Summary of Aerial Overview Surveys and Research in the Kamloops Forest Region - 2002

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2002 Overview of Forest Health in the Kamloops Forest Region

INTRODUCTION

The 2002 aerial overview surveys were conducted between July 18 and August 13, 2002. Complete coverage of the Region was obtained with a total of 48 hours of flying over 13 days. All surveys were completed using the standardised Aerial Overview survey method and digital mapping protocol, and documented mortality or damage resulting from bark beetles, defoliators, and any other visible forest health factors. Standards can be located on the Ministry of Forests website (http://www.for.gov.bc.ca/hfp/FORSITE/overview/overview.htm)

Bark beetle and defoliator damage levels used in the aerial overview surveys are:

Bark beetle intensity class	Current mortality	Defoliation intensity class	Attributes
Light	1-10%	Light	some branch tip and upper crown defoliation, barely visible from the air
Moderate	11-29%	Moderate	thin foliage, top third of many trees severely defoliated, some completely stripped
Severe	30%+	Severe	bare branch tips and completely defoliated tops, most trees sustaining >50% total defoliation

The most damaging pests in 2002 in the Kamloops Region, based on area affected, were western spruce budworm (70,818 ha), two-year cycle budworm (64,174 ha), mountain pine beetle (35,302 ha), western balsam bark beetle (24,864), birch leaf miner (9,720 ha), western hemlock looper (7,423 ha), and Douglas-fir beetle (2,189 ha). Other less important pests included spruce beetle (1,027 ha), Douglas-fir tussock moth (91 ha), satin moth (324 ha), pine needle cast (469 ha), and assorted damage by abiotic agents such as wildfire, windthrow, and flooding.

Table 1. Summary of hectares affected by pests in the Kamloops Forest Region during the 1999 - 2002 aerial overview surveys.

Damaging Agent	Hectares Affected			
	1999	**2000**	**2001**	**2002**
wildfire	1,670	560	2,885	1,472
mountain pine beetle[a]	29,750	21,218	31,529	35,302
Douglas-fir beetle	235	1,535	4,048	2,189
spruce beetle[b]	340	673	1,803	1,027
western balsam bark beetle	17,230	16,708	23,188	24,864
western spruce budworm	1,130	14,693	22,416	70,818
two-year cycle budworm	0	74,023	0	64,174
western hemlock looper	0	0	0	7,423
false hemlock looper	0	0	0	512
Douglas-fir tussock moth	0	0	49	91
pine needle cast	350	6,400	155	469
satin moth	190	503	2,009	324
birch leaf miner	0	0	4,466	9,720

[a] Includes Manning Provincial Park

[b] Spruce beetle infestations are difficult to detect in overview surveys, therefore estimates of area attacked are most likely underestimated.

REGIONAL OVERVIEW

MOUNTAIN PINE BEETLE, *DENDROCTONUS PONDEROSAE*

The mountain pine beetle (MPB), *Dendroctonus ponderosae*, continues to be the most devastating forest health issue in the Province. The Kamloops Region has maintained a lower rate of increase than most other regions of the province impacted by the MPB (Fig. 1). The Cariboo and Prince George Regions have the largest areas affected, with 539,315 ha and 685,598 ha of red attack, respectively. Since 1999, the area under attack in B.C. has increased twelve-fold to total over 1.96 million ha in 2002. Due to another mild, favourable winter for the beetle, predictions are for continued expansion of the population throughout the province.

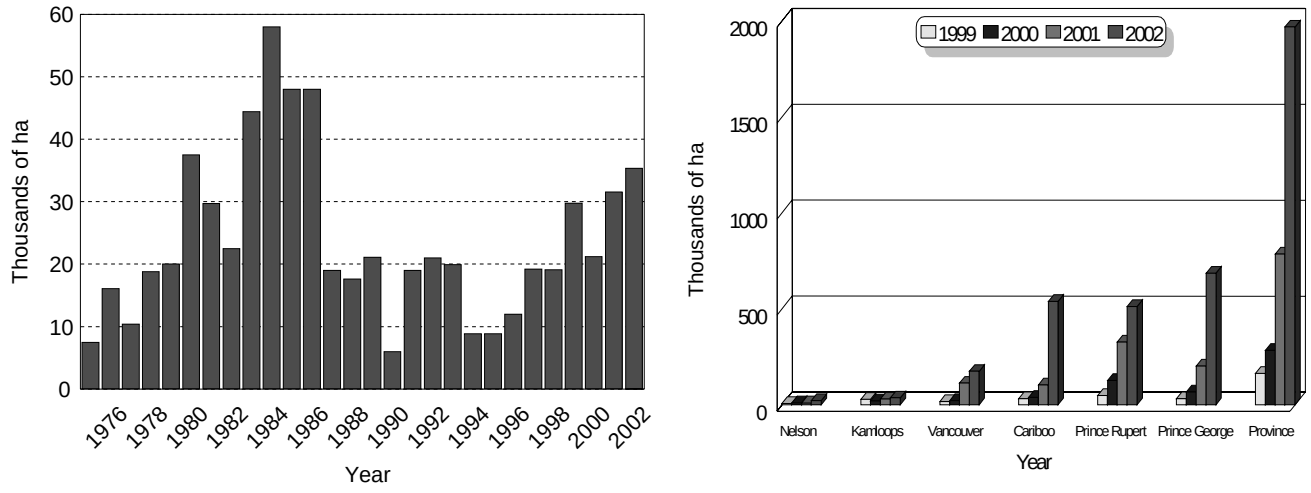


Figure 1. Hectares affected by mountain pine beetle (left) 1974-2002 in the Kamloops Region and, (right) 1999-2002 in all Regions.

