Summary of Aerial Overview Surveys in the Southern Interior Forest Region - 2006

This summary was prepared by:

Lorraine Maclauchlan

Michelle Cleary

Leo Rankin

Art Stock

Kevin Buxton

2006 Overview of Forest Health in the Southern Interior Forest Region

Introduction

The 2006 Aerial Overview Surveys were carried out between July 15 and August 23, 2006. A total of 357 hours and 71 days of fixed-wing flying were required to complete all surveys. 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://srmwww.gov.bc.ca/risc/pubs/teveg/foresthealth/index.htm), and documented mortality and/or damage resulting from bark beetles, defoliators, and any other visible forest health factors, such as foliar diseases and abiotic damage. Severity ratings for major bark beetles continued to use the expanded categories of trace (less than 1% current mortality) and very severe (greater than 50% current mortality).

Wildfire activity in Washington State early in the season contributed to hazy conditions over much of the Southern Interior Region, but otherwise, weather conditions were generally good for the 2006 surveys. Haze and the resulting poor visibility had occasional impact on the detection of very light defoliation, and of smaller, scattered areas of bark beetle mortality.

The most damaging pest in the Southern Interior Region continued to be mountain pine beetle (5,125,880 ha); other pests causing large scale damage were western spruce budworm (755,916 ha), western balsam bark beetle (283,478 ha), spruce beetle (82,318 ha), Douglas-fir beetle (55,816 ha), two-year cycle budworm (63,490) ha, and larch needle cast (68,227 ha).

Bark beetle severity class	Current mortality	Defoliation severity class	Attributes
Trace	< 1%	Light	some branch tip and upper crown defoliation, barely visible from the air
Light	1-10%	Moderate	thin foliage, top third of many trees severely defoliated, some completely stripped
Moderate	11-30%		
Severe	31-50%	Severe	bare branch tips and completely defolated tops, most trees sustaining >50% total defoliation
Very Severe	> 50%		

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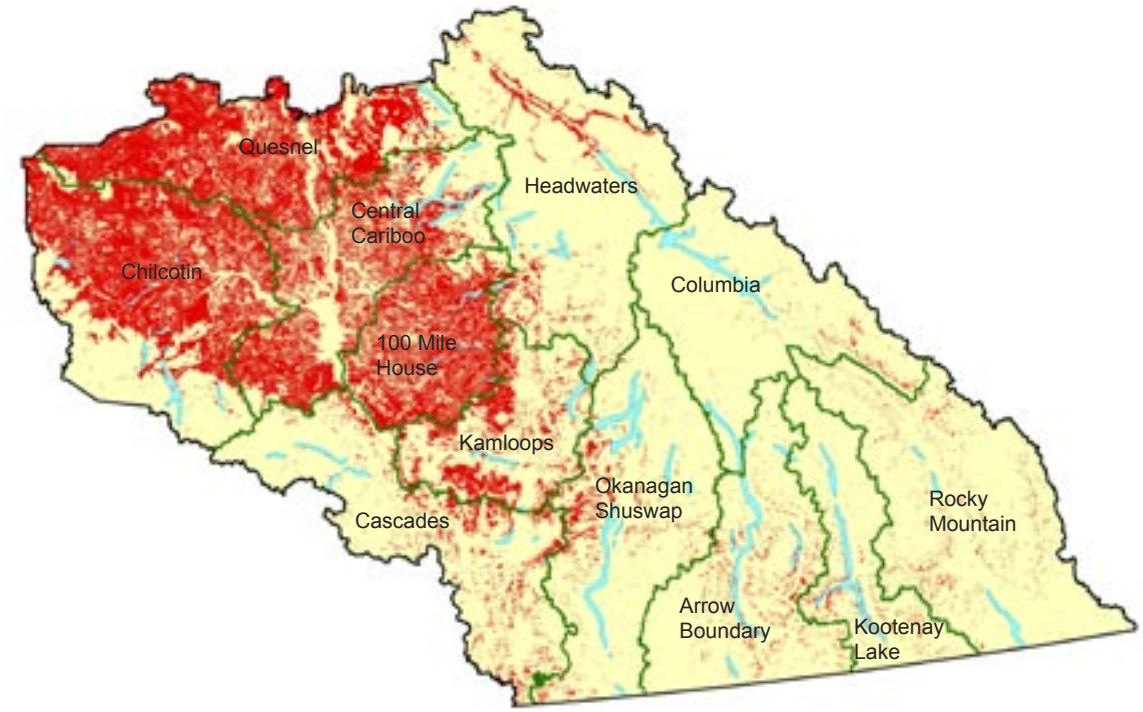


Figure 1. Mountain pine beetle infestations in the Southern Interior Forest Region, 2006.

Figure 2. Beetle management unit boundaries, and associated mountain pine beetle strategies as of January, 2007.

Table 1. Area summaries for forest health factors mapped during the 2006 aerial overview surveys.

Forest District and Damaging Agent	Area of Infestation (ha)					
	Trace	Light	Moderate	Severe	Very Severe	Total
Mountain Pine Beetle						
Chilcotin	110,456.1	393,060.3	657,974.2	182,607.5	11,920.2	1,356,018.2
Quesnel	171,397.0	270,900.1	474,782.8	300,941.8	53,915.6	1,271,937.3
Central Cariboo	184,229.3	290,221.5	152,017.1	81,084.2	107,198.0	814,749.9
100 Mile House	97,357.9	187,305.8	138,030.3	108,573.9	191,739.0	723,006.9
Kamloops	13,688.6	97,064.0	112,408.6	54,496.1	43,048.5	320,705.8
Cascades	16,990.4	91,337.3	70,065.1	14,077.2	2,531.4	195,001.3
Headwaters	67,986.7	51,553.2	31,349.6	5,994.2	764.1	157,647.7
Okanagan Shuswap	11,885.4	60,091.7	32,897.7	11,056.0	3,012.4	118,943.2
Arrow Boundary	2,014.7	14,755.9	22,537.8	16,928.0	14,291.8	70,528.2
Rocky Mountain	1,150.5	12,282.8	14,784.6	8,612.9	8,996.1	45,827.0
Kootenay Lake	708.9	8,649.3	10,896.0	5,563.7	5,018.8	30,836.7
Columbia	753.8	4,018.0	9,192.0	2,602.4	4,110.3	20,676.5
Total	**678,619.1**	**1,481,239.9**	**1,726,935.8**	**792,537.9**	**446,546.1**	**5,125,878.8**
Douglas-fir Beetle						
Central Cariboo	27,737.2	10,185.5	1,020.4	1,088.6	0.0	40,031.7
Quesnel	1,508.1	3,419.1	831.4	291.4	3.8	6,053.7
100 Mile House	3,338.7	665.3	108.2	0.0	0.0	4,112.1
Chilcotin	1,535.5	636.7	370.7	88.2	0.0	2,631.0
Rocky Mountain	5.5	387.1	660.1	0.0	0.0	1,052.7
Arrow Boundary	0.0	476.7	128.9	0.0	0.0	605.6
Columbia	22.7	133.4	262.3	0.0	26.6	445.0
Kamloops	0.0	203.2	34.6	37.6	11.5	287.0
Kootenay Lake	0.0	160.8	101.9	0.0	0.0	262.7
Okanagan Shuswap	12.2	141.4	44.5	0.0	0.0	198.1
Cascades	0.0	117.9	0.0	0.0	0.0	117.9
Headwaters	0.0	7.3	11.1	0.0	0.0	18.4
Total	**34,159.8**	**16,534.3**	**3,574.0**	**1,505.7**	**41.9**	**55,815.8**
Spruce Beetle						
Central Cariboo	21,088.0	6,564.2	2,021.1	90.4	0.0	29,763.6
Quesnel	18,734.3	6,610.3	3,138.8	0.0	0.0	28,483.4
100 Mile House	7,234.4	6,728.4	888.4	427.3	0.0	15,278.5
Cascades	51.3	536.3	2,604.6	295.5	63.6	3,551.2
Kamloops	0.0	804.1	1,111.9	39.0	0.0	1,955.0
Headwaters	1,245.1	0.0	56.6	0.0	0.0	1,301.8
Okanagan Shuswap	0.0	536.6	394.9	87.4	0.0	1,018.9
Arrow Boundary	114.5	108.2	14.5	0.0	21.5	258.8
Columbia	0.0	84.4	171.0	0.0	0.0	255.3
Chilcotin	44.3	50.9	133.6	0.0	0.0	228.8
Rocky Mountain	0.0	190.2	0.0	5.6	0.0	195.7
Kootenay Lake	0.0	26.7	0.0	0.0	0.0	26.7
Total	**48,511.8**	**22,240.2**	**10,535.5**	**945.2**	**85.1**	**82,317.8**
Western Balsam Bark Beetle						
Okanagan Shuswap	57,289.8	35,546.0	358.2	0.0	0.0	93,194.0
Headwaters	34,725.3	15,676.4	186.0	0.0	0.0	50,587.7
Quesnel	39,486.8	1,163.2	0.0	0.0	0.0	40,650.0
Central Cariboo	26,065.1	2,812.2	123.5	0.0	0.0	29,000.7
Cascades	5,640.1	8,436.6	54.7	0.0	0.0	14,131.5
Chilcotin	11,931.5	885.2	123.0	5.3	0.0	12,944.9
100 Mile House	9,649.5	2,605.0	233.5	0.0	0.0	12,488.1
Arrow Boundary	1,935.6	5,962.7	705.5	27.6	47.1	8,678.4
Kamloops	3,836.3	3,212.2	60.1	0.0	0.0	7,108.7
Rocky Mountain	301.3	4,403.0	578.5	96.7	7.9	5,387.4
Kootenay Lake	217.9	4,314.6	433.0	20.0	0.0	4,985.5
Columbia	554.9	3,369.6	325.7	70.7	0.0	4,320.9
Total	**191,634.0**	**88,386.7**	**3,181.7**	**220.2**	**54.9**	**283,477.5**

Table 1 continued. Area summaries for forest health factors mapped during the 2006 aerial overview surveys.

Forest District and Damaging Agent	Area of Infestation (ha)				
	Light	Moderate	Severe	Very Severe	Total
Western Spruce Budworm					
Central Cariboo	154,980.8	66,659.4	24,412.6	0.0	246,052.8
Cascades	122,126.4	115,771.2	2,136.0	0.0	240,033.5
100 Mile House	101,498.8	21,534.5	5,339.8	0.0	128,373.1
Kamloops	43,193.2	28,407.0	0.0	0.0	71,600.2
Chilcotin	13,685.3	16,080.8	29,230.9	0.0	58,997.0
Okanagan Shuswap	8,700.4	2,159.1	0.0	0.0	10,859.4
Total	**444,184.8**	**250,611.9**	**61,119.2**	**0.0**	**755,916.0**
Two-Year Cycle Budworm					
Quesnel	34,386.4	464.9	0.0	0.0	34,851.3
Central Cariboo	14,165.7	0.0	0.0	0.0	14,165.7
Headwaters	9,480.7	998.3	0.0	0.0	10,479.0
100 Mile House	3,667.0	0.0	0.0	0.0	3,667.0
Rocky Mountain	0.0	281.4	0.0	0.0	281.4
Kamloops	0.0	45.2	0.0	0.0	45.2
Total	**61,699.9**	**1,789.8**	**0.0**	**0.0**	**63,489.7**
Larch Needle Blight					
Rocky Mountain	1,234.0	5,390.0	20,299.4	8.2	26,931.5
Kootenay Lake	2,113.9	4,639.3	14,495.9	0.0	21,249.1
Arrow Boundary	1,536.6	5,441.2	11,718.0	89.8	18,785.5
Okanagan Shuswap	452.2	656.5	33.2	0.0	1,141.9
Columbia	51.2	52.5	15.6	0.0	119.3
Total	**5,387.8**	**16,179.4**	**46,562.0**	**97.9**	**68,227.2**
Aspen Serpentine Leafminer					
Columbia	1,938.7	2,244.2	1,615.1	0.0	5,669.3
Arrow Boundary	785.4	1,598.9	1,859.3	0.0	4,243.5
Kootenay Lake	564.3	556.1	886.2	0.0	2,006.6
Rocky Mountain	120.8	186.9	650.4	0.0	958.1
Total	**3,409.2**	**4,586.1**	**5,011.0**	**0.0**	**12,877.5**
Western Hemlock Looper					
Headwaters	661.1	22.0	0.0	0.0	683.1
Okanagan Shuswap	308.9	8.8	0.0	0.0	325.7
Total	**970.0**	**30.8**	**0.0**	**0.0**	**1,008.8**
Western Blackheaded Budworm					
Kootenay Lake	975.0	192.4	0.0	0.0	1,167.4
Arrow Boundary	128.9	0.0	0.0	0.0	128.9
Rocky Mountain	10.0	0.0	0.0	0.0	10.0
Total	**1,113.8**	**192.4**	**0.0**	**0.0**	**1,306.2**
Forest Tent Caterpillar					
Kootenay Lake	16.9	139.0	0.0	0.0	155.9
Rocky Mountain	0.0	0.0	36.9	0.0	36.9
Quesnel	0.0	32.9	0.0	0.0	32.9
Arrow Boundary	0.0	15.1	0.0	0.0	15.1
Total	**16.9**	**186.9**	**36.9**	**0.0**	**240.8**
Birch Leafminer					
Kamloops	2,038.8	89.7	0.0	0.0	2,128.5
Arrow Boundary	30.2	794.3	66.9	0.0	891.3
Okanagan Shuswap	659.2	166.2	0.0	0.0	825.4
Kootenay Lake	267.9	268.6	50.7	0.0	587.2
Columbia	6.6	62.1	110.3	0.0	179.0
Rocky Mountain	0.0	0.0	23.9	0.0	23.9
Total	**3,002.6**	**1,380.8**	**251.9**	**0.0**	**4,635.3**

Table 1 continued. Area summaries for forest health factors mapped during the 2006 aerial overview surveys.

Forest District and Damaging Agent	Area of Infestation (ha)				
	Light	Moderate	Severe	Very Severe	Total
Satin Moth					
Cascades	0.0	0.0	6.2	0.0	6.2
Total	**0.0**	**0.0**	**6.2**	**0.0**	**6.2**
Pine Needle Cast					
Okanagan Shuswap	100.1	0.0	0.0	0.0	100.1
Headwaters	0.0	4.4	0.0	0.0	4.4
Total	**100.1**	**4.4**	**0.0**	**0.0**	**104.5**
Drought					
Central Cariboo	0.0	0.0	24.4	0.0	24.4
Total	**0.0**	**0.0**	**24.4**	**0.0**	**24.4**
Flooding					
Chilcotin	0.0	0.0	143.3	0.0	143.3
Columbia	0.0	0.0	8.5	0.0	8.5
Headwaters	0.0	0.0	5.1	0.0	5.1
Rocky Mountain	0.0	0.0	4.0	0.0	4.0
Total	**0.0**	**0.0**	**160.8**	**0.0**	**160.8**
Slide					
Okanagan Shuswap	0.0	0.0	0.0	6.6	6.6
Total	**0.0**	**0.0**	**0.0**	**6.6**	**6.6**
Windthrow					
Central Cariboo	0.0	59.7	585.1	228.7	873.5
Quesnel	0.0	0.0	367.3	0.0	367.3
100 Mile House	0.0	0.0	200.1	0.0	200.1
Rocky Mountain	0.0	0.0	53.8	0.0	53.8
Kootenay Lake	0.0	0.0	42.9	0.0	42.9
Columbia	0.0	0.0	25.7	0.0	25.7
Arrow Boundary	0.0	0.0	14.6	0.0	14.6
Kamloops	0.0	0.0	9.6	0.0	9.6
Total	**0.0**	**59.7**	**1,298.9**	**228.7**	**1,587.3**
Wildfire					
Quesnel	0.0	0.0	21,784.9	0.0	21,784.9
Chilcotin	0.0	0.0	12,235.2	0.0	12,235.2
Cascades	4.6	0.0	5,833.5	216.9	6,054.9
Columbia	0.0	0.0	4,000.4	0.0	4,000.4
Okanagan Shuswap	0.0	0.0	2,836.7	6.1	2,842.8
Kootenay Lake	0.0	0.0	1,909.3	0.0	1,909.3
Central Cariboo	0.0	0.0	1,357.1	0.0	1,357.1
Arrow Boundary	0.0	0.0	829.7	0.0	829.7
Rocky Mountain	0.0	0.0	711.4	0.0	711.4
Kamloops	0.0	2.5	694.2	0.0	696.7
Headwaters	0.0	0.0	307.9	0.0	307.9
100 Mile House	0.0	0.0	74.6	0.0	74.6
Total	**4.6**	**2.5**	**52,574.7**	**223.0**	**52,804.7**

Regional Overview

Mountain Pine Beetle, *Dendroctonus ponderosae*

Mountain pine beetle infestations continued to increase overall in the Southern Interior Region, and affected area totalled 5.13 million hectares, up from 4.85 million hectares in 2005 (Table 1, 2). The rate of increase in total area has slowed considerably in the last 2 years (Fig. 3), as the proportion of susceptible, but uninfested stands has declined, especially in the Cariboo and Kamloops areas. The proportion of infested stands sustaining moderate or greater levels of current mortality continued to increase, with 58% of the total mapped area falling into these categories (Fig. 4). This trend towards increasing severity of infestation was seen in most areas of the Region. The exception was the Quesnel District, where severity levels are beginning to fall - the proportion of infested stands in the severe and very severe categories has dropped from 45% in 2005, to 28% in 2006. This reflects the fact that many stands in the District are becoming depleted of susceptible pine.

