88.7%
Central Cariboo	Average	12.3	35.7%	4.1%	20.7%	6.0%
42 stands	Maximum	19.3	51.0%	28.1%	63.0%	50.6%

Permanent Sample Plots

Twenty-four permanent sample plots (0.25 ha) established throughout the core mountain pine beetle outbreak area in 2005-2006 in young lodgepole pine stands were re-assessed in 2007. These plots were established to study mountain pine beetle attack behaviour, brood development and emergence success from young trees. The influence of other factors such as adjacent hazard and risk, treatment, density, and ecosystem were evaluated. The presence of *Ips* and other forest pests was recorded.

As with the 2006 assessment, location rather than any of the above attributes was most important, with respect to mountain pine beetle attack in these young stands. The total percent attack (green, red and grey) ranged from 0-91.9%. The southern portion of the Southern Interior Region had the highest level of current (2007) attack in the permanent sample plots (Table 4). Overall, attack levels have declined in 2007, from 2006 incidence. However, in the south, mountain pine beetle has not been in mature stands for as many years, and there is still plenty of risk to young stands.

The older plots (41-55 years) had the highest level of cumulative attack; on average, 85% of the plot trees were attacked (green, red, grey) (Table 5). The younger age classes were less affected; however, between 40-53% of the plot trees were attacked.

In 2007, as in 2006, attack densities were very high, ranging from 178-289 galleries/ m². Such high densities should not be conducive to successful mountain pine beetle development and emergence. In 2006, 16 of the 24 plots had between 10%-76% current attack. Successful emergence from these plots ranged from 15% to 91% in 2007, with 9 of the 16 plots having >50% emergence. Several of the stands were greatly affected by woodpecker activity in the spring, prior to adult (beetle) emergence, causing a decline in successful emergence. Larger diameter trees had greater emergence success than the smaller trees. Plots, which had very high levels of green attack in 2006, did not have much current attack this year. This result is similar to that seen in 2006, where those stands, which had significant levels of attack in 2005, did not have much in 2006. The beetles that successfully emerged from the plot trees did not remain in the stand.

In half the permanent sample plots assessed in 2007, over 45% of plot trees had some woodpecker activity. Woodpeckers frequently remove the bark when searching for insects. This in turn hastens the rate of decay in standing, dead trees. Sloughing and checking in dead trees due to mountain pine beetle has been visually assessed since 2006. Affected trees are degrading more rapidly in the wetter ecosystems than the drier sites. Some trees already have very large cracks down the bole (visible due to lack of bark because of the woodpeckers) and would be hazardous to remove from the stand.

Other bark beetles were also present in the plots and have contributed to tree mortality. *Ips pini*, *Hylurgops rugipennis*, and various twig beetles have been very active this year. In many cases, especially in the smaller trees, *Ips* and twig beetles have been more successful than the mountain pine beetle in causing mortality.

This project is ongoing and next year's assessment will add to our information regarding mountain pine beetle behaviour and tree degradation in young stands.

Table 4. Average percent total MPB attack in plots located in five Forest Districts (2005-2007).

Location	# of Plots	Average % attack 2007	2006	2005
Vanderhoof-Nadina	4	1.4	44.1	0
Prince George-Quesnel	6	1.1	13.7	15.5
Central Cariboo	5	1.6	6.5	26.7
100 Mile House	5	4.2	37.0	12.7
Kamloops-Okanagan	4	10.5	50.4	2.8

Table 5. Average annual percent MPB attack and cumulative attack in permanent sample plots, categorized by stand age.

Stand Age	# of Plots	Average % attack 2007	2006	2005	Cumulative 2005-2007
20-25	6	0.2	19.1	21.3	40.6
26-30	10	4.9	40.9	4.2	50.0
31-40	5	4.0	19.6	27.3	52.8
41-55	3	4.2	18.5	28.3	85.0

Long-Term Spacing Trials

From 1988-89, four spacing trials were established in young pine stands throughout the southern interior to monitor and assess pest damage. In the Monte Creek, Stump Lake, Riske Creek and Daves Creek trials, 3 spacing regimes (2.0 m, 2.5 m and 3.0 m) and unspaced controls were set up in a 4 x 4 randomized block design. Each treatment block was 50 m x 50 m. In 1995, another trial was established on TFL 15 using the same design. The trials were assessed in 2007 for pest incidence, damage and other parameters. Only TFL 15 had no MPB attack, although attack levels were low in Riske Creek and very low in Daves Creek. MPB attack was very high in the Monte Creek and Stump Lake trials with attack in the 3.0 m spacing regimes averaging 83.5% and 47.1%, respectively (Table 6). Percent stems attacked were strongly correlated with density. The average percent stems attacked was significantly less in the unspaced controls than the lower density treatment blocks (Tables 6 and 7). Figure 4, showing an aerial view of the Monte Lake trial overlaid with the treatment blocks, clearly illustrates the effect of density.