Table 2. 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, 2001-2006.

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

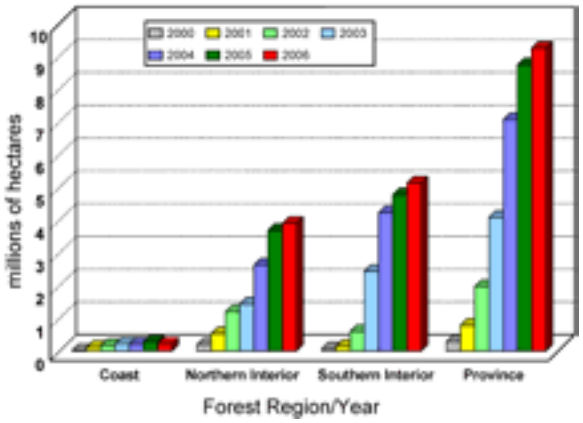


Figure 3. Area affected by mountain pine beetle from 2000 - 2006 in British Columbia, by Forest Region.

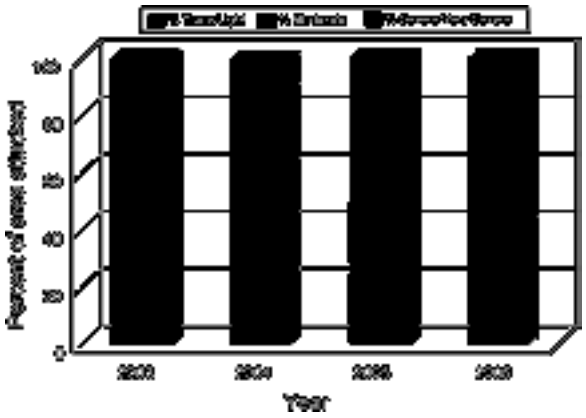


Figure 4. Proportion of mountain pine beetle infested area by infestation severity level, from 2003 - 2006, in the Southern Interior Forest Region.

The number of spot infestations in the Southern Interior Region has increased, with nearly 72,000 trees killed in 5,672 separate spot infestations (up from 35,033 trees in 3,839 spot infestations in 2005; Table 2). This is mainly the result of an increase in the number of spot infestations in the Kootenays and in parts of the Okanagan - most other areas saw either declining or static numbers of spots. Overall, average polygon size remains relatively high, at 85.5 hectares; however, in most areas of the Kootenays, average polygon size has dropped dramatically. A larger number of spot infestations, coupled with a decreased average polygon size, could indicate declining populations due to aggressive management.

Beetle Management Unit (BMU) strategies were re-assessed in all areas after the completion of the Aerial Overview Surveys, and an additional one million hectares of the Southern Interior Region's landbase has been downgraded to Salvage. The entire landbase of the Quesnel, Central Cariboo, Chilcotin, 100 Mile House, and Kamloops Districts, and over half of the landbase of the Cascades District, is now designated as Salvage. Additionally, a few BMU's in the Arrow Boundary, Columbia, and Okanagan Shuswap Districts have been downgraded from Suppression to Holding Action (Table 3). Harvesting is the key management tool in Holding Action and Salvage BMU's. No single tree treatments, or detailed aerial surveys are conducted in Holding Action or Salvage BMU's. Green:red expansion ratio data is no longer being collected in Salvage BMU's (ground sampling is not conducted in these areas). Given the severity of infestation in some areas, reliable green:red ratio data can be very difficult to obtain. Many stands are overwhelmed in one or two years by large aerial dispersal of mountain pine beetle into previously low or uninfested areas. Table 4 lists green:red ratios for Districts with significant areas still under Suppression or Holding Action strategies.

Levels of attack in younger pine stands (age 20-60 years) continue to increase, throughout the core outbreak areas in the Cariboo, and into more southern areas of the Region. The study that was initiated in 2005 to quantify levels of damage and future risk to young pine, was continued in 2006, and results are summarized on pages 41 - 46 of this report.

Table 3. Beetle management unit mountain pine beetle strategy designations in the Southern Interior Forest Region as of January 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	14 (924,714)	11 (1,158,975)	1 (172,487)	26 (2,256,176)
Okanagan Shuswap	22 (1,655,371)	8 (552,616)	5 (241,180)	0	35 (2,449,168)
Headwaters	0	17 (934,794)	4 (163,286)	22 (1,816,295)	43 (2,914,375)
Columbia	39 (1,256,850)	0	0	19 (795,142)	58 (2,144,309)
Arrow Boundary	13 (671,943)	22 (983,072)	4 (119,431)	10 (597,231)	49 (2,371,678)
Kootenay Lake	17 (844,661)	4 (196,674)	0	6 (199,522)	27 (1,240,857)
Rocky Mountain	23 (919,300)	53 (1,839,774)	0	1 (41,458)	77 (1,240,857)
Total	114 (5,348,125)	118 (5,394,305)	272 (11,243,510)	59 (3,622,135)	564 (24,178,058)

35-year old lodgepole pine stand heavily infested by mountain pine beetle in the Quesnel Forest District.

Table 4. Green:red mountain pine beetle ratios for the Southern Interior Forest Region, 2006.

Forest District	Average Green:Red Ratio	Range
Cascades	1.7	0.3 - 22
Okanagan Shuswap	4.0	<1 - 20
Headwaters (RV)	2.3	<1 - 7
Columbia	1.0	<1 - 21
Rocky Mountain	1.8	0.5 - 3
Kootenay Lake	5.0	0.6 - 9
Arrow Boundary	2.0	0.4 - 18
Regional Average	2.5	<1 - 20+

Affected area within provincial parks continues to increase, and now totals 294,837 hectares in 126 separate parks (Table 5). This is an increase from 241,030 hectares in 2005, and 194,720 hectares in 2004. Thirty-three parks sustained at least 1,000 hectares of red attack in 2006. Nearly half of all attack in parks was within the Quesnel and Chilcotin Districts. The most affected park was Itcha Ilgachuz Park, in the Quesnel and Chilcotin Districts, with 57,600 ha of mostly moderate and severe mortality mapped. Other provincial parks with over 10,000 hectares of mapped red attack were Big Creek Park, Bowron Lake Park, Wells Gray Park, Kluskoil Lake Park, and Mount Robson Park. Infestations in the National Parks (Yoho, Kootenay, Glacier, and Mount Revelstoke) have declined to 11,287 hectares, which reflects the decline in overall affected area observed in much of the Kootenays.

Many provincial parks are now removing dead trees from camping and day-use areas due to safety concerns. Treatment with verbenone, an anti-aggregation pheromone, in Lac Le Jeune Provincial Park and surrounding private land (near Kamloops), was overwhelmed by the extreme beetle pressure seen in the 2006 dispersal flight.

Table 5. Area (hectares) of mountain pine beetle in provincial parks in the Southern Interior Region in 2006. Numbers in brackets refer to additional areas within National Parks*.

Forest District	Total Number of Parks	Number of Parks with MPB	Total Park Area (ha)	Area of MPB in Parks (ha)
Chilcotin	13	10	390,766	80,122
Quesnel	18	13	202,497	55,828
Central Cariboo	11	7	195,766	41,082
Headwaters	40	15	848,744	38,224
100 Mile House	29	19	48,342	31,022
Kamloops	49	29	66,498	26,099
Okanagan Shuswap	110	20	186,990	7,369
Arrow Boundary	33	7	169,813	6,065
Kootenay Lake	23	9	215,975	5,492
Cascades	35	9	200,814	2,607
Rocky Mountain	35	10	272,461 (41,517)	849 (2,808)
Columbia	21	2	50,929 (387,783)	78 (8,479)
Total	305**	126**	2,849,616 (429,300)	294,837 (11,287)

*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.

Extensive mountain pine beetle mortality in the Baezaeko River area of the Quesnel Forest District (left), and in the Scuitto Creek area of the Kamloops Forest District (right).

Secondary species of pine, including ponderosa pine, whitebark pine, and western white pine, are being affected by the mountain pine beetle in many areas of the Southern Interior Region. Widespread ponderosa pine mortality was observed throughout the Kamloops, South and North Thompson River, Bonaparte River, Merritt, Nicola River, and Westwold areas, with more scattered mortality in the Fraser River and Okanagan areas. In a few areas, western pine beetle is the primary mortality agent of ponderosa pine, but generally, mountain pine beetle is the dominant mortality agent (Table 6). In total, over 45,000 hectares of ponderosa pine mortality were mapped, with the heaviest mortality in the Heffley Creek, Kamloops, Copper Creek, Criss Creek, Battle Creek, Barnes Creek, Hat Creek, and Merritt areas.

Extensive ponderosa pine mortality near Kamloops.

Whitebark pine mortality caused by mountain pine beetle.

Table 6. Summary of mountain pine beetle/western pine beetle ground sampling in poderosa pine.

Forest District	Number of sites MPB only	WPB only	MPB + WPB	Total
Cascades	19	2	0	21
Kamloops	86	13	13	112
Total	**105**	**15**	**13**	**133**

Scattered western white pine mortality was observed this year in the lower Kootenay Lake area. As this species tends to be very scattered and difficult to distinguish from lodgepole pine, it is often not accounted for separately during the surveys. Whitebark pine mortality was noted in many high elevation areas throughout the Kootenays, and in the Stein River - Kwoiek creek area in Cascades District. Mortality was mapped on a total of 8,750 hectares. Western white pine and whitebark pine populations are also heavily impacted by white pine blister rust, and coupled with the mortality due to mountain pine beetle, these species will likely further decline. Whitebark pine is a key species in high elevation ecosystems of the Kootenays, Rocky Mountains, and Cascade Mountains, and provides an important food source for several bird and mammal species.

Douglas-fir Beetle, *Dendroctonus pseudotsugae*

Douglas-fir beetle populations continue to increase, and mortality was mapped on 55,816 ha in 2006, up from just under 43,000 in 2005. The number of spot infestations increased by nearly 60%, to 1,080 (Table 7). The majority of the attack was seen in the Central Cariboo District (40,000 ha); significant mortality was also seen in the Chilcotin, 100 Mile House, Quesnel, and Rocky Mountain Districts, with lesser levels in all other Districts. Most of the mortality in the Cariboo was classified as trace (<1% mortality), representing large areas of very scattered attack. Severe western spruce budworm defoliation in the Chilcotin District masked much of the Douglas-fir beetle caused mortality along the Chilcotin River; therefore, totals are likely underestimated.

Table 7. Number of "spot" infestations of Douglas-fir beetle in the Southern Interior Forest Region, by District, 2006.

District	# spot infestations	# trees
Kamloops	65	695
Cascades	19	175
Okanagan Shuswap	131	1,060
Headwaters	18	181
Columbia	39	270
Rocky Mountain	152	1,751
Arrow Boundary	229	2,828
Kootenay Lake	42	234
Quesnel	83	1,279
Chilcotin	74	1,715
Central Cariboo	202	2,460
100 Mile House	26	380
Total	**1,080**	**13,028**

Spruce Beetle, *Dendroctonus rufipennis*

Spruce beetle infestations have expanded in 2006, and were mapped on 82,318 ha. This is an increase from 2005 levels of 41,119 ha. Most of the increase was in the form of trace (<1% attack) mortality in the Central Cariboo and Quesnel Districts. The Kamloops and Okanagan Shuswap Districts also experienced significant increases in mortality, while a significant decrease was seen in the Headwaters District. Significant mortality also continued in the 100 Mile House District.

Spruce beetle (Dendroctonus rufipennis) adult.

Western Balsam Bark Beetle, *Dryocoetes confusus*

Western balsam bark beetle mortality declined in most Districts, and total area mapped dropped from 383,110 ha in 2005, to 283,478 ha in 2006. The most significant reductions were in the Headwaters, Quesnel, Chilcotin, and Rocky Mountain Districts. Unlike most other areas, mortality in the Okanagan Shuswap District continues to increase, and was mapped on 93,194 ha, up from 77,085 ha in 2005. Relatively large areas of mortality were also mapped in the Central Cariboo, Cascades, and 100 Mile House Districts, with lower levels in most other Districts.

Western Spruce Budworm, *Choristoneura occidentalis*

Western spruce budworm populations expanded significantly, and defoliation was mapped on a total of 755,916 ha. Defoliation was mapped in six Districts: Central Cariboo (246,053 ha), Cascades (240,034 ha), 100 Mile House (128,373 ha), Kamloops (71,600 ha), Chilcotin (58,997 ha), and Okanagan Shuswap (10,860 ha). The greatest expansions were seen in the Kamloops and Cascades Districts, where area affected jumped over 10-fold and 2.5-fold, respectively. Affected area also increased significantly in the Central Cariboo and Okanagan Districts. This is the highest recorded area of defoliation in the Southern Interior Region since 1987, when over 820,000 ha were defoliated.

Egg mass sampling was conducted during the fall of 2006 at 300 sites in the Region (Table 8). Population levels have continued to rise in the Cariboo and Kamloops areas, with corresponding increased levels of defoliaiton expected in 2007. In much of the Cascades District, populations are expected to remain spotty, but widespread, and defoliation is predicted to occur over a wide area in 2007. Defoliation levels in the Okanagan Shuswap District are expected to remain light, although overall area affected is expected to increase in 2007.

2006 Western Spruce Budworm Spray Program

Numerous areas in the Region were identified as high priority for direct control in 2006. Results of the 2005 egg mass sampling coupled with assessments of stand condition indicated increasing damage and some scattered mortality in areas targeted for treatment. Just under 44,000 ha, in 26 separate spray blocks, were treated with Foray 48B (active ingredient *Bacillus thuringiensis* var. *kurstaki*) at a rate of 2.4 litres/ha using a combination of rotary and fixed-wing aircraft. This was the largest *B.t.k.* spray program conducted for western spruce budworm in the province since it was first operationally used in the 1980's. Treatments were located in the Alexis Creek, Riske Creek, Merritt, and Princeton areas (Fig. 5).

Table 8. Summary of Southern Interior Forest Region fall 2006 western spruce budworm egg mass sampling results, showing predicted 2007 defoliation.

	Number of sites in each defoliation category					
District	**Nil**	**Light**	**Moderate**	**Severe**	**Total number of sites**	**Average # egg masses/10m² foliage***
Cascades	8	50	11	0	69	25
Kamloops	1	13	19	1	34	59
Okanagan Shuswap	1	13	0	0	14	21
Chilcotin	0	1	9	8	18	153
Central Cariboo	10	34	13	13	70	64
100 Mile House	6	57	24	8	95	59
Total	**26**	**168**	**76**	**30**	**300**	

*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

Western spruce budworm B.t.k. spray operations in the Merritt area: aerial application using a Lama 315B (left) and staging area near the spray block (right).

B.t.k. loading and refuelling operations in the Princeton area. Aircraft picured is a Lama 315B.

A total of 16,500 ha in 16 spray blocks were treated in the Merritt-Princeton area. Application was conducted using 2 rotary wing aircraft (315B Lama helicopter and Hiller UH12ET helicopter) equipped with Simplex spray systems supplied and operated by Western Aerial Applications. The *B.t.k.* was successfully applied between June 12 and June 17, 2006. In some treatment areas, insect populations were extremely high, thus considerable defoliation occurred prior to the treatment date. Budworm larvae must be "open-feeding" (about 4th instar) and trees must be fully flushed before *B.t.k.* spraying can commence. Therefore, it is typical to have some damage prior to treatment. However, 2006 egg mass sampling in treated areas indicates a significant reduction in budworm populations. Treatment in these sites is not necessary in 2007.

A total of 27,482 ha in 10 separate spray blocks were treated in the Alexis Creek - Riske Creek area. The Provincial Airtanker Center in Kamloops oversaw the aerial application on a cost-recovery basis, using two AT802 Air Tractor fixed-wing aircraft equipped with T-Jet spray systems (operated by Conair Aviation). The spray program was completed between June 20 and June 26, 2006. Larval development was optimal in most spray blocks, and weather conditions were good. Egg mass sampling conducted in the fall indicated that populations were lowered in all spray blocks; however, due to extremely high populations prior to treatment, egg mass counts in some blocks still were high enough to indicate significant defoliation for 2007.

All spray aircraft are now utilizing GPS spray guidance systems, which have all but eliminated the need for physical block boundary marking. This greatly simplifies ground set-up and spray monitoring, reduces the number of ground personnel required, and enables spray operations to be switched to different locations more easily. GPS guidance systems also allow for more accurate, even spray swaths. Western Aerial Applications is using the Trimble Trimflight III, and Conair Aviation is using the SatLoc M3.

The final costs of the spray program were $27.75/ha using rotary wing in the Merritt - Priceton area, and $22.84/ha using fixed wing in the Alexis Creek - Riske Creek area. Smaller, more topographically variable spray blocks in the Merritt - Princeton areas resulted in higher costs/ha.

Deteriorating stand conditions, due to multi-storied stand structures and past defoliation, have been identified over larger areas. Predictions of continued high defoliation rates in these areas indicate a need for an expanded spray program in 2007.

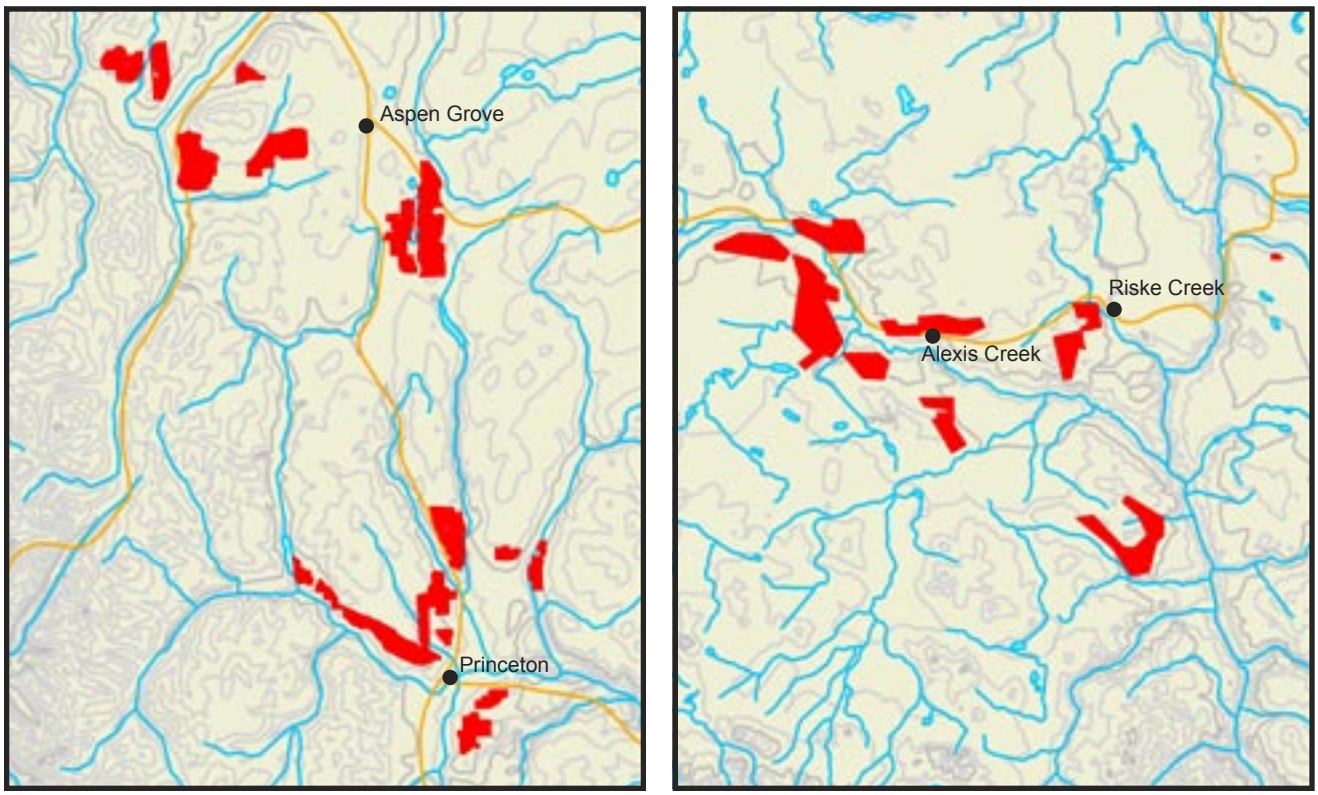


Figure 5. Western spruce budworm spray block locations in the Merritt - Princeton (left), and Cariboo (right) areas.

Western Hemlock Looper, *Lambdina fiscellaria lugubrosa*

Just over 1,000 hectares of mostly light defoliation was mapped in the Okanagan Shuswap and Headwaters Districts. The damage was in the Queest Mountain, Ratchford Creek, Albreda River, Dore River, and Crescent Spur areas. Pheromone trap catches at 27 permanent trapping sites were all extremely low (Table 9), and larval beating conducted at these sites yielded very few larvae. Most of the defoliated areas were small, scattered and not in close proximity to any of the permanent trapping sites. Populations are not expected to expand significantly in 2007.

Two-Year Cycle Budworm, *Choristoneura occidentalis*

Defoliated area has increased slightly from the last "on" year of this insect's feeding cycle - from 51,170 ha in 2004, to 63,490 ha in 2006. Most of the defoliation was in the Quesnel, Central Cariboo, and Headwaters Districts, with small amounts in the 100 Mile House, Rocky Mountain, and Kamloops Districts. Most of the defoliation was light.

Table 9. Average number of western hemlock looper moths caught per 6-trap cluster from 2002 - 2006 in the Southern Interior Forest Region.

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

Gypsy Moth, *Lymantria dispar*

One positive gypsy moth trap catch was confirmed from the Grand Forks Municipal Park. No other gypsy moths were caught.

Birch Leafminer, *Fenusa pusilla*

Defoliation expanded in the Kamloops and Okanagan Shuswap Districts, and was also observed in the Columbia, Arrow Boundary, Kootenay Lake, and Rocky Mountain Districts. Populations appear to have declined in the 100 Mile House District, as no defoliation was observed.

Douglas-fir Tussock Moth, *Orgyia pseudotsugata*

No defoliation was recorded in 2006. The 20 permanent 6-trap cluster trapping sites in the Kamloops, Cascades, and Okanagan Shuswap Districts caught an average of only 11.4 moths/trap/site (Table 10). The three-tree larval beatings conducted at these sites collected only 5 larvae. An additional 160 single traps placed throughout the Kamloops, Cascades, and Okanagan Shuswap Districts caught very low numbers of moths (Table 11).

Western Blackheaded Budworm, *Acleris gloverana*

Western blackheaded budworm defoliation was mapped on just over 1,300 ha in 2006, most of which was in the Kootenay Lake District.

Blackheaded budworm defoliation on western hemlock, near Revelstoke.

Aspen Serpentine Leafminer, *Phyllocnistis populiella*

Nearly 13,000 ha of trembling aspen were defoliated in the Columbia, Arrow Boundary, Kootenay Lake, and Rocky Mountain Districts. This insect is generally quite common and widespread; however, damage is often light and not easily visible during aerial surveys.

Damage caused by aspen serpentine leaf miner.

Larch Needle Blight, *Hypodermella laricis*

Larch needle blight was very widespread in the Kootenays in 2006, and damage was mapped on 68,227 ha. Most of the defoliation was classified as moderate and severe. Infection was likely exacerbated by generally cool, wet spring conditions. No long-term damage or mortality is expected to occur; however, there may be growth losses in many of the more severely impacted areas.

Western larch stand defoliated by larch needle blight.

Table 10. Average number of Douglas-fir tussock moths caught per 6-trap cluster from 2001 - 2006 in the Southern Interior Forest Region (Okanagan Shuswap, Cascades, and Kamloops Forest Districts).

		Average Trap Catches					
Site	**Location**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
1	McLure	1.3	0.2	6.3	3.3	0	9.8
2	Heffley Creek	13.8	6.7	76.3	5.5	38.0	14.8
3	Inks Lake	9.7	7.8	30.0	1.5	0.3	10.2
4	Six Mile	8.2	3.5	67.0	9.7	33.6	52.5
5	Battle Creek	17.2	10.7	67.7	5.6	1.2	14.0
6	Barnes Lake	39.2	10.3	52.2	6.7	1.5	34.5
7	Veasey Lake	56.7	16.3	83.0	2.7	0	13.8
8	Pavilion	17.7	1.0	9.7	0.3	0	1.5
9	Stump Lake	3.8	0	3.2	1.2	3.8	2.8
10	Monte Creek	5.5	3.5	10.7	13.8	40.2	18.3
11	Chase	14.2	28.0	36.3	11.2	9.3	0
12	Yankee Flats	0.7	1.7	1.0	0.3	2.0	0
13	Vernon	19.6	28.8	24.8	22.7	79.8	12.2
14	Wood Lake	6.8	0.3	1.1	6.7	11.0	0.3
15	Kelowna	6.2	0.5	no traps - fire	deleted	deleted	deleted
16	Summerland	16.8	1.5	0	0	4.5	1.0
17	Kaleden	5.7	1.2	0.3	0.3	18.6	11.6
18	Blue Lake	4.2	2.7	9.2	8.4	39.8	8.3
19	Stemwinder Park	49.3	2.5	1.2	1.0	29.5	1.5
20	Ashnola River	46.7	1.2	0.5	0	14.3	0
21	Spences Bridge	19.7	0.7	21.3	1.5	0	1.5
	Regional Average	**6.0**	**17.3**	**25.1**	**5.1**	**16.4**	**10.4**

Table 11. Average number of Douglas-fir tussock moths caught per trap (single trap per site) from 1994 - 2006.

	Forest District					
		Okanagan Shuswap			**Cascades**	
Year	**Kamloops** (±100 traps[1])	**Salmon Arm** (9 traps)	**Vernon** (±46 traps)	**Penticton** (27-30 traps)	**Merritt** (±30 traps)	**Lillooet** (15 traps)
1994	19.5	NT	NT	NT	0.1	8.0
1995	10.4	NT	0.9	3.6	2.6	NT
1996	1.9	NT	1.5	4.4	1.9	1.2
1997	17.0	0.0	2.5	9.3	17.0	1.6
1998	25.8	0.0	10.6	24.4	25.8	4.9
1999	4.8	0.0	6.8	27.0	19.7	2.5
2000	3.6	2.9	5.9	19.3	17.0	2.0
2001	3.1	0.1	1.9	4.9	4.8	1.0
2002	15.2	2.0	5.6	6.6	13.8	2.4
2003	25.8	11.9	11.9	5.0	5.9	5.4
2004	18.7	6.0	9.8	4.9	4.2	2.0
2005	1.7	0	1.5	0.2	1.4	0
2006	3.7	0	1.6	0.3	2.1	0.4

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

Wildfire

Most major wildfire activity occurred in the Chilcotin and Quesnel Districts, which had over 34,000 hectares of the total 52,800 hectares burned. Large areas of wildfire also occurred in the Cascades and Columbia Districts.

Windthrow

Windthrow damage was observed on 1,587 ha, mostly in the eastern Cariboo. Windthrow has been occurring sporadically in this area for several years, and may be contributing to the maintenance and buildup of local spruce beetle populations`.

Other

Pine needle cast (*Lophodermella concolor*)was common on lodgepole pine throughout the Kootenays. However, distribution was patchy, severity varied between trees, and the overall impact was very low. The needle cast was not generally intense enough to be mapped from the aerial overview survey. Hence, there is no estimate of overall area of infection. A wet spring and early summer likely contributed to a high incidence of this pathogen.

Severe wildfire damage in the Quesnel Forest District.

Severe windthrow damage in lodgepole pine.

Vole feeding on juniper.

Widespread damage to junipers was observed throughout the Cariboo, and in the Cache Creek and Kamloops areas, caused by high vole populations. Feeding damage consisted of branch girdling, and in some cases mortality of younger seedlings.

Other forest health factors observed during the aerial overview surveys included 241 ha of forest tent caterpillar, 105 ha of pine needle cast, 6 ha of satin moth, 24 ha of bear damage, 420 ha of an unknown defoliator in the Kootenays, and small areas of flooding (161 ha) and drought (24 ha) damage.

Nelson Area Summary

The Nelson portion of the Southern Interior Aerial Overview Survey was conducted between July 20 and August 16, 2006, and required 114.8 hours of flight time over 23 days. The surveys covered the area of the old Nelson Forest Region (Arrow Boundary, Columbia, Kootenay Lake, and Rocky Mountain Forest Districts, as well as all National Parks). Due to a hectic fire season, availability of aircraft was problematic and directly limited the daily amount of time spent in the air mapping. Surveys were conducted by contract personnel (Julie Castonguay[1] of Sattva Consulting, and Neil Emery of Nazca Consulting).

Arrow Boundary Forest District

Mountain Pine Beetle

Mountain pine beetle infestations decreased by 30%, from 100,596 ha in 2005, down to 70,528 ha in 2006. All of this decline was in the light and moderate severity categories. The area of severe and very severe increased dramatically, from 5,591 ha to 31,220 ha (45% of total infestation area). The average polygon size fell from 72 to 39 hectares, while the total number of polygons incresed by 30% to 1,809. The number of spot infestations increased dramatically, from 159 (960 trees) in 2005, to 851 (13,794 trees). This trend is likely due to a combination of refinements in surveying techniques, and a more long-range dispersal in 2005. The areas with the greatest declines in area were the Granby River, Burrell Creek, Rossland, Castlegar, Fruitvale, Snow Creek, Cariboo Creek, and most areas in the northern end of the District. Despite the decline in overall area affected, infestations are still widespread throughout most of the central, eastern, and southeastern areas of the District.

Douglas-fir Beetle

Mortality was mapped on 606 ha in 2006, down from 1,591 ha in 2005. This decline was seen across all severity levels. The number of spot infestations increased slightly, from 182 (680 trees) in 2005, to 229 (2,828 trees). Most of the activity was in the southwestern portion of the District, and spot infestations were scattered throughout the Kettle River, West Kettle River, Granby River, and Christina Lake areas.

Douglas-fir beetle mortality in the Arrow Boundary Forest District.

[1] *now with the Ministry of Forests and Range.*

Western Balsam Bark Beetle

Mortality due to western balsam bark beetle was mapped on 8,678 ha in 2006, down from 14,670 ha in 2005. This was scattered across most high elevation areas of the District. While the most extensive areas of mortality are still in the upper Kettle River - Granby River area, significant decreases were seen in this area. Nearly all of the area mapped was in the trace (<1%) and light (1-10%) categories.

Spruce Beetle

259 ha of mostly trace and light spruce beetle mortality was mapped, just south of the Valhalla Park boundary, and in the Greasybill Creek area.

Larch Needle Blight

Larch needle blight/needle cast damage was widespread throughout the south of the District, in the West Kettle River, Rock Creek, Granby River, Boundary Creek, Christina Lake, Koch Creek, Big Sheep Creek, Erie Creek, and Salmo areas. Defoliation was mapped on 18,785 ha, 65% of which was classified as severe.

Western Blackheaded Budworm

Light defoliation on Western Hemlock due to western blackheaded budworm was observed on a small area (129 ha) in the Beatrice Creek area, in Valhalla Park.

Serpentine Leafminer

Serpentine leafminer defoliation on aspen was mapped over 4,244 ha. The most widespread and severe infestations were seen in the New Denver and Incomappleux River areas.

Birch Leafminer

Damage on birch and alder from birch leafminer was observed on 891 hectares in the Inonoaklin Creek and Seaton Creek areas.

Other

Other forest health factors observed in the District included a amall area of forest tent caterpillar 10 km east of Nakusp, 15 ha of windthrow near Dog Creek, and 830 ha of wildfire. A complex of black stain root disease and *Ips* was observed and ground checked in the north west corner of the Distict. More information is needed to confirm incidence levels.

Columbia Forest District

Mountain Pine Beetle

Total area of infestation has decreased from 35,843 ha in 2005, to 20,677 ha in 2006. However, the amount of severe and very severe mortality rose by over 4-fold, and accounted for 30% of all infested area, while the amount of light mortality fell by 85%. The number of spot infestations has increased from 70 (325 trees) in 2005, to 342 (4,223 trees) in 2006. The most notable decreases in infested area occurred in the Golden, Beaver River, Bush Arm, southern Yoho National Park, and Kootenay Crossing areas. However, severity levels increased in most of these areas, and also in the Kootenay River and central Yoho National Park areas. Small scattered infestations were seen throughout the Columbia Reach, Bachelor Creek, and lower Lake Revelstoke areas.

Western Balsam Bark Beetle

Mortality was mapped on 4,321 ha in 2006, down from 9,920 ha in 2005, most of which was classified as light. Infestations were scattered relatively evenly throughout the high-elevation forests of the District.

Douglas-fir Beetle

Douglas-fir beetle activity increased to 445 ha in 2006, up from 295 ha in 2005. In addition, 39 small spot infestations were mapped, killing 270 trees. Most mortality was in the southern Kootenay National Park, and in the Columbia Reach area, between Bush Arm and Cummins River. In general, infestations in the Lake Revelstoke area have declined.

Spruce Beetle

Spruce beetle mortality expanded to 255 ha in 2006, up from 168 ha in 2005. Small, isolated pockets of light and moderate mortality was mapped in the Cummins River, Horne Creek, Blaeberry River, and Gorman Creek areas.

Mountain pine beetle infestation in an inaccessible area near Golden.

Serpentine Leafminer

Damage from serpentine leafminer was mapped on 5,670 ha. Defoliation was seen throughout the lower Lake Revelstoke, Revelstoke, Illecillewaet River, Beaver River, and lower Columbia Reach areas.

Other

Other forest health factors recorded were 179 ha of birch leafminer in the Illecillewaet River and Beaver River, 119 ha of larch needle blight damage, small areas of flooding and windthrow mortality, and 4,000 ha of wildfire.

Rocky Mountain Forest District

Mountain Pine Beetle

Total area affected was 45,827 ha, down over 50% from the 2005 total of 96,993 ha. The most significant declines were in the Bobbie Burns Creek, Steamboat Mountain, southern Kootenay National Park, Toby Creek, Dutch Creek, Findlay Creek, Moyie Lake, lower Bull River, and lower Elk River areas. All of the area decline was in the trace, light, and moderate categories; the amount of infestation classed as severe (30-50%) and very severe (50-100%) increased by 3 fold to 17,609 ha. The most severe infestations were in the Cross River, Redding Creek, St. Mary River, Perry Creek, and Wild Horse River areas. The number of spot infestations has increased significantly in most areas of the District, and 1,621 separate spot infestations (21,333 trees) were mapped, up from 603 (4,120 trees) in 2005.