Figure 4. Aerial view of Monte Lake spacing trial overlaid with block layout illustrating the lower levels of MPB attack in unspaced control blocks.

Table 6. Average MPB attack in five spacing trials, by spacing regime.

	Ave. % pine attacked				
	Monte Cr.	Stump Lake	Riske Cr.	Daves Cr.	TFL 15
2 m	75.7	23.7	0.8	0	0
2.5 m	72.2	41.1	2.7	0.6	0
3.0 m	83.5	47.1	3.1	0	0
No spacing	18.4	12.6	0	0	0
Average	38.5	22.2	0.9	0.1	0

Table 7. Average stem density (stems per ha) in five spacing trials, by spacing regime.

	Average density (stems per ha)				
	Monte Cr.	Stump Lake	Riske Cr.	Daves Cr.	TFL 15
2.0 m	1,935	1,940	2,425	1,033	1,129
2.5 m	1,330	1,495	1,690	795	1,101
3.0 m	1,000	1,210	1,145	805	795
No spacing	8,025	6,350	6,300	4,975	9,401

2007 Verbenone Flake Trial

Verbenone flakes were aerially applied to 100 hectares of 25 year old lodgepole pine on June 28, 2007, to assess the efficacy of this product in protecting stand from MPB attack. Five treatment blocks, each 20 ha, and 5 control blocks were selected on the basis of having less than 8% 2006 attack and with moderate adjacent MPB pressure. Each of the 10 blocks contained a baited Lindgren funnel trap that was monitored weekly for beetle flight. The verbenone was applied at 6.7 kg/ha (15% a.i. by weight; 1,000 gm a.i. per ha) using a Hiller 12E helicopter equipped with a spreader. The verbenone flake formulation was efficient to handle and a very even coverage was attained (Figure 1).

Assessments consisted of the following:

-Weekly trap catch collection
-10 strip plots, 3 m x 10 m per block
-5 variable radius plots per block to assess attack status & tree statistics (diameter, etc.)
-Star-probe at each trap: 3 metre width in each of the cardinal directions to determine trap influence

All trees greater than 10 cm DBH were assessed, and all MPB attack was recorded (regardless of tree size).

Tree size was not significantly different between blocks with average pine dbh in the control vs. treatment blocks 12.9 cm and 12.8 cm, respectively (Table 2). All assessments showed significantly fewer successful mass attacks by MPB in treated blocks compared to untreated blocks (Tables 1 and 2). Attack was highest around funnel traps in both treated and untreated blocks but on average was more contained in treatment blocks (Figure 2). There was no significant difference in trap catches among blocks except for a late catch in the Control-2 block (Figure 3). Beetles were flying from mid-July through September but the peak flight occurred in mid- to late August (Figure 3). Traps were taken down in September due to very cold weather and minimal beetle activity. In summary, the verbenone flake treatment showed favourable results, but since the 2007 MPB pressure was much less than experienced in 2006 it is questionable whether this treatment would protect stands from more severe beetle pressure.

Table 1. Strip surveys results of verbenone flake trial showing number pine and categories of MPB attack in each control and treatment block (average of 5 control blocks and 5 treatment blocks).

	Number of trees	
	Control blocks	Treatment blocks
Healthy Pl	1390	1601
MPB mass attack	118	15
Unsuccessful MPB attack	12	16
Old MPB & other	52	7
Other species	176	172
Average % successful 2007 MPB attack	7.8%	0.9%

Table 2. Summary from circular plots assessed in the verbenone flake trial showing, by treatment block, average pine diameter at breast height (DBH), percent healthy pine, percent with successful 2007 MPB attack, percent with old MPB attack and percent pine dead from mortality agents other than MPB..