Western Balsam Bark Beetle

Mortality due to western balsam bark beetle was mapped on 5,387 ha, down sharply from 21,874 ha in 2005. Most of the affected area continued to be classified as light. Infestations in the southern part of the District, especially in the Skookumchuck River - St. Mary River, and Bull River - White River areas, declined, and only a few scattered infestations were mapped in these areas in 2006. Most of the remaining infested area was in the Spillamcheen River - Vowell Creek area, with mortality scattered in other high-elevation areas of the District.

Douglas-Fir Beetle

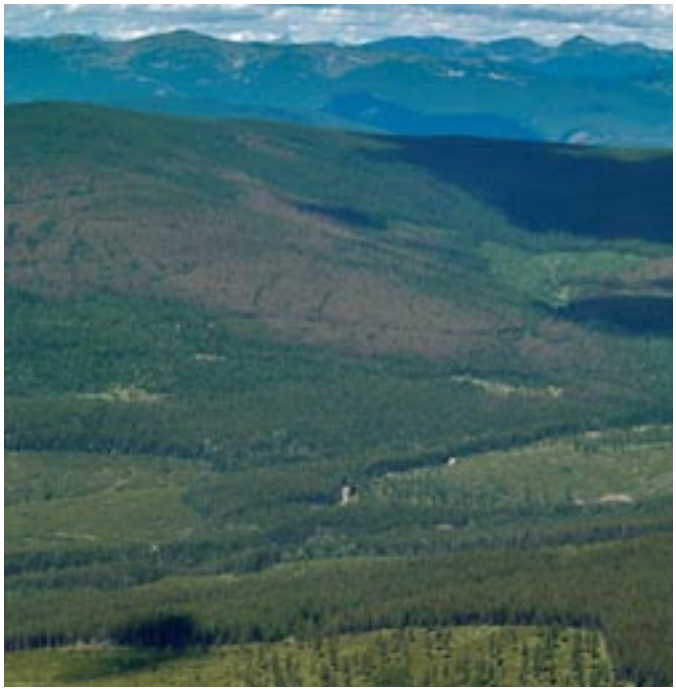
Douglas-fir beetle remains active in the District. While overall infestation area declined from 1,782 ha in 2005, to 1,053 in 2006, the proportion classified as moderate or greater increased to 62% of the total area. Decreased mortality was seen in the Hellroaring Creek, Whiteswan Lake, and Wild Horse River areas. Increased mortality was seen in Kootenay National Park. The number of spot infestations increased to 152 (1,751 trees) from 83 in 2005, mainly due to increases in the Gold Creek, Grasmere, Wigwam River, and Flathead areas.

Spruce Beetle

Spruce beetle mortality was observed on 196 ha, most of which was in the Fenwick Creek area. A small infestation was also observed in the Flathead River valley.

Larch Needle Blight

Larch needle blight was mapped on 26,932 ha, most of which was classified as severe. The most extensive areas of damage were in the Yahk River, Gilnockie Creek, Tepee Creek, Wigwam River, St. Mary River, and Dewar Creek areas. Smaller areas of damage were seen throughout much of the District.



Severe larch needle blight damage.

Serpentine Leafminer

Damage on aspen from serpentine leafminer was observed in the Fort Steele, Elko, and Grave Lake areas. Most of the 958 hectares mapped were classified as severe.

Two-Year Cycle Budworm

Moderate two-year cycle budworm defoliation was mapped on 281 ha in the upper Elk River.

Other

Other forest health factors observed included 37 ha of forest tent caterpillar near Moyie River, 24 ha of birch leafminer in the Wigwam River area, 10 ha of blackheaded budworm at Frances Creek, 54 ha of windthrow damage, 4 ha of flooding damage, and 711 ha of wildfire.

Two-year cycle budworm defoliation in the upper Elk River.

Kootenay Lake Forest District

Mountain Pine Beetle

Total area affected by the mountain pine beetle fell by 25%, from 42,024 ha in 2005, to 30,837 ha in 2006. However, the proportion classified as severe and very severe increased sharply - from just 2% of the total area in 2005, to nearly 35% in 2006. At the same time, the average polygon size has decreased from 53 to 34 hectares, and the number of spot infestations has increased from 122 to 196. In general, overall area decreased in most locations, especially in the Carney Creek, Kaslo, Glacier Creek, Lardeau, and Upper Goat River areas. Most infestations in the Nelson, Boswell, Kuskanook, and lower Goat River areas increased significantly in intensity, even though overall extent decreased.

Western Balsam Bark Beetle

Damage from western balsam bark beetle activity declined in most areas, and was mapped on 4,986 ha, down from 8,880 hectares in 2005. Infested areas were scattered throughout most high elevation areas of the District. Most mortality was classified as light.

Douglas-Fir Beetle

Douglas-fir beetle mortality was mapped on 263 ha in 2006, up from 136.6 ha in 2005. The number of spot infestations also increased, from 21 spots in 2005 to 42 spots in 2006. Most activity was in the Woodbury Creek and Ainsworth areas, with many smaller scattered infestations in the Argenta, Fry Creek, and Kaslo areas.

Western Blackheaded Budworm

Western blackheaded budworm defoliation was mapped on 1,167 ha, in the Wynndell, Kid Creek, West Arm, Crawford Creek, and Tenderfoot Creek areas.

Larch Needle Blight

Larch needle blight damage was widespread throughout the southeast areas of the District, in the Moyie River, Summit Creek, and Corn Creek areas. Activity was also scattered throughout most other areas of the District, and was mapped on a total of 21,249 ha.

Spruce Beetle

Several small, scattered pockets of mortality were mapped, totalling 27 ha.

Serpentine Leafminer

Defoliation was mapped on 2,007 ha in the Duncan Lake, Lardeau River, and Kaslo River areas.

Birch Leafminer

Defoliation was observed on 587 ha, in the Lardeau River, Westfall River, Duncan River, and Kaslo River areas.

Other

Other forest health factors mapped during the overview surveys were 156 ha of forest tent caterpillar, 43 ha of windthrow, and 1,910 ha of wildfire.

Mountain pine beetle galleries in lodgepole pine.

Western pine beetle galleries in ponderosa pine.

Kamloops Area Summary

The Kamloops portion of the aerial overview surveys were conducted between July 21 - August 2, 2006, and required 55.3 hours of flight time over 10 days of flying. Surveys covered the Kamloops, Cascades, Okanagan Shuswap, and Kamloops TSA portion of the Headwaters District. In general, weather conditions were clear and cloud-free; however, hazy conditions (caused by large wildfires in Washington State) prevailed in the more mountainous areas. Surveys were conducted by both Ministry of Forests (Kevin Buxton, Forest Health Specialist), and contract personnel (Janice Hodge, JCH Forest Pest Management).

Kamloops Forest District

Mountain Pine Beetle

After 2 years of rapid increases in overall area infested, much of the susceptible area in the District is now infested to some degree, and as a result the area infested has increased only slightly, from 290,325 ha in 2005, to 320,706 ha in 2006. Infestation severity has increased in most areas, with over 65% of all attack classified as moderate or greater. The proportion of attack classified as trace and light has decreased, and the number of spot infestations has declined from 537 (5,840 trees) in 2005, to 196 (2,350 trees) in 2006. Increased severity levels were seen in most areas of the District, especially in the Bonaparte Plateau, upper Deadman River, Tranquille Lake, Arrowstone Plateau, Tunkwa Lake, Logan Lake, Barnes Creek, Highland Valley, Greenstone/Chuwels Mountain, and McConnell Lakes areas. Infestations in other areas of the District also continued to expand, but to a lesser degree. In a few areas of the District, declines in either area of attack, or attack severity, or both, were seen. This was the result of a combination of harvesting, and/or host depletion due to several years of MPB-caused mortality. This was most apparent at lower elevations along the west side of the North Thompson River, from Watching Creek, north through TFL #35 and Lemieux Creek, and in the Red Plateau, and lower Deadman River and Criss Creek areas. Slight population declines were also apparent in some areas around Martin Prairie and Scuitto Creek.

Extensive severe and very severe mountain pine beetle infestations in the Tunkwa Lake area.

Ponderosa pine stands have experienced a sharp increase in mortality. Slightly over 10% of the total MPB area (33,122 ha), and over 30% of the spot infestations (69 spots, 825 trees), in the District were in ponderosa pine. Nearly half of these areas sustained moderate or greater mortality. Significant levels of mortality were observed in low elevation stands throughout the District, with the highest mortality levels being in the Barnes Creek, Scottie Creek, Battle Creek, Hat Creek, Sabiston Creek, Dewdrop, Kamloops, Sugarloaf Hill, Heffley Creek, and Pritchard areas. Ground checks conducted during the summer indicated that a proportion (approximately 25%) of these stands had significant populations of western pine beetle . Western pine beetle was more prevalent near the sites of large wildfires and /or drought mortality of 2003. Most other areas of ponderosa pine mortality were due primarily to mountain pine beetle activity, and the proximity of these areas to large populations in nearby lodgepole pine stands. Very high green attack levels have been observed in many parts of the District, and mortality rates are expected to increase dramatically in the next year.

In the Lac Le Jeune area, several large diameter spruce trees were observed that had been successfully attacked by mountain pine beetle. Stands in this area have a high component of lodgepole pine, and extremely high beetle population pressure. Larvae were developing successfully when checked in early November. Ministry staff will monitor the brood production from these trees over the next season. Successful attack of spruce, and successful brood development and emergence, has previously been observed by forest health staff in the Price George area.

Leith McKenzie, Kamloops District Stewardship Forester, examining mountain pine beetle attack in spruce near Lac Le Jeune.

Ponderosa pine mortality, resulting from mountain pine beetle attack, in the Kamloops area.

Spruce Beetle

Spruce beetle mortaility increased substantially in 2006, and was mapped on 1,955 ha in the District, up from 321 ha in 2005. Most mortality was in the Porcupine Ridge and Tod Mountain areas. Smaller infestations were observed near Samatosum Mountain and Cairn Peak (upper Hat Creek area).

Spruce beetle damage in the upper Hat Creek area, Kamloops Forest District.

Western Balsam Bark Beetle

Mortality levels remained fairly static, down slightly from 7,757 ha in 2005, to 7,109 ha in 2006. The proportion of the mapped area classified as trace decreased, while the proportion classified as light increased. Very minor amounts of moderate mortality were observed. Mortality levels increased in the Harp Mountain and Watching Creek areas, but declined in the Adams Lake and Tod Mountain areas. Other infestations in the Chu Chua and Porcupine Ridge areas continued.

Douglas-fir Beetle

Douglas-fir beetle in a windfall near Inks Lake, in the Kamloops Forest District.

Mortality was mapped on 287 ha, up from 72.6 ha in 2005. The number of spot infestations also increased substantially, from 11 (100 trees) in 2005, to 65 (695 trees) in 2006. Most of the beetle activity was near Kamloops, in the Jamieson Creek - Dairy Creek, Paul Lake, and Heffley Creek areas. Smaller, scattered infestations were also observed in several locations in the northern and northeastern areas of the District.

Western Spruce Budworm

Populations increased substantially across a wide area, and defoliation was observed over 71,600 ha, up from just 6,725 ha in 2005. Damage was mapped in many areas in the southern part of the District, with the most severe defoliation being in the Hat Creek, Walhachin, Criss Creek, Sabiston Creek, and Tranquille River areas. Defoliation was also observed as far north as the Dixon Creek and Barriere River areas. Moderate to severe defoliation is expected in the Hat Creek, Veasey Lake, Cache Creek, Barnes Creek, Walhachin, Sabiston Creek, Criss Creek, Tranquille River, and Monte Creek areas in 2007.

Birch Leafminer

Birch leafminer continued to damage stands in the eastern part of the District. Defoliation was mapped on 2,129 hectares in the Louis Creek, Fadear Creek, and Adams Lake areas.

Other

Other forest health factors observed included 45 hectares of two-year cycle budworm in the Taweel Lake area, 9.6 hectares of lodgepole pine windthrow near Mow Creek, and 700 hectares of wildfire.

Cascades Forest District

Mountain Pine Beetle

Affected area has nearly doubled, from 103,400 ha in 2005, to just over 195,000 hectares in 2006. The average polygon size has also nearly doubled, from 38.4 ha, to 60.5 ha. The number of spot infestations has decreased, from 927 (9,830 trees) to 668 (7,511 trees). In 2005, large increases were seen in the trace category (<1% red attack) and in the number of spot infestations; in 2006, however, the proportion of trace attack dropped, while the levels of light and moderate mortality increased. The levels of severe and very severe also increased significantly. This indicates that while the level of scattered, lighter attack is still high, many areas are beginning to coalesce into larger, more continuous areas of higher infestation rates. This trend is especially evident north of Merritt along the boundary with the Kamloops District, in Murray Creek, Pimainus Creek, Skuhun Creek/Chataway Lake, Surrey Lake, and Rey Creek areas. Other large increases in affected area were seen in the Watson Bar Creek, French Bar Creek, upper Nicola River/Pennask Lake, Shakan Creek, Tulameen River, Shrimpton Creek, and Missezula Lake areas. Most other areas of the District also experienced increased levels of attack, as evidenced by a sharp increase in the levels of small, scattered areas of mortality, and spot infestations. This was most evident in the Yalakom River - South French Bar Creek, Relay Creek, Siwash Creek, upper Willis Creek, and Smith Creek areas.

Mountain pine beetle continues to attack ponderosa pine in many areas of the District, and of the total area, just over 10,000 hectares was ponderosa pine mortality. 102 spot infestations (1,310 trees) of the 668 mapped in 2006, were in ponderosa pine. This mortality was observed throughout low elevation areas in close proximity to large mountain pine beetle populations, especially in the Fraser River, Spences Bridge, Merritt, Aspen Grove, and Kingsvale areas.

Spruce Beetle

Spruce beetle populations continue to be high in many areas of the District, and mortality was mapped on 3,551 ha, up slightly from 3,113 ha in 2005. While mortality levels dropped in the Carpenter Lake area, increased mortality was seen in the Lost Valley Creek and Arthur Seat areas. An increase in smaller, scattered pockets of attack was seen in the Gott Creek and eastern Shulaps Range areas.

Western Balsam Bark Beetle

Western balsam bark beetle populations have remained relatively stable over the last few years, and mortality was mapped on 14,132 ha, nearly unchanged from 2005 levels of 13,645 ha.

Douglas-fir Beetle

Douglas-fir beetle was mapped on 118 ha, up very slightly from 90 ha in 2005. The number of spot infestations decreased from 54, to just 19 (175 trees) in 2006. Most of the area mapped was in the Big Bar area, while a number of small scattered spots of mortality were observed along the Similkameen River, south of Princeton. Populations appear to be relatively low in most areas.

Western Spruce Budworm

Western spruce budworm populations expanded greatly in 2006, and defoliation was mapped on 240,034 ha, up over 2.5-fold from 2005 levels of 92,293 ha. In addition, the proportion of the total area classified as moderate or severe more than doubled, to just under 50%. Defoliation extent and severity expanded in nearly all areas where defoliation was present in 2005, with the most severe defoliation mapped in the Carpenter Lake, Spius Creek, Coldwater River, Aspen Grove, Tulameen, Allison Creek, and Princeton areas. Defoliation also expanded into the Cayoosh Creek, Stein River, Fraser River, Twaal Creek, Maka Creek, Nicola Lake, Peter Hope Lake, and Quilchena Creek areas. As in 2005, several areas of mixed Douglas-fir and subalpine fir in the upper Coldwater River area were defoliated. Eggmass sampling conducted in the fall of 2006, indicates that defoliation levels will be widespread but variable in 2007, with pockets of moderate defoliation scattered in the Yalakom River, Pavilion Lake, Lily Lake, Maka Creek, Tulameen River, and Iron Mountain areas.

A spray program was conducted in June 2006 to control budworm populations in several areas. For details refer to page 12 of this report. Approximately 20,000 ha of highly impacted stands are targeted for treatment with *B.t.k.* in 2007.

Western spruce budworm defoliation in the Fountain Valley area.

Wildfire

Wildfire burned 6,055 ha of forest in the District, due mostly to the large Tatoosh fire in the Pasayten River area, which burned in a mix of lodgepole pine, Douglas-fir, and spruce. Approximately 560 ha of MPB infested forest was burned. Other fires in the Lytton and Lillooet areas burned in lower elevation, dry sites, and had minimal impact on local bark beetle or defoliator populations.

Other

Other forest health factors included a small area of satin moth (6.2 ha) south of Hedley.

Okanagan Shuswap Forest District

Mountain Pine Beetle

Infested area increased by 1.5-fold, from 78,680 ha in 2005, to 118,943 ha in 2006. Increases were seen in all severity ratings; approximately 40% of all mapped area was classified as moderate or greater. The number of spot infestations has increased slightly, from 636 (5,570 trees) in 2005, to 754 (7,130 trees) in 2006. Most of the expansion was in the upper Nicola River, Tahaetkun Mountain, Musgrave Creek, Silver Creek, Ashnola River, and Ewart Creek areas. As well, a large number of small, scattered infestations were observed throughout the southwest portion of the District, in the Terrace Creek, Trepanier Creek, Trout Creek, and Shingle Creek areas. Infestations in the eastern portion of the District remained relatively static.

A decrease in area infested was seen in the Monte Creek, Weyman Creek, and lower Charcoal Creek areas, due to a combination of harvesting and host depletion.

Extensive salvage harvesting activities in the Weyman Creek area.