		Pine status (% of Pl stems)			
Treatment Regime	Average DBH (cm)	Healthy	2007 Successful MPB Attack	Old MPB Attack	Dead (other causes)
Control-1	13.3	92.0%	0.0%	6.0%	2.0%
Control-2	14.9	56.4%	12.8%	30.8%	0.0%
Control-3	12.3	98.2%	1.8%	0.0%	0.0%
Control-4	11.9	79.0%	21.0%	0.0%	0.0%
Control-5	12.4	100.0%	0.0%	0.0%	0.0%
Average	12.9	85.1%	7.1%	7.4%	0.4%
Treatment-1	13.5	100.0%	0.0%	0.0%	0.0%
Treatment-2	13.8	100.0%	0.0%	0.0%	0.0%
Treatment-3	11.5	100.0%	0.0%	0.0%	0.0%
Treatment-4	12.2	100.0%	0.0%	0.0%	0.0%
Treatment-5	13.1	88.9%	4.4%	6.7%	0.0%
Average	12.8	97.8%	0.9%	1.3%	0.0%

Figure 1 Verbenone flake distribution in a treatment block.

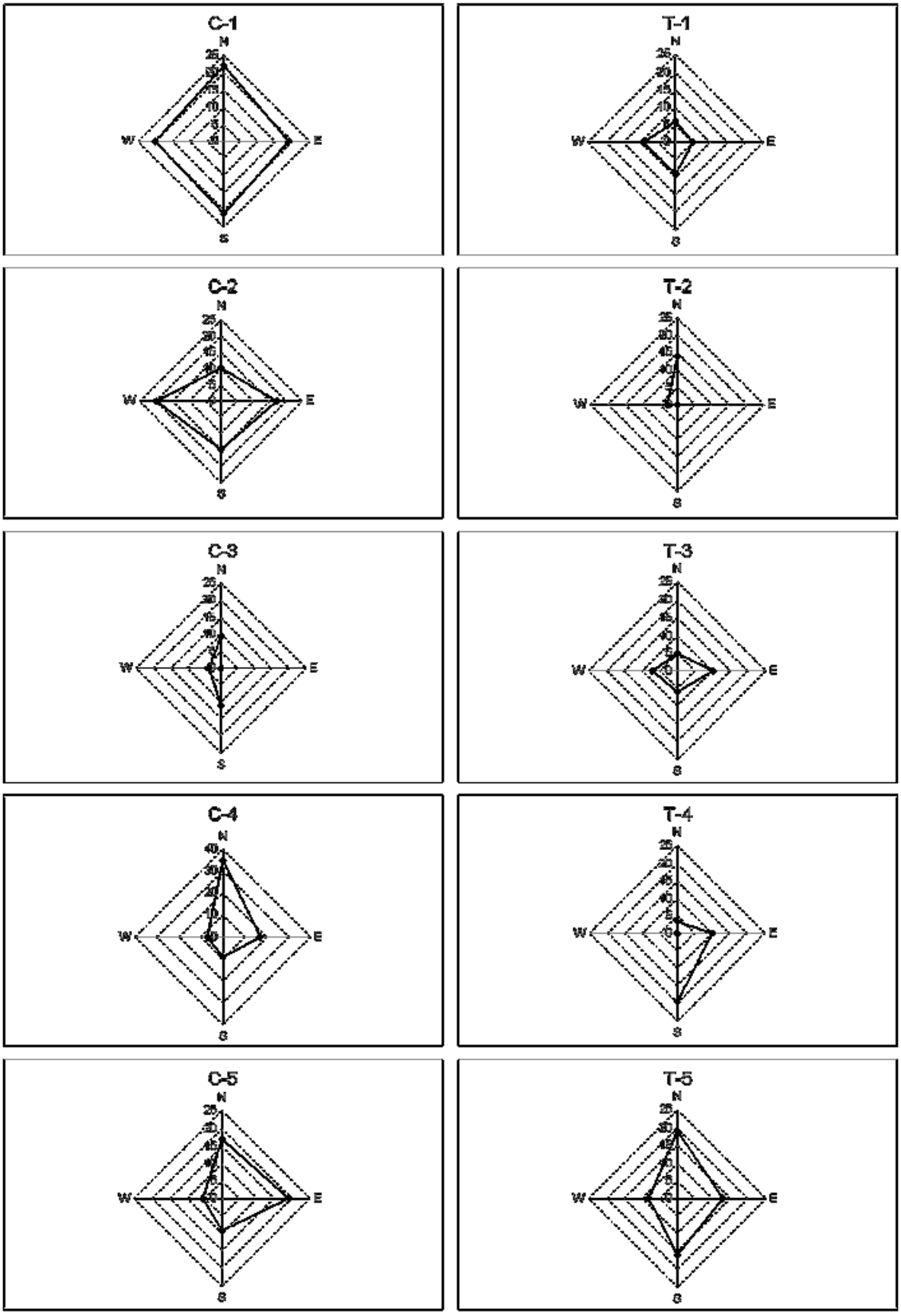

Figure 2. Area of MPB attack around Lindgren funnel traps in untreated control blocks (left column) and treated blocks (right column).

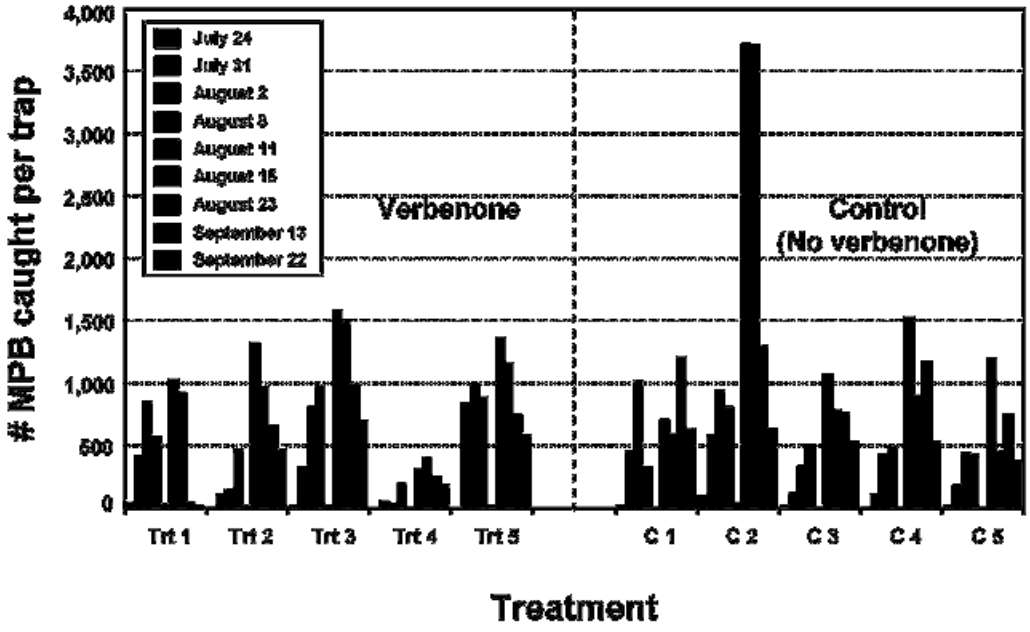

Figure 3.Number of mountain pine beetle caught in traps in 5 treatment and 5 control blocks on 7 sampling dates July 24- August 23, 2007.

Hiller 12E helicopter equipped with spreader for verbenone application.

Single Tree Systemic Injection Trial Using Emamectin Benzoate and Fipronil for Protection of Lodgepole Pine From Mountain Pine Beetle

Leo Rankin, Forest Entomologist
Southern Interior Forest Region, Williams Lake, B.C.

During the fall of 2005 and the spring of 2006, trials were established to test the efficacy of emamectin benzoate (EB) and fipronil (Fip) to protect lodgepole pine trees from successful attack by mountain pine beetle. Trees were selected and injected at the base with an Arborjet Tree IV injection pump system. The experimental site was located approximately 25 km east of 100 Mile House in the 100 Mile House Forest District. The site was located around 2050 metres elevation in the SBSdw1 biogeoclimatic zone. Trees between 18.2 and 39.1 cm DBH were injected at the base. The average tree diameter injected was 26.6 cm DBH. Three tree groupings were selected at 25 meter spacing including a non-treated control tree, an EB injection tree and a Fip injection tree. The average uptake of the injected chemical was approximately sixty minutes during a tree injection. The trees were assessed for beetle attack in early August and it was determined that no aggregation baiting was required to initiate attack as most trees were mass attacked.