Ponderosa pine mortality was observed in several locations in 2006. Most of this mortality was in the Monte Lake, Westwold, Falkland, and Chase - Niskonlith areas, and was primarily due to mountain pine beetle attack. Several of these areas, especially those in close proximity to the large 2003 wildfire areas (Niskonlith, Falkland, and Kelowna) contained a mix of western pine beetle and mountain pine beetle populations, with some areas being almost entirely western pine beetle. It is expected that mortality of ponderosa pine due to mountain pine beetle will increase over the next several years, as population levels increase in nearby lodgepole pine forests.

Woodpecker activity in a ponderosa pine stand infested with both western pine beetle and mountain pine beetle, in the Niskonlith Lake area.

Spruce Beetle

Spruce beetle mortality increased in the Snowy Protected Area and Cathedral Park area, and additional infestations were observed in the northern end of the District, near Celista Mountain, Pukeashun Mountain, and upper Scotch Creek. Mapped area totalled just under 1,020 ha, up from 233 ha in 2005.

Douglas-fir Beetle

Douglas-fir beetle activity remains at a fairly low level in the District, and was mapped on 198 hectares, with a further 1,060 trees killed in 131 spot infestations. Mortality was scattered throughout Douglas-fir stands in the District, especially in the Mission Creek, OK Falls, Keremeos, Salmon Arm, Scotch Creek, and Seymour Arm areas.

Western Balsam Bark Beetle

Western balsam bark beetle continues to be active over wide areas of the District, and mortality was mapped on 93,194 ha, up slightly from 2005 levels of 77,086 ha. The proportion of area classified as trace (<1% current attack) has fallen slightly, to just over 60% of the total area. The largest areas of widespread mortality continues to be in the Buck Hills - Greystokes area, where nearly 30,000 ha were mapped. Most other main infestations were in areas where mortality has been on-going for several years, and included the Winnifred Creek, Hunters Range, Park Range - Tsuius Mountain, Pukeashun Mountain, Headwaters lakes, and Shatford Creek areas.

Western Spruce Budworm

Defoliation by western spruce budworm expanded in 2006, and damage was observed on 10,860 ha in the Monte Lake, Westwold, Falkland, Sunnybrae, Peachland Creek, and Similkameen River areas. Eggmass sampling, conducted in the fall of 2006 in the Westwold and Falkland areas, predicts that light defoliation will occur again in 2007.

Western balsam bark beetle mortality near Silver Star ski resort.

Western Hemlock Looper

A few small, scattered populations of western hemlock looper remained active, and 326 ha of defoliation was observed in the Queest Mountian, North Queest Mountain, and Ratchford Creek areas. This activity was unexpected, as sampling conducted in 2005 indicated that populations had dropped to non-outbreak levels. Trapping results from 2006 indicate low populations throughout the District.

Birch Leafminer

825 hectares of birch leafminer defoliation were mapped in the Scotch Creek, Turtle Valley, and Outlet Creek areas.

Larch Needle Blight

Scattered larch needle blight damage was observed in the Inkaneep Creek, Saunier Creek, Wilkinson Creek, and Shuttleworth Creek areas. Affected area totalled 1,142 hectares, and was mostly classified as light or moderate.

Wildfire

Most of the wildfire damage was due to 2 large fires, near Tuktakamin Mountain (215 ha) and Border Lake (1,813 ha). Some of the areas within the Border Lake fire had high levels of standing dead, spruce beetle - killed timber, and 280 hectares of mountain pine beetle infested stands were burned. A few other smaller fires increased the total area affected to 2,843 ha.

Other

Other forest health factors observed included 100 ha of pine needle cast in the Mission Creek area, and 7 ha of slide damage.

Headwaters Forest District

Mountain Pine Beetle

Mountain pine beetle infestations have expanded by over 1.5 - fold, from 99,060 ha in 2005, to 157,648 ha in 2006. Most of the increases in the south were in the T.F.L. #18, Wells Gray Park, Vavenby, and Reg Christie Creek areas; in the north, most areas along the Fraser River corridor experienced expansions, especially in the Cedarside, Raush River, Dunster-Croydon, and McBride areas. As well, trace levels of mortality were observed in the Highway 16 corridor up to the Alberta border. The number of spot infestations has declined to 320 (2,950 trees).

Western Balsam Bark Beetle

Area affected by western balsam bark beetle fell in the northwest of the District, and to a lesser extent in many areas in the south. As a result, total mapped area dropped by nearly 50%, from 96,177 ha in 2005, to 50,588 ha in 2006. Most of this decrease occurred in the trace mortality category.

Spruce Beetle

Spruce beetle activity declined in most parts of the District, and was mapped on only 1,302 ha, down from just under 10,000 ha in 2005. Most of the area mapped was classified as trace, and was scattered mainly throughout the northern part of the District, in the West Twin Creek, Cariboo River, and Canoe Reach areas.

Douglas-fir Beetle

Douglas-fir beetle activity has continued to decline in the District, and only a few small, scattered infestations were seen, in the Kinbasket lake, Vavenby, lower Wells Gray Park, and Joseph Creek areas. A total of 18.4 ha of light and moderate mortality and 18 spot infestations were mapped.

Two-Year Cycle Budworm

Defoliation has dropped to 10,479 ha, from just under 30,000 ha in the last "on" year (2004) in this insect's feeding cycle. Defoliation was scattered in small patches throughout much of the District, mainly in the T.F.L. 18, Wells Gray Park, North Thompson River, Albreda River, and Castle Creek areas. Population levels of this insect have been declining for several years, after peaking in 2000.

Western Hemlock Looper

A few small patches of defoliation were mapped, totalling 683 ha, in the northern end of the District, especially in the Goat River, West Twin Creek, East Twin Creek, Dore River, and Albreda areas.

Other

Other forest health factors noted during the overview surveys included 4 ha of pine needle cast near Raft River, 5 ha of flooding near TumTum Lake, and a few small, scattered wildfires.

Red stage mountain pine beetle attacked lodgepole pine in the Quesnel Forest District.

Cariboo Area Summary

The Cariboo portion of the aerial overview surveys were conducted between July 21 - August 20, 2006, and required 151.4 hours of flight time over 38 flight days. Surveys covered the Quesnel, Chilcotin, Central Cariboo, 100 Mile House, and Robson Valley TSA portion of the Headwaters District.Surveys were conducted by contract personnel (Joe Cortese, Alta Vista Management; Don Wright, Timber Wright Contracting; Mikko Sapponen, TMS Timber; and Bob Erickson).

Quesnel Forest District

Mountain Pine Beetle

Overall infested area has remained nearly unchanged from 2005 totals, at 1,271,937 ha. Red attack levels have begun to decline in some areas of the District, as available live host material becomes depleted, especially in the Kluskus Lakes, Batnuni Lake, Cottonwood River, Nyland Lake, and T.F.L. #52 areas. The proportion of infested area classified as severe or very severe has fallen, from 46% of the total in 2005, to 28% of the total in 2006. However, the overall extent of the infestation has remained unchanged. Continuous, unbroken mortality is still occurring in most areas of the District, especially as bettles move into younger, lower hazard, pine-leading stands. The highest current mortality rates were seen in the Narcosli Creek, Tzenzaicut Lake, Puntchesakut Lake, Sliding Mountain, and Bowron Lake areas.

Extensive grey stage mountain pine beetle attacked lodgepole pine west of Quesnel.

Spruce Beetle

Spruce beetle mortality was mapped on 28,483 ha in the eastern part of the District, up from only 2,613 ha in 2005. Two-thirds of this was classified as trace, with the rest either light or moderate. Most of the infested area was in the Beaver Pass, Pundata Creek, Swift River, Keithley Creek, Hardscrabble Mountain, and Bowron Lake Park area. Scattered windthrow events throughout these areas over the last few years may have contributed to increased populations moving into standing live trees.

Douglas-fir Beetle

Douglas-fir beetle infestations were mapped on 6,054 ha , with an additional 1,280 trees killed in 83 separate spot infestations. Most mortality was in the the Victoria Creek and Wells areas. Many scattered, small infestations were also seen along the Fraser River north of Quesnel, and south of Narcosli Creek.

Western Balsam Bark Beetle

Western balsam bark beetle activity continued throughout the eastern parts of the District, mainly in the upper Swift River, T.F.L. #52, and Bowron Lake Park areas. Total infested area dropped to 40,650 ha, down from 70,741 ha in 2005.

Subalpine fir attacked by western balsam bark beetle.

Two-Year Cycle Budworm

Defoliation was visible throughout the Willow River and Lightning Creek areas, and totalled 34,851 ha. This is an expansion from the last year of visible defoliation (2004), when defoliation was mapped on 15,250 ha. Populations have fluctuated significantly during the last several years.

Wildfire

Several large wildfires occurred in the western end of the District, mostly early in July. Overview surveys mapped a total of 16,670 ha. Accounting for a few fires that occurred after the surveys were completed, the actual area burned totalled 21,785 hectares. Most of the wildfires occurred in areas with substantial levels of both red and grey attacked (by mountain pine beetle) lodgepole pine.

The Wutlus Lake wildfire east of Nazko, in the Quesnel Forest District.

Windthrow

Several small scattered pockets of windthrow were mapped in the Willow River, Swift River, and Lightning Creek areas. All of the 367 ha mapped were classified as severe. Windthrow has been occurring sporadically in this general area for several years, and has contributed to the general buildup of spruce beetle populations.

Other

Forest tent caterpillar was mapped on 33 ha, along the Fraser River just north of Quesnel.

Central Cariboo Forest District

Mountain Pine Beetle

Mountain pine beetle infestations have expanded slightly, to just under 815,000 ha, up from 700,215 ha in 2005. Increases were seen in both the very severe (nearly a two-fold increase) and the light (70% increase) categories. In general, the greatest overall increase in mortality rates was seen in the southwest, in the Caspard Creek, Churn Creek, Black Dome Mountian areas. Infestations also expanded in the upper Big Creek, Dash Creek, Lone Valley Creek, and Flapjack Peak areas. Increased mortality rates were also seen in the upper Moffat Creek - Black Creek areas. Infestation levels in the Beavertail Lake - Mackin Creek area continue to be high, although mortality rates are beginning to decline, due to host depletion. Large, continuous areas of mortality continue to cover many areas of the District, and mountain pine beetle is present in virtually any stand with a significant pine component. Average polygon size remains relatively high, at 68 hectares.

Western Balsam Bark Beetle

Most activity continues to be in the northeast, in the Quesnel Lake, upper Horsefly River, and upper Molybdenite Creek areas. Total area mapped increased slightly from 25,200 ha in 2005, to 29,000 ha in 2006. Nearly 90% of all infestations were classified as trace.

Douglas-fir Beetle

Douglas-fir beetle populations continued to expand, and mortality was mapped on 40,032 ha, up nearly two-fold from 2005 levels of 20,361 ha. The number of spot infestations also nearly doubled, from 109 (1,156 trees) in 2006, to 202 (2,460 trees). Widespread but mostly scattered infestations were mapped throughout the Chilcotin River, Gaspard Creek, Empire Valley, Alkali Lakes, Dog Creek, Chimney Lake, and 140 Mile House areas, as well as along the Fraser River from the Sheep Creek Bridge north through to Mcleese Lake. Many smaller scattered infestations and spots were also seen in the Beedy Creek, and Beaver Creek areas, and throughout much of the northeast, in the Little River, Quesnel Lake, and Horsefly Lake areas.

Spruce Beetle

New infestations were observed throughout the eastern Quesnel Lake and Molybdenite Lake areas, while increased mortality was seen in the McKusky Creek - Eureka Peak area. As a result, total area mapped was up nearly three-fold, to 29,764 ha.

Western Spruce Budworm

Western spruce budworm defoliation has expanded throughout the Chimney Creek, Springhouse Mountain, Farwell Creek, Big Creek, Meldrum Creek, and Dog Creek areas. As a result, overall area mapped increased from 193,235 ha in 2005, to 246,052 ha in 2006. The proportion of the defoliated area classified as moderate or severe has increased substantially, from 22% (43,060 ha) to 37 % (91,920 ha). The highest levels of defoliation were throughout the Meldrum Creek - Riske Creek area, where most stands were either moderately or severely defoliated. Stands in the Chimney Lake and Big Creek - Farwell Creek areas were also heavily impacted, with moderate and severe defoliation throughout these areas. 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.

Two-Year Cycle Budworm

Two-year cycle budworm defoliation was observed in the Mitchell Lake, Niagra Creek, Molybdenite Creek, Grain Creek, and Spanish Lake areas, on a total of 14,165 ha. All defoliation was classified as light. This is more than double the area defoliated in the last "on" year, in 2004. Populations of this defoliator have fluctuated over the last several years.

Other

Other forest health factors observed in the District were 875 ha of windthrow (mostly in the Moffat Lakes area), 1,357 ha of wildfire, and a small area of drought mortality north of Horsefly Lake.

Chilcotin Forest District

Mountain Pine Beetle

The overall infestation area remained almost unchanged from 2005 levels, at 1,356,018 hectares. However, infestation intensity has continued to increase sharply, and almost all areas with trace mortality in 2005 are now experiencing light or moderate mortality. Scattered attack has expanded well up into most of the high elevation valleys along the southern and southwestern edges of the District, where 242 spot infestations were mapped, in the Mosley Creek, Homathko River, Tatlayoko Lake, Chilko Lake, and upper Taseko River areas. The highest attack levels were seen in the northwest of the District, in the Dean River, Anahim Lake, and Nimpo Lake areas. The area of moderate or greater attack has increased by 1.7 fold, to 63% of the total infested area (852,500 ha).

Mountain pine beetle infestations in the Chilcotin Forest District.

Western Balsam Bark Beetle

Western balsam bark beetle mortality rates fell, reversing the trend of increase seen over the last few years. Infestations were mapped on 12,945 ha, almost all of which was classified as trace. All activity continues to be in the south and southwest of the District, in the Taseko Lake, Chilko Lake, Tatlayoko Lake, and Klinaklini River areas.

Spruce Beetle

Spruce beetle populations remained at relatively low levels in 2006. Mortality was mapped on 229 ha, scattered around the Farrow Creek, south end of Chilko Lake, and Homathko River - Mosley Creek areas.

Douglas-fir Beetle

Infestations were mapped on 2,631 ha, nearly 60% of which was classified as trace. This is down sharply from 13,225 ha in 2005. Most of this decrease was in the Redstone, Lees Corner, and Hanceville area. There was an increase in small scattered infestations and spots in the Puntzi Lake, lower Chilko River, and Alexis Creek areas, and near the junction of Big Creek and the Chilcotin River. Heavy western spruce budworm defoliation throughout the area likely masked much of the Douglas-fir beetle mortality, and may be partly responsible for the decreased area. Ground surveys have indicated that green attack levels are very high in many areas.

Western Spruce Budworm

Overall area defoliated by western spruce budworm remained nearly unchanged, at 58,997 ha. Defoliation severity increased in most areas between Hanceville and the junction of the Chilko and Chilcotin Rivers, with 77% of all defoliation in the District classified as moderate or severe. Budworm populations continued to expand to the west, where defoliation was observed west of Redstone, and to the junction of the Chilko and Taseko Rivers. 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 agressive 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.

Severe western spruce budworm defoliation and tree mortality near Alexis Creek.

Wildfire

A large wildfire in the Tezla Lake area burned approximately 11,900 ha. Most of the area contained significant levels of mountain pine beetle-killed lodgepole pine. A few other scattered wildfires increased the total area burned to 12,235 ha.

Other

62 ha of bear damage and 143 ha of flooding mortality was observed in the Chilko Lake area.

100 Mile House Forest District

Mountain Pine Beetle

Mountain pine beetle mortality continues to increase throughout the District. Although infested area increased by only 15%, the amount of red attack increased sharply in most areas, especially in the eastern half of the District. The 100 Mile House District is experiencing the most widespread extreme mortality rates in the Southern Interior Region - just under 30% (190,000 ha) of the infested area was classified as very severe, and 60% (438,343 ha) were classified as moderate or greater. The number of spot infestations has dropped to almost nil (6 spots only). Much of the increased area has come from infestations expanding into high and low elevation areas with minor pine components.

Extensive, severe mountain pine beetle mortality along the upper Deadman River, near the border between the 100 Mile House and Kamloops Forest Districts.

Douglas-fir Beetle

Douglas-fir beetle infestations have increased slightly, from 3,050 ha in 2005, to 4,112 ha in 2006. Most of the infested area was classified as trace, and represents very scattered, low levels of mortality. The number of smaller spot infestations has remained low, at just 26 (380 trees). Most of the mortality was seen in the Lac La Hache, Horse Lake, Pigeon Creek, Canoe Creek, Loon Lake, Bonaparte Lake, Deka Lake, and Canim Lake areas.

Western Spruce Budworm

Defoliation expanded slightly in 2006, to 128,373 ha, and the proportion of area sustaining moderate or severe defoliation increased to over 35%. Defoliation expanded along Highway 97, from 100 Mile House north to 130 Mile House. In the Clinton - Bonaparte Lake area, overall area declined, while defoliation intensity increased significantly. Widespread light defoliation continued to occur throughout the Canoe Creek - Big Bar Creek area. Eggmass sampling carried out in the fall of 2006 predicts moderate and severe defoliation in the Clinton, Kelly Lake, 70 Mile House, Loon Lake, and Big Bar Lake areas, in 2007. Light defoliation is expected throughout the Jesmond, China Gulch, Canoe Creek, Eightythree Creek, 100 Mile House, and Lac La Hache areas.