The injected systemic insecticides were assessed for post mountain pine beetle attack survival in October 2007. Virtually all trees in the trial including controls were attacked heavily and suffered high mortality. The assessments indicated that neither EB or Fip provided adequate protection to prevent mortality from mountain pine beetle. Both the Fall and Spring injections exhibited high mortality. For EB, mortality was 93% and 95.4% mortality for Fall and Spring injections respectively. In the Fip treatments, mortality was 93% and 100% mortality for Fall and Spring injections while controls had 96% and 100% mortality. Surviving or non-attacked trees were always in the small diameter classes which are least attractive to mountain pine beetle, generally more vigorous and resistant and capable of surviving beetle attack.

It appears there was some treatment effect demonstrated by the Fall injection although the trees were almost all killed. The success under the bark did not appear to be as high in the EB injections and there was far less woodpecker activity on the EB trees. The control trees had immense amounts of woodpecker bark removal and the Fip trials were intermediate in woodpecker activity. It is hypothesized that EB injections (and to a lesser extent Fip) inhibited brood development and beetle survival but the beetle attack still resulted in enough fungal inoculation to kill the trees. At this time we are considering the establishment of another trial to test a new EB-fungicide formulation which may limit blue stain fungi while controlling the beetle.

Possible drought effects in the Kootenay-Boundary, south-east BC.

Art Stock, Forest Entomologist
Southern Interior Forest Region, Nelson, B.C.

No systematic assessment of possible drought damage has been done in south-east CB, however, there are several symptoms that appear to be drought related. Stressed cedars are appearing in large numbers in the southern part of the ICH in the Kooteny-Boundary. Normal "winter flagging" has been occasionally severe, and dead tops or tree mortality are common (Figure 1).

Figure 1. Dead and dead top cedars, Kootenay Lake District.

Douglas-fir on ridges and steep slopes (especially SW slopes) appear to be supporting a "high endemic" population of Douglas-fir beetle, which is killing groups of apparently stressed standing live trees. This is occurring from the east side of Lake Koocanusa into the Boundary TSA. This presents a problem if some other event such as a windstorm creates significant habitat for larger populations to develop. Such an event occurred in Rocky Mountain and Kootenay Lake Districts in mid July of 2007. As noted elsewhere in this report there was a severe weather event that moved from Creston north through Cranbrook causing significant windthrow damage. Areas around Creston, the Goat River system, and Kid Creek north to Cranbrook were hardest hit. A total of 224 hectares in Kootenay Lake District, and 303 hectares in Rocky Mountain District were mapped, but some scattered unmapped blowdown also likely occurred. (This windstorm also knocked down spruce in riparian zones and ponderosa pine in other areas. This creates potential population increases of spruce beetle and western pine beetle populations, respectively).

Chronic birch decline, widespread in south-east British Columbiat has sometimes been ascribed to drought impacts, perhaps including ubiquitous occurrence of leaf miner species, which has been observed but not systematically assessed.

Finally, mountain pine beetle populations appear to have more success attacking drought stressed trees. It is now common for beetle attacked trees to show no symptoms, i.e. "pitch tubes", during years of below average precipitation.

Pathology Update

Needle Diseases

Dothistroma (red band) needle blight (*Dothistroma septosporum*) infects lodgepole pine needles of all ages throughout the growing season whenever environmental conditions are suitable for sporulation and infection. Damage can be severe in areas experiencing mild, wet weather.

An overview flight was conducted in the northern portion of the Headwaters District to examine the extent of Dothistroma in stands of lodgepole pine. Most severely affected areas were Castle Creek and the Upper Holmes River drainage southeast of McBride. The Holmes River drainage was also the locale for a number of other foliar pathogens on young planted host species including *Rhabdocline pseudotsugae* and *Phaeocryptopus gaeumannii* on Douglas-fir and *Meria laricis* on western larch.

In a selected number of stands of lodgepole pine found along the north end of Kinbasket Lake, 70-80% of trees were severely blighted with about 1 year foliage retention. On the east and west side of the North Thompson River, north of Blue River, about 20% of trees in stands of lodgepole pine were severely blighted. Future monitoring of Dothistroma will be essential, particularly for areas like the Robson Valley that may experience increases in summer precipitation indirectly associated with climate change, which will likely benefit the development of foliar pathogens.

Dothistroma needle blight on Western white pine:
Observations on planted white pine (Idaho-resistant stock) from a variety of sites in the Okanagan Shuswap, Arrow Boundary, Columbia, and Kootenay Lake Forest Districts revealed unique host reactions on trees infected with *Dothistroma septosporum*. Symptoms include small (5-10 mm) resinous lesions in the bark at the base of needles showing characteristic banding and fruiting bodies of *D. septosporum*. Necrosis in bark ceases following the formation of a secondary periderm. Frequently, several circular lesions on the main stem amalgamate to form what appears to be a larger stem canker. No fruiting was observed on any circular depressions in the bark. A first report summarizing observations of Dothistroma on western white pine is currently being written for Northwest Fungi.

Dothistroma septosporum infection on western white pine Idaho-resistant stock in the Adams Lake area, Headwaters Forest District.

Atropellis Canker

Field observations from juvenile (>25 year-old) stands in the Columbia, Okanagan and Kamloops Forest Districts suggest that *Atropellis piniphila* is having an, as of yet, unquantifiable impact on lodgepole pine post-free growing. Such observations are supported by data obtained from the Okanagan TSA Effectiveness Evaluation study investigating whether stands are currently meeting timber productivity expectations (unpublished). Atropellis canker is rarely observed on pine before about the age of 20 and therefore is not easily detected in a free-growing survey. Stem deformation, resinosus and black stain reduces the quality of the wood and lumber recovery. More surveys are needed to quantify the incidence and severity of Atropellis in pine and its associated impact on timber supply.

Sunken, resinous lesion on stem caused by Atropellis piniphila.

Phellinus Root Disease

Special Project: FSP-FIA Y081130. Distribution and Incidence of Phellinus root disease in the Southern Interior Region:
Phellinus sulphurascens (syn. *P. weirii*), the cause of Laminated root disease, is known to occur across a variety of BEC zones in the SIFR causing mortality and growth loss in natural and planted stands of Douglas-fir and predisposing trees to windthrow or attack by other pests and pathogens. Its distribution appears to be quite patchy and it frequently occurs in stands together with *Armillaria ostoyae* and Douglas-fir beetle (*Dendroctonus pseudotsugae*).

Specific work objectives aim to establish a root disease inventory (occurrence and incidence) according to a sampling matrix of Inventory Type Group, BEC and age class obtained from a network of growth and yield permanent sample plots in the Okanagan and Kamloops TSA. Preliminary results for the Okanagan TSA suggest that Phellinus is more frequently found in Douglas-fir leading timber types in the ICH (61%) compared to the IDF (15%). Incidence data for the Kamloops TSA is still being compiled. Future work will concentrate on building upon the existing incidence database and determining stand-level losses and a first approximation OAF for Phellinus to be used in TSR.

Advanced decay in Douglas-fir caused by Laminated root disease.

Forest Health Field Training Sessions

A number of Forest Health field training sessions were held this year in the Headwaters, Cariboo, Kootenay Lake and Arrow Boundary Districts. Participants included District staff, licensees, and private woodlot owners. Topics covered a wide range of forest health issues with emphasis on field diagnostics, current research of important forest pests, and challenges surrounding forest health and management of young stands particularly as it relates to free growing.

Forest health field training session with Headwaters District staff.

Birch Dieback

Birch dieback is widespread and damaging throughout the interior wetbelt in the SIFR. However, the condition has not been extensively investigated in BC, partly because of time and resource constraints, but also because we have not yet perceived it is as a major issue in our managed commercial forests.

The decline appears to be a result of several factors, some of which are listed below, that appear to be working together or in sequence. Over time, these factors prevent normal tree growth and defensive processes, speed up the aging process, and hasten tree death.

•Birch is a shallow rooted species and stresses that damage roots can also contribute to decline. Such stresses can include abnormally warm winters when an insulating blanket of snow is temporarily absent, fires, or root exposure resulting in abnormal freezing and drying injury that may induce xylem cavitation.

•Root diseases (*Armillaria ostoyae* and *A. sinapina*) can occur on trees older than 40 years of age and especially in situations where they are mixed with conifers and are overtopped.

•An insect complex of bronze birch borer and birch leaf miner species are currently common and causing damage to birch in south eastern BC and may be an important part of the decline complex. Birch leaf miner populations have been increasing steadily in the region over the last 4-7 years. Moisture stress such as the ongoing "drought" over the last decade has likely had some impact particularly in terms of the incidence of bronze birch borer.

A simple explanation of why decline occurs does not seem likely. There are usually a number of predisposing factors (climate or site factors, age, changed microclimate due to logging or other habitat changes), inciting factors (fungal pathogens and insects, period of drought frost, freeze/thaw, mechanical damage), and contributing factors (canker fungi, root disease, wood and bark boring insects), all of which cause reduction in tree vigor and induce a state of decline from which it is difficult for trees to recover.