Spruce Beetle

All infestations continue to be in the northeast of the District, and have increased slightly to 15,279 ha. Mortality has increased in the Deception Creek and McNeil Lake areas, while declines were seen in the Pendleton Lakes and Windy Creek areas.

Western Balsam Bark Beetle

Scattered mortality was observed throughout the northeast of the District. Infestations were mapped on a total of 12,488 ha, down slightly from 15,446 ha.

Two-Year Cycle Budworm

Light defoliation was observed on 3,667 ha in the Boss Creek and McKinley Creek areas.

Other

Scattered pockets of windthrow were seen in the Lang Lake and McNeill Lake areas. Total area affected was 200 hectares. Spruce beetle populations are active in the McNeill Lake area, and may be exacerbated by windthrow. Two small wildfires, in the Meadow Lake, and Canim Lake areas, burned 75 hectares.

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. Updated spring 2007 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>. See also, pages 41 - 46 of this report for some 2006 mortality results in young pine.

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 - April of 2006, extensive sampling for mountain pine beetle was conducted in all Districts, at a total of 153 sites. Mountain pine beetle overwintering mortality rates were below 55% in all areas, with the exception of the Quesnel District, and the Robson Valley TSA. R-values were above 5, with the exception of the Quesnel District (Table 1). The lowest mortality rates, and the highest R-values, were seen in the Kamloops TSA (the Kamloops District, and southern portion of the Headwaters District). These areas experienced very large beetle flights in 2006.

Table 1. Average percent mortality of mountain pine beetle progeny during the winter of 2005-2006, with associated R-values.

District or TSA	# sites	# trees	average % mortality	average R-value
Quesnel	5	50	94.9%	1.0
Central Cariboo	10	100	37.4%	5.0
Chilcotin	10	100	44.0%	9.8
100 Mile House	10	100	38.1%	12.1
Headwaters (Robson Valley)	10	100	77.9%	5.3
Headwaters (Clearwater)	15	150	27.1%	16.2
Arrow Boundary	11	114	44.3%	9.7
Golden	9	84	37.6%	9.5
Kootenay Lake	10	102	53.3%	7.9
Rocky Mountain	6	51	51.0%	5.4
Lillooet	16	161	45.0%	7.8
Merritt	15	150	35.5%	13.8
Kamloops	15	150	22.0%	17.0
Okanagan Shuswap	11	110	47.8%	7.4
Totals/Averages	153	1,522	46.9%	9.1

Douglas-fir Beetle

Sampling for Douglas-fir beetle was carried out in the Central Cariboo (10 sites), Chilcotin (10 sites), and 100 Mile House (7 sites) Districts. Larval mortality and R-values were moderate in all areas (Table 2).

Table 2. Percent mortality of Douglas-fir beetle progeny during the winter of 2005-2006, with associated R-values.

District or TSA	# sites	# trees	% larval mortality	R-value
Central Cariboo	10	100	70.3%	4.6
Chilcotin	10	100	78.5%	4.5
100 Mile House	7	70	69.3%	3.3
Totals/Averages	**27**	**270**	**72.7%**	**4.1**

Spruce Beetle

Sampling for spruce beetle was carried out in the Central Cariboo and Quesnel Districts (6 sites total). Larval mortality rates were low, and R-values were high (Table 3).

Table 3. Percent mortality of spruce beetle progeny during the winter of 2005-2006, with associated R-values.

District or TSA	# sites	# trees	% larval mortality	R-value
Central Cariboo	3	30	30.6%	10.8
Quesnel	3	30	35.3%	7.3
Totals/Averages	**6**	**60**	**33.0%**	**9.1**

Updated Bark Beetle Susceptibility Ratings for the Southern Interior Forest Region

A project was initiated in the fall of 2006 to produce a complete set of updated susceptibility ratings for mountain pine beetle, spruce beetle, and Douglas-fir beetle, for the Southern Interior Forest Region. The process took advantage of updated methodologies for calculating susceptibility ratings (see sidebar for references). For the mountain pine beetle rating, continuous functions have been developed to replace the previously used discrete functions for stand age and density factors. Both spruce beetle and Douglas-fir beetle methodologies have been significantly modified and updated from the methodologies outlined in the Forest Practices Code Bark Beetle Guidebook. Input data for the susceptibility ratings included: Vegetation Resources Inventory (VRI) data (for forest cover information), Variable Density Yield Projection System 7 (for basal area information), and the TRIM 25 metre digital elevation model (for location, elevation, and aspect information). The main outputs of this project are spatial data files based on VRI linework, with susceptibility rating attributes. This product will assist forest managers in directing activities to stands which have the highest potential for stand impacts, and the highest potential for beetle population build-up. The spatial data is freely available to all users and may be accessed through the Southern Interior Forest Region, Forest Health webpage, http://www.for.gov.bc.ca/rsi/ForestHealth/Index.html.

Chapter 8 – Decision Support Systems. Terry L. Shore, Bill G. Riel, Les Safranyik, and Andrew Fall. In: The Mountain Pine Beetle – A Synthesis of Biology, Management and Impacts in Lodgepole Pine. 2006. Safranyik, L.; Wilson, W.R. (Eds.) Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, British Columbia.

A Susceptibility and Risk Rating System for the Spruce Beetle, *Dendroctonus rufipennis*, Draft version 10, August 2005. L. Safranyik and T.L. Shore, Canadian Forest Service, Pacific Forestry Centre, Victoria, B.C.

A Susceptibility and Risk Rating System for the Douglas-fir Beetle in British Columbia. Draft version 10, April 2001. T.L. Shore and L. Safranyik. Canadian Forest Service, Pacific Forestry Centre, Victoria, B.C

Summary of results of the 2006 young pine project

Background and Project Summary

B.C. has approximately 1.96 million ha of young, lodgepole pine- leading stands between the ages of 20-55 years. In 2004, and to a much smaller degree in 2003, localized mountain pine beetle (MPB) attack was noted in young stands within the core outbreak area (Vanderhoof, Prince George and Quesnel Districts). A project was initiated in 2005 to quantify the current levels of mortality in these stands and to evaluate and predict future risk. In 2005 the study was focused on six Districts (Prince George, Vanderhoof, Quesnel, 100 Mile House, Central Cariboo and Nadina) that contain 490,236 ha, or 25%, of B.C.'s young pine inventory. By 2006, many young stands in the Kamloops, Cascades and Okanagan Shuswap Districts were also affected. The 2006 MPB attack in young stands is higher than previously observed and the intensity of attack in the more southern Districts was very high.

Young pine stands were assessed for MPB and associated insect attack and brood production. Stand-targeted aerial surveys, ground surveys and 24 permanent sample plots made up the complement of 2006 assessments. Other collaborative research efforts incorporated climate monitoring (Dr. R. Winkler, Mayson Lake Research Trial) and evaluation of verbenone trials in high value immature stands.

The aerial surveys were conducted between July 17 through September 22, 2006, with the final area in Prince George completed November 8, 2006. A total of 226 1:20,000 BCGS mapsheets, an increase of 83 from 2005, and over 2,528 stands were assessed in 2006. In 2006, 74% of the stands surveyed had some level of MPB attack compared to 49% with MPB attack in 2005. Approximately 9% of stands surveyed by air had over 50% visible mortality.

A total of 306 stands were ground surveyed in 10 Districts in 2006. Green attack levels were highest in Kamloops and 100 Mile House, with 79.1% and 62.2% stems attacked, respectively. (Table 5).

2006 Results

A total of 766,012 ha of candidate pine stands were identified within the study area (Table 1). Fourteen percent coverage by area, was achieved in the 2006 aerial surveys, ranging from 24% coverage in Vanderhoof to 3% in the Chilcotin. Greater than 80% of all stands assessed over 30 years of age had some level of MPB attack (Table 2) and 54.6% of very young stands (20 to 25 years) had some level of MPB attack. Attack ranged from less than 1% to over 95%.

In the aerial assessments, average red attack ranged from a low of 5.7% in Nadina to a high of 17% in Prince George (Table 3). Similarly, the highest percentage of stands affected was in Prince George and the lowest in Nadina, with 96% and 45% stands affected respectively.

Table 1. Total hectares of leading lodgepole pine stands (>80% pine) by age increments within the study area.

	hectares of lodgepole pine by age category (years)					
District	**20-25**	**26-30**	**31-40**	**41-50**	**51-55**	**Total**
100 Mile House	21,925	12,177	13,723	8,715	1,863	58,403
Cascades	20,237	7,312	4,387	5,302	7,209	44,447
Central Cariboo	26,168	12,017	24,130	31,901	5,633	99,849
Chilcotin	8,321	5,000	41,123	73,655	15,759	143,858
Kamloops	6,301	3,677	2,189	3,962	2,330	18,458
Nadina	26,715	16,129	14,849	8,419	8,292	74,404
Okanagan Shuswap	36,603	14,862	10,763	4,496	2,290	69,014
Prince George	23,762	12,060	24,184	18,032	2,506	80,544
Quesnel	28,162	14,002	15,759	25,067	13,776	96,766
Vanderhoof	21,314	14,836	23,281	10,782	10,056	80,269
Total	**219,508**	**112,072**	**174,386**	**190,331**	**69,714**	**766,012**

Figure 1 compares the frequency of 2005 and 2006 mountain pine beetle attack within stands as assessed in aerial surveys. From the aerial data, 27.1% (23,885 ha) of the area surveyed was still free of MPB. However, 7,795 ha, or 9%, had over 50% attack, while another 15% (13,576 ha) had between 25-50% attack (Fig. 2).

Data from air and ground surveys, expressed as average green attack, broken down into two broad age categories, 20 to 40 years and greater than 40 years, is compared in Table 4. A steady increase in the annual attack rate is seen in all Districts with the greatest increase occurring in 100 Mile and the lowest in Nadina (Table 4).

Table 2. Summary of all aerially surveyed polygons having some level of MPB attack in 2006, for all Districts, by age category.

Age Category	# stands surveyed	Area (hectares)	% stands with MPB attack	Avg. % red attack	Avg. % total attack
20-25	727	25,652	54.6%	5.1%	5.5%
26-30	594	22,120	73.6%	11.9%	12.9%
31-40	578	22,555	80.6%	16.1%	18.4%
41-50	388	11,506	85.8%	16.8%	21.6%
51-55	214	6,141	93.9%	20.4%	28.7%
unknown	27		70.4%	11.4%	13.1%
Total	**2,528**	**87,974**			

Table 3. 2006 aerial surveys statistics by District, showing hectares surveyed, number of mapsheets and stands surveyed, and attack levels in each District.

	Chilcotin	100 Mile House	Vanderhoof	Quesnel	Nadina	Prince George	Central Cariboo
Ha surveyed	4,413	12,302	18,906	21,423	5,494	9,018	16,376
No. mapsheets	13	32	44	41	16	37	43
No. polygons	165	357	535	424	127	415	503
Avg. % red attack	7.4%	7.3%	13.7%	15.6%	5.7%	17.0%	9.7%
Avg. % red+grey attack	11.5%	10.3%	15.1%	19.5%	7.5%	17.7%	12.2%
% stands affected	65.5%	59.4%	77.8%	84.0%	44.9%	96.0%	72.2%

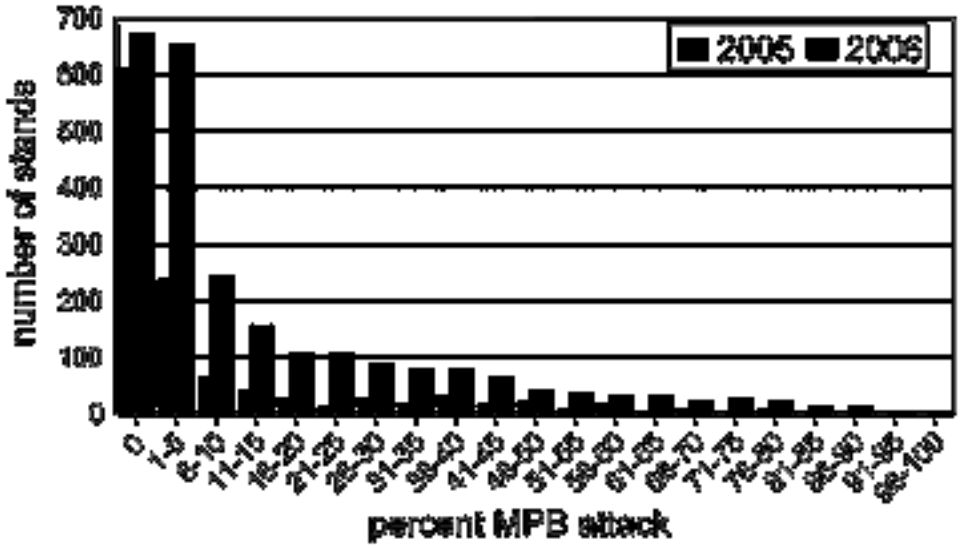


Figure 1. Frequency of MPB attack in stands aerially surveyed in 2005 and 2006.

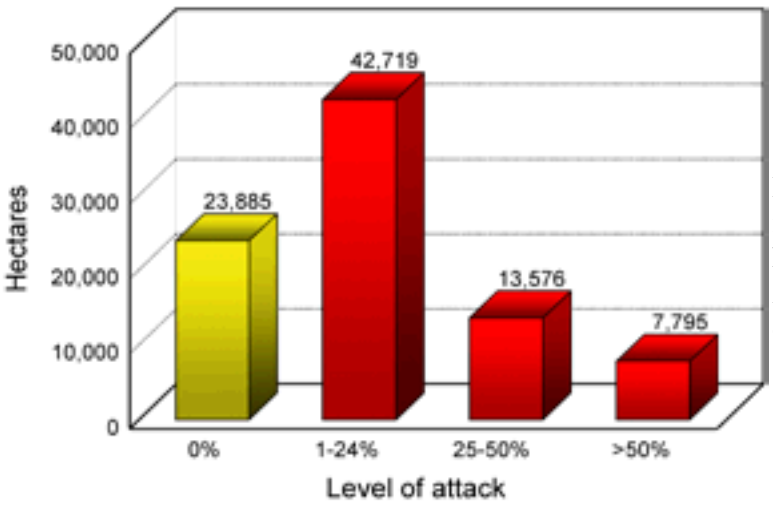


Figure 2. Total area assessed in the 2006 aerial surveys having no MPB attack, 1-24% attack, 25-50% attack, or >50% attack.

Table 4. Estimates of average green attack in stands 20 to 40 years, and greater than 40 years of age. Green attack levels were obtained from aerial surveys (red attack was expressed as the previous years green attack), and ground surveys conducted in 2005 and 2006. Therefore, only 2006 green attack is noted (from ground surveys).

Forest District/ Survey Type	Age Class	Percent attack in each year		
		2004	2005	2006
Prince George				
ground	20-40 years	<1%	16%	35%
air	20-40 years	<1%	14%	
ground	41-55 years	8%	17%	52%
air	41-55 years	2%	21%	
Vanderhoof				
ground	20-40 years	2%	8%	25%
air	20-40 years	<1%	14%	
ground	41-55 years	<1%	<1%	27%
air	41-55 years	7%	24%	
Central Cariboo				
ground	20-40 years	5%	19%	28%
air	20-40 years	1%	8%	
ground	41-55 years	30%	16%	27%
air	41-55 years	7%	16%	
100 Mile House				
ground	20-40 years	<1%	7%	62%
air	20-40 years	2%	4%	
ground	41-55 years	15%	9%	52%
air	41-55 years	7%	17%	
Nadina				
ground	20-40 years	<1%	1%	3%
air	20-40 years	1%	2%	
ground	41-55 years	13%	15%	7%
air	41-55 years	5%	18%	
Quesnel				
ground	20-40 years	3%	25%	29%
air	20-40 years	2%	15%	
ground	41-55 years	11%	41%	19%
air	41-55 years	13%	27%	

Very small diameter pine were attacked in 2006 in 100 Mile House, Central Cariboo and Quesnel, with average green attack diameter (dbh) of 12.4 ± 1.3 cm, 13.3 ± 6.7 cm and 13.9 ± 1.7 cm, respectively (Table 5). Larger stems were targeted by MPB in Kamloops, Cascades and the Okanagan, but 2006 was the first year of significant attack in these districts and the beetle is still primarily in spaced stands.

Table 5. Summary of ground surveys conducted in young pine stands in 2006, by District. The table lists number of stands surveyed, percent with MPB attack, the average percent green and red attack, and the average dbh (diameter at breast height) of all pine and of green attack pine (± S.D.).

	# stands surveyed	% with MPB	Avg. % green attack	Avg. % red attack	Ave. dbh ± S.D. (cm)	
					All pine	green attack
Okanagan Shuswap	16	56.3	1.0	0.2	14.3 ± 1.5	16.0 ± 1.4
Cascades	15	53.3	7.7	0	15.0 ± 1.6	16.7 ± 2.0
Kamloops	8	100.0	79.1	2.1	16.6 ± 1.6	17.4 ± 1.9
Quesnel	50	94.0	27.0	32.4	13.8 ± 1.5	13.9 ± 1.7
Central Cariboo	43	90.7	28.1	24.4	13.1 ± 1.6	13.3 ± 6.7
Chilcotin	21	95.2	16.7	10.6	11.9 ± 1.6	15.0 ± 2.6
100 Mile House	40	87.5	62.2	7.3	12.5 ± 1.2	12.4 ± 1.3
Prince George	43	83.7	36.5	17.0	15.5 ± 2.5	17.1 ± 8.2
Vanderhoof	33	60.6	24.9	8.0	14.1 ± 1.9	24.9 ± 2.8
Nadina	37	29.7	3.3	4.0	15.0 ± 1.9	17.4 ± 1.9

Green attack levels increased again in 2006 in young pine stands throughout the ground survey areas. The more northern Districts such as Prince George and Vanderhoof saw only slightly higher levels of attack than in 2005 (Fig. 3) with attack levels increasing significantly in more southerly districts. Both the frequency of stands having 2006 attack and the level of attack was highest in 100 Mile House (Fig. 3). Kamloops also had extremely high levels of attack but only 8 stands were surveyed. We expect the attack to level off in the north and central areas of B.C. as the beetle starts to decline significantly in mature stands. Attack levels will likely increase toward 100 Mile House, Kamloops and farther south.

Twenty-four 0.25 ha permanent plots are established throughout the core outbreak area. Location is the most important attribute with respect to MPB attack in these stands. The total percent attack ranged from 0-82%. Plots in older stands had the highest level of attack; however, even in very young stands, the percent green attack could be high. In both 2005 and 2006 attack densities on individual stems were very high, ranging from 178-293 galleries/m². Such high densities are not conducive to successful mountain pine beetle development and emergence. In plots established in 2005, results show that 2006 attack occurred in those stands that did not have 2005 attack. Stands which had high levels of 2005 attack, did not receive much fresh attack in 2006. The beetles that successfully emerged from the plot trees did not remain in the stand.

Brood production from young pine was more successful overall in 2006. Stands that had been spaced and/or fertilized were better hosts for the MPB. Collections made from adjacent mature and young stands (35 years) in mid-December, 2006, following a late November cold-snap, gave very comparable R-values of 6.5 and 5.3, respectively. We can expect the extent and severity of mortality to increase over the next two years, particularly in the south of the province from 100 Mile House and south.

A risk rating system for young pine stands is in development and the first iteration should be completed by early summer. For more information on this study and a copy of the full 2006 report, check the Southern Interior Region Forest Health website (http://www.for.gov.bc.ca/rsi/ForestHealth/Index.html).

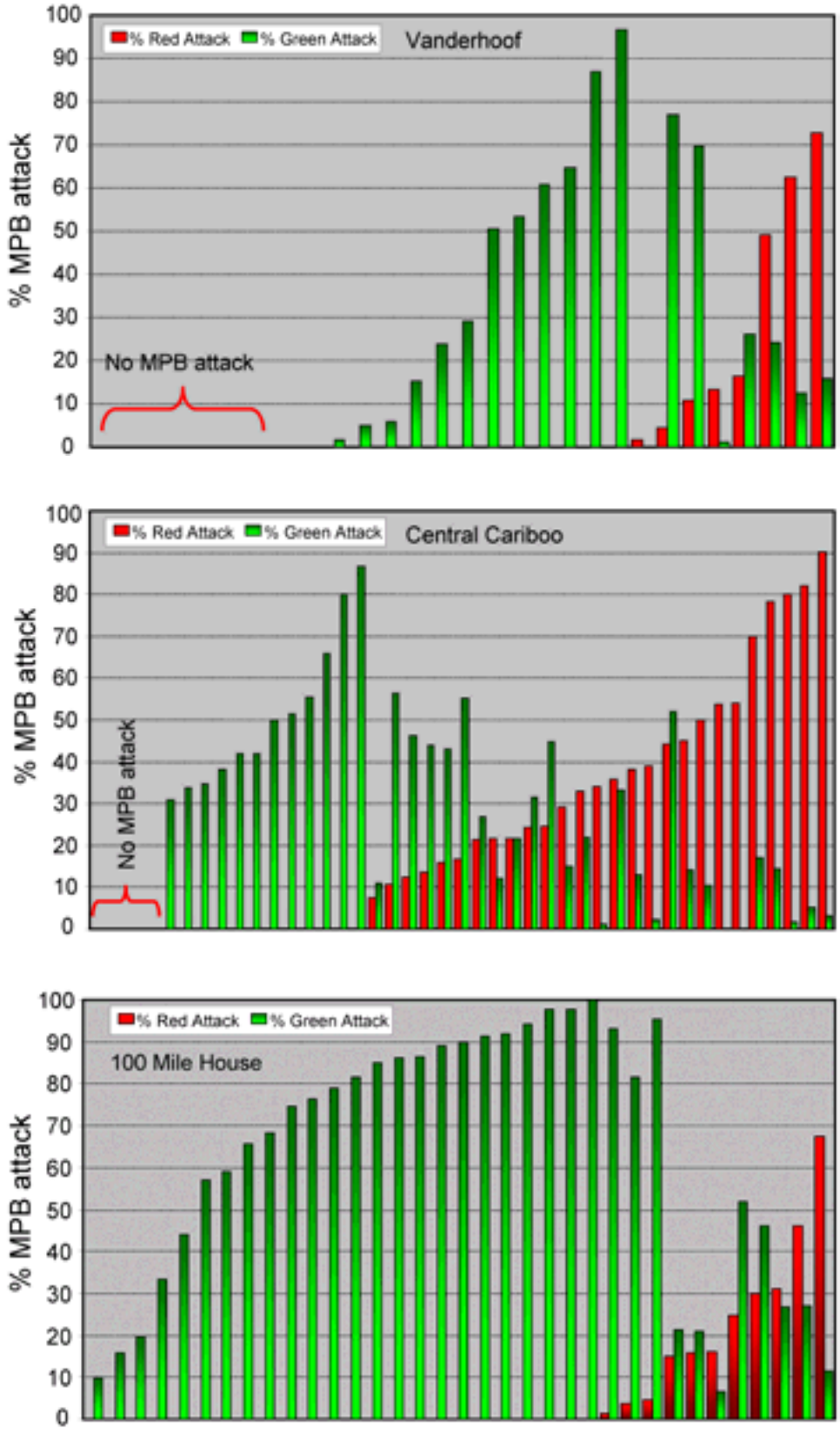


Figure 3. Percentage green and red attack in individual stands ground surveyed in Vanderhoof, Central Cariboo, and 100 Mile House Districts in 2006. Each vertical bar represents the % MPB attack in a single stand.

A 54 year old leading lodgepole pine stand in the Quesnel District showing high rates of red attack. BCGS mapsheet number 93B086, polygon 534.

Young pine (30 years old) overwhelmed by mass attack in 2006, near Mayson Lake, north of Kamloops.

Ponderosa Pine Mortality in the City of Kamloops

A very high level of ponderosa pine mortality was experienced in and around Kamloops in 2006. Severe outbreaks of mountain pine beetle (MPB) in lodgepole pine stands close to town, coupled with populations of western pine beetle (WPB) building in proximity to the 2003 fires presented a unique challenge to the community. Ponderosa pine was killed by one or more of a complex of bark beetles: western pine beetle, mountain pine beetle, turpentine beetle (*Dendroctonus valens*) and *Ips*. Thompson Rivers University, the city of Kamloops, and many homeowners attempted to protect trees with Sevin® and/or verbenone, with varying degrees of success. Some of the mountain pine beetle brood from the 2006 flight was able to develop through to adults and emerge from attacked trees by late summer. These beetles established galleries in previously attacked trees, rather than initiate new attacks. Three trapping sites, with 3 Lindgren funnel traps per site, were established on the Thompson Rivers University campus to monitor mountain pine beetle and western pine beetle flight over the summer (Fig. 1). The western pine beetle had its peak flight in early June with a minor second flight in late July (Fig. 1). Mountain pine beetles were caught throughout the summer but the peak flight was the last week of July to first week of August.

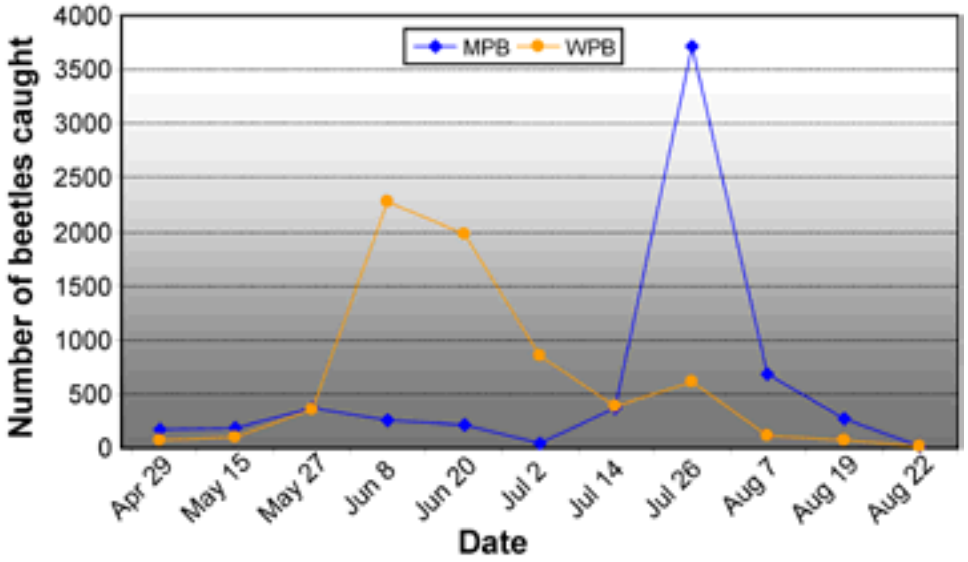


Figure 1. Trap catch results from three trapping sites on Thompson Rivers University campus showing total number of beetles caught (3-traps per sites x 3 sites) at 12 day intervals from April 29 – August 22, 2006. MPB=mountain pine beetle; WPB=western pine beetle.

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

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 from mountain pine beetle (MPB). 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, B.C. in the 100 Mile House Forest District. The site was located around 2,050 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 metre spacing, and included 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 mountain pine beetle attack in early August, and it was determined that no aggregation baiting was required to initiate beetle attack as most trees were mass attacked. The injected sytemics should provide protection for the pine trees and allow them to survive the MPB attack. The efficacy of the treatments will be evaluated in the early spring of 2007.

MCH Use For Douglas-fir Beetle in the Cariboo-Chilcotin

During the late winter and early spring of 2006, MCH (3-methylcyclohex-2-en-1-one) antiaggregation pheromone baits were distributed to disperse small populations of Douglas-fir beetle (IBD) in the Central Cariboo (DCC), Chilcotin (DCH), and 100 Mile House (DMH) Forest Districts. Antiaggregation pheromones provide a chemical message to beetles that host trees are completely occupied by infesting beetles and that they should search further for appropriate susceptible hosts. The beetles disperse in all directions and in most cases do not succeed in finding new host trees to successfully attack.

Small infestation centres were baited at a concentration of 75 baits per hectare, which is approximately a 12m by 12 m grid distribution. Sites were selected in areas where harvesting was not an available option due to access, topographical impediments, or management restrictions such as those linked to mule deer winter ranges and old growth management areas (OGMAs). Besides treating small infestations, fresh isolated windthrow patches may be treated to prevent beetle attack. MCH may also be employed as a post-sanitation harvesting treatment to prevent trees stressed by logging, residual logging debris, and stumps from being attacked by residual beetle populations. In some cases, larger infestations were baited in a push-pull treatment where baits were placed to push the beetles out, and trap trees were placed to pull the beetles into a more accessible logging site. Initial surveys in the fall indicate that MCH was very effective at reducing infestation size, preventing attack of windthrow patches, and dispersing small infestations.

In the Central Cariboo Forest District, 436 sites were treated by the Ministry of Forests and Range. In addition, B.C. Hydro treated more than 75 sites where Douglas-fir hazard trees were felled adjacent to power lines. Over-flow attack was minimal in sites checked.

In the 100 Mile House Forest District, 88 sites were grid baited with MCH in spring 2006. The baited areas varied in size between 0.5 and 2.0 ha. Sites using a push-pull treatment with MCH and trap trees were very successful. MCH sites established without trap trees, that were re-surveyed, had no current attack in the MCH treated areas.

In the Chilcotin Forest District, there were a total of 144 sites treated with MCH, out of 631 total sites mapped during the aerial survey (23% of total sites). The district staff inspected 72 of the MCH sites (50%). Of the sites inspected, 40 (56%) had no spill-over. The 32 sites containing overflow attack included 329 current attack trees. There was tremendous variation between sites, with one site containing 101 overflow attack. If we exclude the one large overflow site, the average attack for the remaining sites is 7.4 new infested trees/site. The situation in the Chilcotin was an extreme test of MCH because the Douglas-fir beetle pressure was very high, and in many cases survey information around MCH treated sites was incomplete. Extensive overflow attack in a few of the MCH sites was almost certainly due to large adjacent undetected beetle infestations.

Overall, the MCH treatment program of Douglas-fir beetle control was very successful. However, there were a few lessons learned. If possible, it is important to try to avoid treating spots with incomplete beetle population information. A push-pull treatment program using trap trees and MCH is recommended for infestations over 10 trees in order to reduce risk of overflow. The larger the treatment site, the greater the risk of overflow attack into the surrounding forest. Pushing beetle infestation centres greater than 25 trees is not recommended without incorporating trap tree use.

Western Spruce Budworm Moth Trapping Versus Egg Mass Sampling as a Predictive Tool

Trapping versus egg mass sampling to predict western spruce budworm populations has been ongoing for the past few years. The objective of this project is to test the predictive capability of trapping moths in pheromone baited traps (milk carton traps) compared to the standard method of annual fall egg mass sampling. Only a small trapping project was conducted in 2006 using the high dosage (330 nanograms) eastern spruce budworm lure in 3 traps per site. The active ingredient contained in the eastern spruce budworm lure is 95% E-11 tetradecenal / 5% Z-11 tetradecenal. All lures were supplied by Phero Tech Inc. The 3-trap clusters were placed in groups of 3 to 7 sites at six locations where other monitoring was occurring (Table 1).

Egg mass sampling was conducted in each of the general geographic areas where traps were placed as part of our operational program. Fifteen overstory Douglas-fir were selected at each sampling site and a 45 cm branch tip from the north and south aspect, taken at mid-crown, was clipped and evaluated for the presence of western spruce budworm egg masses. The number of egg masses was then expressed as an average per 10 m^2 foliage for each site (Table 1) to give a prediction of defoliation in 2007.

Table 1. Average number of western spruce budworm moths caught at six locations (average moths per site; 3 traps per site)(±S.D.) with predicted population for 2007 compared to egg mass sampling results (±S.D.) and the predicted defoliation for 2007.

Location	No. sites	Avg. moth catch (±SD)	Population prediction	Avg. # egg masses/10m^2 (±SD)	No. sites	2007 defoliation prediction
Tulameen	5	104.9 ± 45.8	Moderate	19.3 ± 22.5	9	Low
Copper Mountain	4	126.7 ± 26.5	Moderate	14.0 ± 8.1	3	Low
China Road	3	145.2 ± 5.2	Moderate	16.6 ± 6.1	3	Low
Lindley Lake	6	86.3 ± 14.6	Low	27.6 ± 23.9	4	Low
Lindley Lake West	5	86.4 ± 5.7	Low	21.2 ± 23.9	4	Low
Kentucky Alleyne	7	89.7 ± 13.3	Low	12.6 ± 17.4	4	Low

History of MSMA use in the Southern Interior Forest Region

Glowon Liquid Tree Killer® (active ingredient monosodium methanearsenate, known as MSMA) has been used operationally in B.C. for the suppression of mountain pine beetle and spruce beetle since 1982. The registration of this pesticide expired in 2006 and it was decided not to pursue re-registration. Therefore, existing stocks of MSMA will be disposed of and alternate methods of single tree control will be used.

For control of mountain pine beetle, MSMA is applied approximately 3 weeks post-attack by making an axe-frill slightly above ground level and applying MSMA into the frill. The chemical is then translocated up the phloem-cambium interface, creating a toxic environment for developing beetle brood. This is a very effective way to control small, remote populations of mountain pine beetle that can not be immediately accessed by other conventional means such as harvesting. At the time of application, treated trees and patches of trees were marked with "Pesticide Treated" tags and flagging tape, and can be distinguished by the evidence of an axe-frill at their base. As harvesting has accelerated in most areas throughout B.C. and the southern interior, some of these treated trees are being encountered by harvesting crews. A policy is currently being drafted and will be circulated later in 2007 as to how to record and deal with any treated trees that are encountered.

As part of the process in creating this policy, the Southern Interior Forest Region compiled a list of MSMA treatments throughout the Region. Figure 1 shows the total amount of MSMA used from 1982-2004 in the Southern Interior Forest Region. Table 1 lists the MSMA use by District in the Southern Interior Forest Region. Maps with locations of treated trees will be posted on the Southern Interior Forest Region web site.