Typical birch dieback symptoms.

Special Project: Dr. Suzanne Simard (Associate Professor) and Ameur Manceur (Ph.D. Candidate) from the University of British Columbia will be working with Michelle Cleary and Art Stock to help answer some of these questions surrounding incidence and severity of birch decline including identifying the pests and pathogens and the consortium of environmental stresses affecting birch physiology and dieback.

Armillaria Root Disease

Armillaria root disease (*Armillaria ostoyae*) causes considerable losses in immature and mature stands throughout much of the SIFR by killing natural and planted coniferous trees and causing progressive reduction in stem growth on older trees that sustain chronic (non-lethal) infections.

It is questionable as to whether stands established on sites infected with Armillaria will continue to remain free-growing after declaration. Tree mortality in new plantations starts as early as 4-5 years following planting. Mortality usually peaks around ages 12-15 and will continue for several years thereafter. Since the disease is not fully expressed at the time most free growing declarations are made, large openings and understocked stands can be expected post-free growing.

Armillaria mycelial fans on a killed Douglas-fir tree.

Management strategies aimed at inoculum removal and/or regeneration of species that have low susceptibility to killing by Armillaria is encouraged on infested sites. A revised table of susceptibility ratings for conifers can be found in the FORREX Stand Establishment Decision Aid (SEDA) for Armillaria root disease for the SIFR. Linkages to SIFR Forest Health SEDAs can be found on the SIFR Forest Health website.

Special Project: Armillaria root disease population genetics study in the Robson Valley:

In 2007, Simren Brar, a 4th year undergraduate forest science student at UBC with a special interest in molecular forest pathology, spent several months collecting mycelial samples from trees killed by Armillaria from a selected number of stands previously surveyed as part of the larger Armillaria Map Verification Project in the Robson Valley led by Richard Reich. The objective of this study, which currently comprises Simren's undergraduate thesis project, is to examine the population structure of Armillaria isolates via DNA characterization of disease centres (e.g. number, size, age of individual genets). UBC researchers Dr. Yousry El-Kassaby and Dr. Richard Hamelin are collaborators on this thesis project. Results will facilitate interpretation of spatial patterns of disease centres as they relate to operational surveys at the landscape level.

Special Project: Armillaria root disease – Mixed Species Operational Trial:

Results pertaining to effective root disease resistance operating in western red cedar against *Armillaria ostoyae* led to the establishment of an operational trial near Nakusp in collaboration with Pope and Talbot, Inc. This trial will measure the effectiveness of stumping versus mixed conifer plantations including western red cedar on sites heavily infested with Armillaria root disease. A similar trial was implemented in 2005 in Tolko's operating area near Enderby. Mortality and growth responses in Douglas-fir and western red cedar will be measured on a 3-year cycle.

Upcoming Meetings

Western White pine Management Conference, June 17-18, 2008, Vernon B.C.

Western white pine has been decimated throughout its natural range since the introduction of white pine blister rust (*Cronartium ribicola*) to western North America. For several decades now, the selection and breeding of white pines resistant to blister rust has remained a high priority for pathologists, geneticists, and forest practitioners.

Despite its high ecological and commercial value there has been a reluctance to include western white pine in reforestation plans. However, high survival rates of genetically improved, blister rust-resistance stock and impressive growth yields have been demonstrated which now warrants us to 'rethink' our desire to manage this species.

This workshop will provide silviculturalists opportunities to learn information from a wide range of topics including: the autoecology of western white pine, wood properties and utilization; the biology of the fungus and the history of rust in B.C and the U.S; advances in genetic resistance of western white pine and the status of the resistance breeding programs in the U.S. and Canada; growth and yield results from operational research trials; and management strategies for western white pine, now and in the future.

White pine blister rust stem infection on western white pine, in the Columbia Forest District.

Aecial blisters on stem of western white pine in the Central Cariboo District.

Salvage harvesting activities in the Kamloops District.

Newly hatched Douglas-fir tussock moth larva. Actual length is approximately 4 millimeters.

Early morning aerial application of B.t.k. to control western spruce budworm in the Cascades District.

Extensive, post-outbreak dead lodgepole pine near Sigutlat Lake in Tweedsmuir Park.

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