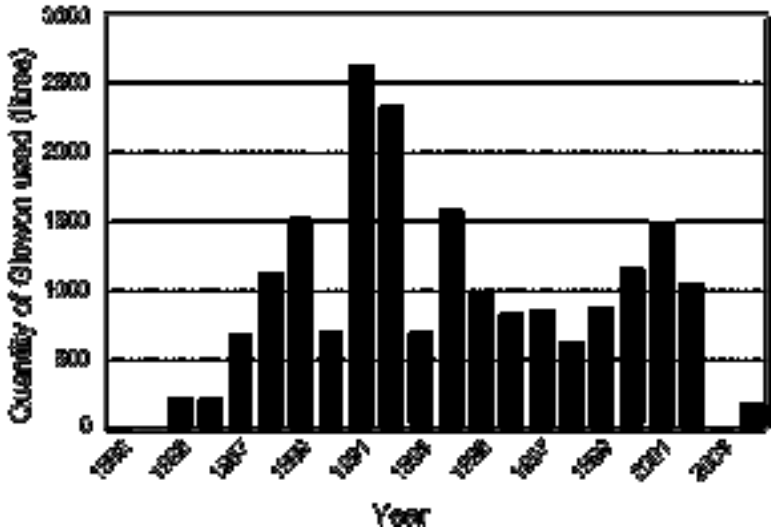


Figure 1. Glowon® (active ingredient MSMA) use in the Southern Interior Forest Region for mountain pine beetle under Pesticide Use Permits and Pest Management Plan: 1982-2004.

Table 1. Glowon® (active ingredient MSMA) use in the Southern Interior Forest Region, by District, by the Ministry of Forests & Range for mountain pine beetle under Pesticide Use Permits and Pest Management Plan (1982-2004).

Forest District	Quantity Glowon® (litres)	Quantity a.i. (kg)	# Years Use
Chilcotin	89.3	28.6	3
100 Mile House	1.4	0.5	1
Central Cariboo			
Williams Lake	33.3	10.6	2
Horsefly	15.0	4.8	2
Kamloops	1,772.0	567.1	20
Cascades			
Merritt	9,538.8	3,052.4	20
Lillooet	483.9	154.9	7
Okanagan Shuswap			
Salmon Arm	79.6	25.5	7
Vernon	2,896.3	926.8	18
Penticton	1,679.9	537.6	11
Headwaters (Clearwater)	119.7	38.3	4
Rocky Mountain			
Cranbrook	1.9	0.6	1
Invermere	389.4	124.6	4
Kootenay Lake	188.8	60.4	6
Arrow Boundary	1,163.0	372.2	8
Columbia (Golden)	7.7	2.5	3
Total	18,459.9	5,907.2	

Mountain pine beetle attack at the Kalamalka Forestry Centre

Jim Corrigan, Michael Carlson, Gary Giampa, Vicky Berger, Chris Walsh and Ward Strong

The Ministry of Forests and Range (MoFR) Kalamalka Forestry Centre (KFC) is located in the North Okanagan just south of Vernon. Approximately six thousand mature (18-25 year-old) grafted lodgepole pine trees are planted in six orchards at this facility (Fig. 1).

Figure 1. Aerial view of the Kalamalka Forestry Centre with the lodgepole pine orchards highlighted in green. Three Clone Bank Blocks (8, 10, 11) are located in the Research Station fields. Two Seed Orchards (307, 230) are situated to the south. A small, retired research plot (EP907 – highlighted but not labeled) is located just southwest of the KFC buildings.

On August 2, 2006, the first mountain pine beetle (MPB) attack was noted on a number of trees in Seed Orchard #307, and upon subsequent inspection, in every lodgepole pine orchard at the facility. Speculation was that large numbers of beetles were blown into the site from the north. In total, over 800 trees were attacked during this early August flight period of the MPB. In addition to the attacks noted at the KFC, about a dozen trees were attacked at the Vernon Seed Orchard Company and at Pacific Regeneration Technologies, while no attacks were detected at MoFR Bailey Road or at the Tolko Eagle Rock Seed Orchards. Attack was uneven and patchy. Over 95% of all attacks were recorded at KFC, and nearly 75% of them were recorded in a single plantation, Seed Orchard #307.

Within 48 hours of the first detection of MPB attacks at the KFC, protective pesticide sprays (2% Sevin solution applied to the boles) were applied to trees in several of the most heavily attacked orchards. In late August, additional trees in EP907 received a Sevin bole spray. In early August Seed Orchards #307 and #230, and Research Blocks 8, 10 and 11 were surveyed to determine the location of attack and severity of attack was rated: i) Not attacked (no pitch tubes seen on bole); ii) 'Light' (1-10 attacks); iii) 'Medium' (11-20 attacks), or iv) 'Severe' (more than 20 attacks seen on bole). Orchard #307 sustained the majority of the more severe attacks and most attacks in Block 8 (79%) and EP907 (100%) were characterized as moderate or severe.

Four pheromone-baited Lindgren funnel traps® were placed in the area on August 11 and were checked twice weekly until mid-September. A sub-sample of every collection has been identified, and all individuals have keyed out to MPB. Based on filed observations and trap catches, there were two beetle flights into the area, ane in early August, and another in late summer (Table 1). Dezene Huber (University of Northern British Columbia – pers. comm.) agrees that these trap catches are reflective of the substantial beetle activity in the surrounding area.

Table 1. Weekly trap catches of mountain pine beetle (MPB) from four pheromone baited Lindgren funnel trap located at the Kalamalka Forestry Centre.

Collection Dates	No. of MPB Caught
Aug. 14 and 17	531
Aug. 21 and 24	563
Aug. 28 and 31	63
Sept. 4 and 7	391
Sept. 11 and 14	41
Sept. 18 and 22	1

Alvin Yanchuk (Manager, Forest Genetics Section, Research Branch, MoFR) suggested examining the distribution of MPB attacks in Seed Orchard #307 across clones, full and half-sib families and provenances. Attack frequency distributions were determined to be non-random for clones, families and provenances in orchard #307 (Chi square, $P<0.001$). Genetic variation for MPB attack frequencies was first observed in the Prince George lodgepole pine progeny test series (EP770.20). Observations of genetic variation in MPB host preferences at multiple levels of genetic hierarchy (clone, family, provenance) in KFC Seed Orchard #307 will allow for further study of resistance/tolerance mechanisms operating in the lodgepole pine host.

Very little frass and sawdust were observed at the base of attacked trees during weekly monitoring, even "medium" and "severely" attacked trees. Attacked trees produced extremely large pitch tubes and many beetles were pitched out. The good general health of the trees in the KFC orchards may allow many to survive the 2006 MPB attack. Recent samples indicate few parent beetles within main galleries and little or no brood production.

Projections are that less than 50 trees will die as a result of the 2006 MPB attack. Included in this mortality are half of the attacked trees in the retired EP907 block. These are among the oldest, and largest, trees (23-25 years old). These trees have not been topped, they are not fertilized and are not on the irrigation system. The good health of the ramets has likely contributed to resistance to lethal attacks in 2006. Most of these trees are well fertilized and continuously drip irrigated. Final evaluations of mortality will be done in the spring of 2007.

The maintenance of strong healthy trees, along with preventative use of chemical pest controls, will likely be the cornerstone of future recommendations for controlling MPB in high-value research, clone bank and seed orchard pine plantations. In the long term, study of host resistance mechanisms and host/parasite interactions using resistant and susceptible clones, families and provenances will contribute to a better understanding of MPB biology.

Pathology Update

Drought

Summer drought is a significant factor affecting early tree survival and plant growth in the Southern Interior Region. Drought-related mortality is most commonly seen on species like Douglas-fir and western red cedar while other tree species such as spruce, lodgepole pine and birch have also shown to be impacted by drought episodes. Tree vigour can be compromised in areas experiencing drought, which may increase the susceptibility of trees to attack by other pests and pathogens, especially root diseases (*Armillaria ostoyae, Phellinus sulphurascens* (syn. *P. weirii*), and *Inonotus tomentosus*).

Drought mortality in young conifers

Armillaria Root Disease

Armillaria root disease (*Armillaria ostoyae*) causes considerable losses in immature and mature stands throughout much of the Southern Interior Region by killing natural and planted coniferous trees and causing progressive reduction in stem growth on older trees that sustain chronic (non-lethal) infections. Mortality can start as early as 4-5 years following planting, however recent research shows the initial flush in mortality peaks between 12-15 years of age. 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.

Mycelial fan characteristic of A. ostoyae.

Where inoculum has not been removed, cumulative mortality in conifer species can be significant. Recent surveys of juvenile mixed conifer stands in the ICH in the Okanagan Shuswap and Arrow Boundary Forest Districts revealed 25% cumulative mortality in Douglas-fir, compared to only 2% in western redcedar. Early results from a species trial near Hidden Lake in the Okanagan Shuswap District and surveys of other juvenile mixed conifer stands in the same area revealed up to 24% cumulative mortality in western larch by age 15, considerably higher than that occurring in Douglas-fir. Western larch becomes more resistant to *A. ostoyae* only after the age of 25 years, and before that critical age it suffers high mortality. The use of western larch for regenerating sites infested with Armillaria requires further scrutiny particularly since the early mortality that occurs in larch adds a sizeable amount of secondary inoculum which can perpetuate root disease losses

Honey mushrooms of A. ostoyae.

in the long-term. Effective resistance in western redcedar against *A. ostoyae* was the subject of intensive study over the past five years and several root disease inoculation trials were implemented in the Okanagan Shuswap and Arrow Boundary Forest Districts to examine differential resistance among conifers to the fungus. Results of this work will be published next year.

A Forest Health Stand Establishment Decision Aid (SEDA) for Armillaria root disease was developed for the Southern Interior Region and will be published in the B.C. Journal of Ecosystems and Management. The SEDA contains information specific to Armillaria root disease management stemming from current and on-going Armillaria research in the Southern Interior Region. The SEDA also contains a revised table of susceptibility ratings for host species and a decision key by BEC zone/subzone that aims to differentiate between the distribution of Armillaria inoculum and extent of damage on host species within the BEC zones/subzone and then suggests appropriate measures to be taken in order to minimize losses. It is recommended that the SEDA be used as a tool for decision making in areas where Armillaria root disease management is priority. Linkages to the SEDA and other relevant material will be posted on the Southern Interior Region Forest Health website.

Laminated Root Rot

Phellinus sulphurascens (syn. *P. weirii*), the cause of Laminated root disease, is known to occur across a variety of BEC zones in the Southern Interior Region, 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 *A. ostoyae* and Douglas-fir beetle (*Dendroctonus pseudotsugae*). Often, Douglas-fir beetle epidemics mask the incidence of root disease by being the obvious killer (i.e. showing more distinct aboveground symptoms) which creates challenges particularly for small scale salvage operations in minimizing the impact of root disease on residual trees and post-harvest regeneration. An ocular estimate of root disease presence in the stand prior to harvesting is key.

Work is currently underway to determine the occurrence and incidence of *Phellinus* root disease in the Southern Interior Region using a matrix of inventory type groups, age classes, and BEC zones, and estimate losses due to *Phellinus* root disease in Douglas-fir obtained from a network of growth and yield permanent sample plots. Results of this work will permit the development of a first approximation OAF (Operational Adjustment Factor) specific to Laminated root disease.

Active root disease centre caused by laminated root rot

Laminated decay caused by P. sulphurascens.

Rust Diseases Of Hard Pine

Pine stem rusts such as Comandra blister rust (*Cronartium comandrae*), Stalactiform blister rust (*Cronartium coleosporioides*), and western gall rust (*Endocronartium harknessii*), affect lodgepole pine throughout much of the province. Major infection events occur in 'wave years' where sporulation coincides with suitable weather conditions in the late spring or early summer. These 'wave years' typically occur once every 5-10 years, however, field observations in the Southern Interior Region suggest that the rate at which these major infection events occur may be more frequent and that the high risk period for rust may also extend beyond the maximum susceptibility age of 15 years for lodgepole pine. The abundance of alternate host species, terrain and host genetics all affect the frequency and severity of infection. Damage tends to be greatest in younger stands while large amounts of infection can impact such stands both pre- and post- free growing. Stem infections can lead to serious stem deformities, reduced tree growth and mortality.

Stalactiform blister rust causing elongated canker and bending of the stem.

Comandra blister rust (Valemount).

Tree mortality and unstocked openings in the stand caused by Comandra blister rust (Ellis Creek).

Bole and branch galls caused by Western gall rust.

Pine Needle Diseases

Pine needle cast (*Lophodermella concolor*) affects lodgepole pine trees throughout much of the Southern Interior Region. The fungus infects the current year's needles which become symptomatic (turning red) the following year. Repeated defoliation (casting) of needles, particularly in younger trees, may reduce growth or result in tree mortality.

Dothistroma needle blight on lodgepole pine in Headwaters Forest District.

Dothistroma (red band) needle blight (*Dothistroma septosporum*) infects needles of all ages throughout the growing season whenever environmental conditions are suitable for sporulation and infection on lodgepole pine. Damage can be severe in areas experiencing mild, wet weather. In 2005, an overview flight was conducted in the Headwaters District to examine the extent of *Dothistroma* in stands of lodgepole pine. Moderately affected lodgepole pine was found in more than 3,600 hectares of all age classes and over 300 hectares of lodgepole pine were severely blighted (primarily younger age classes). However, *Dothistroma* is not new to this area. FIDS reports cite these same areas being impacted more than 20 years ago. Favourable climate conditions in the early spring and summer and a higher concentration of young susceptible hosts on the landscape may have allowed the disease to spread and intensify. Monitoring the incidence, severity, and forest stand impacts caused by needle diseases, including *Dothistroma*, will be essential in future years, particularly for those areas that are likely to undergo increases in summer precipitation indirectly associated with global climate change, which may serve to benefit the development of foliar pathogens.

Forest Pathology Projects

Root diseases, particularly Armillaria root disease, are the most significant forest pathogen impacting coniferous forests in the Southern Interior Region. The presence and impact of root disease on stand productivity is often undetectable, unmeasureable, and underestimated. Strategies to reduce losses due to root disease are limited to inoculum removal via stumping or planting species that are less susceptible to killing by the fungus.

Of particular concern is the uncertainty and/or lack of published information in B.C. regarding the effectiveness of inoculum removal techniques in minimizing or mitigating the impacts of root disease and the use of alternative treatments to control root disease, namely mixed species plantations including resistant hosts or inoculation of stumps with a saprophytic fungus (*Hypholoma fasciculare*) which is hypothesized to out-compete fungal inoculum in stumps. The latter option strictly remains experimental at this stage and is not recommended for use operationally. The following projects are underway to evaluate the effectiveness of various other root disease control treatments:

Stumping Trials:
Several 20+ year old root disease stumping trials in the Southern Interior Region will be re-measured to quantify the effects of inoculum removal on early mortality caused by *A. ostoyae* and *P. sulphurascens* (syn. *P. weirii*) and growth responses following stumping and root raking treatments.

Pre-commercial Thinning and Pop-up Spacing Trials:
Several 15+ year old trials established on sites infested with *A. ostoyae*, *P. sulphurascens* (syn. *P. weirii*), and *Inonotus tomentosus* in the Southern Interior Region, Coast Region, and Northern Interior Region will be evaluated to determine the effects of thinning on the epidemiology of root disease in young plantations.

Armillaria Root Disease - Western Red Cedar Operational Trials:
Recent information pertaining to effective root disease resistance operating in western redcedar against *A. ostoyae* led to the establishment of several field trials in the Southern Interior Region. This study will compare the effects of stumping versus mixed conifer plantations including western redcedar on mortality and growth responses in Douglas-fir.

Publications

Analysis of historic western spruce budworm defoliation in south central British Columbia. 2006. Lorraine E. Maclauchlan, Julie E. Brooks, Janice C. Hodge. For. Ecol. Manage. 226:351-356.

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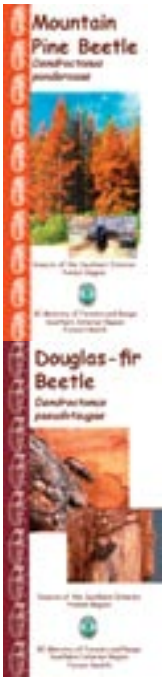

Southern Interior Forest Region, Forest Health Staff, October 2006:

Back row, left to right: Kurtis Isfeld, Chilcotin; Rick Stock, 100 Mile House; Jeff Jacobi, Okanagan Shuswap; Steve Gillette, Headwaters; John Cruikshank, Columbia; Lorraine Maclauchlan, Southern Interior Region.

Middle row, left to right: Heather Rice, Okanagan Shuswap; Heather MacLennan, Headwaters; Michelle Cleary, Southern Interior Region; Kerri Howse, Central Cariboo; Kristine Wilker, Central Cariboo; Leslie Lund, Quesnel; Norma Stromberg-Jones, Headwaters.

Front Row, left to right: Leo Rankin, Williams Lake; Janet Beltz, Okanagan Shuswap; Shane Schofield, Chilcotin; Liz Goyette, Rocky Mountain; Rick Mazzocchi, Arrow Boundary; Leith Mackenzie, Kamloops.

extensive grey stage mountain pine beetle attack in the Quesnel District.

mountain pine beetle attack at the Red Rock Seed Orchard, near Prince George.

woodpecker feeding activity on ponderosa pine infested with western pine beetle, near Niskonlith Lake.

Buprestid larva collected from a fire-damaged tree.

western pine beetle adult.

B.C. Ministry of Forests and Range
Southern Interior Forest Region
515 Columbia Street,
Kamloops, B.C.
V2C 2T7
(250) 828-4179

This summary was prepared by:

Lorraine Maclauchlan, Ph.D., Regional Entomologist (Kamloops)
Michelle Cleary, Ph.D., Forest Pathologist (Kamloops)
Leo Rankin, M.P.M., Forest Entomologist (Williams Lake)
Art Stock, Ph.D., Forest Entomologist (Nelson)
Kevin Buxton, R.F.T., Forest Health Specialist (Kamloops)

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