Mountain pine beetle caused mortality in the Kamloops Region increased slightly to 32,369 hectares in 2002 from 29,457 ha in 2001. Additionally, 2,933 hectares of damage were mapped in Manning Provincial Park, in the Vancouver Forest Region bounding the Merritt District, to bring the total to 35,302 ha. 1,409 spot infestations (under one hectare in size) resulted in the mortality of a further 13,345 trees (up from just over 10,000 trees in 2001). The largest expansion of MPB occurred in the Kamloops District for the second year in a row, where the area of red attack increased by 40% to almost 14,000 ha. Affected area in the Kamloops District has now almost tripled from 2000 levels, and has begun to exceed the affected area in the Merritt District. Significant expansions also occurred in the Lillooet and Clearwater Districts. The total area affected in the Merritt District decreased slightly, with a large decrease in the area of severe damage, to levels similar to 2000. Area affected in all three Districts of the Okanagan TSA fell from 2001 levels. However, most infestations in the south Okanagan-Ashnola River area consisted of widely scattered small patches and spots, indicating an expanding population in the area. The greatest expansions occurred in the Red Plateau, Criss Creek, Battle Creek, and Scottie Creek areas in Kamloops District, and in Manning Provincial Park. Figure 4 shows the extent of mountain pine beetle infestations and current mountain pine beetle beetle management unit boundaries and strategies.

Average polygon size continued to decrease (Fig. 2, Table 2), from 16.3 hectares in 2001 to 13.8 hectares in 2002, while the number of polygons mapped increased from 1,811 to 2,344 (Table 2). As well, the number of spot infestations (under 0.5 ha and /or less than 50 trees) (Fig. 3, Table 2) increased from 1,141 to 1,376. This trend towards an increasing number of smaller, scattered populations has been ongoing for several years, and reflects both an expanding population, and a management approach that has been successful at reducing the size of many areas of attack. Throughout the Okanagan TSA (Salmon Arm, Vernon, Penticton) the spot-to-polygon ratio is high (Fig. 3). This shows continued expansion of the beetle population with many new areas of infestation.

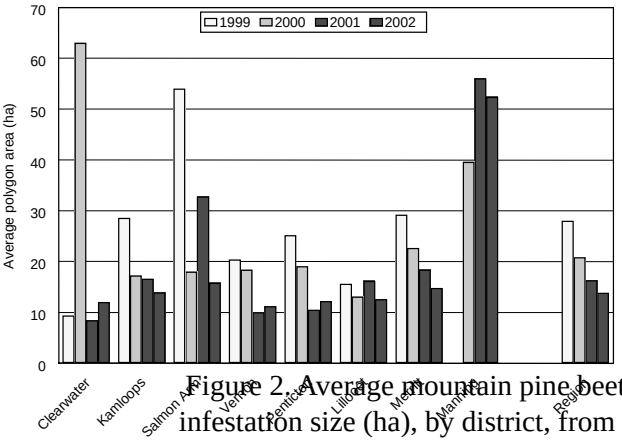


Figure 2. Average mountain pine beetle polygon infestation size (ha), by district, from 1999-2002.

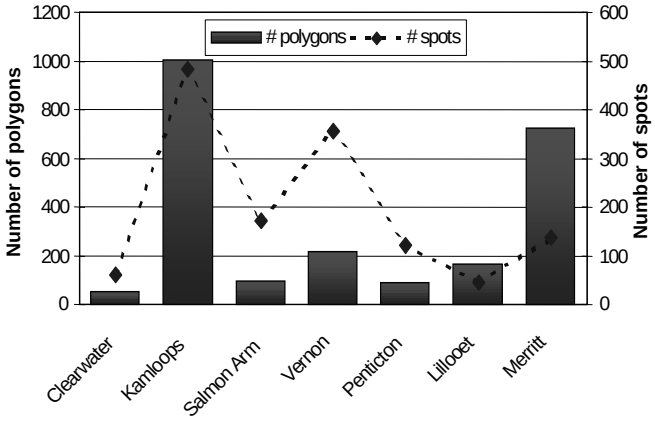


Figure 3. Total number of mountain pine beetle polygons and spots mapped in the 2002 aerial overview survey, by District.

Table 2. Area infested, number of polygons, and average polygon size, for mountain pine beetle in the Kamloops Forest Region, 1999-2002.

Year	Area infested	# polygons	Average polygon size (ha)	# of spot infestations	# trees killed in spot infestations
1999	29,750	921	28.0	681	7,570
2000	21,218	1,024	20.8	771	7,815
2001	31,529	1,811	16.3	1,141	10,250
2002	32,369	2,344	13.8	1,376	13,070

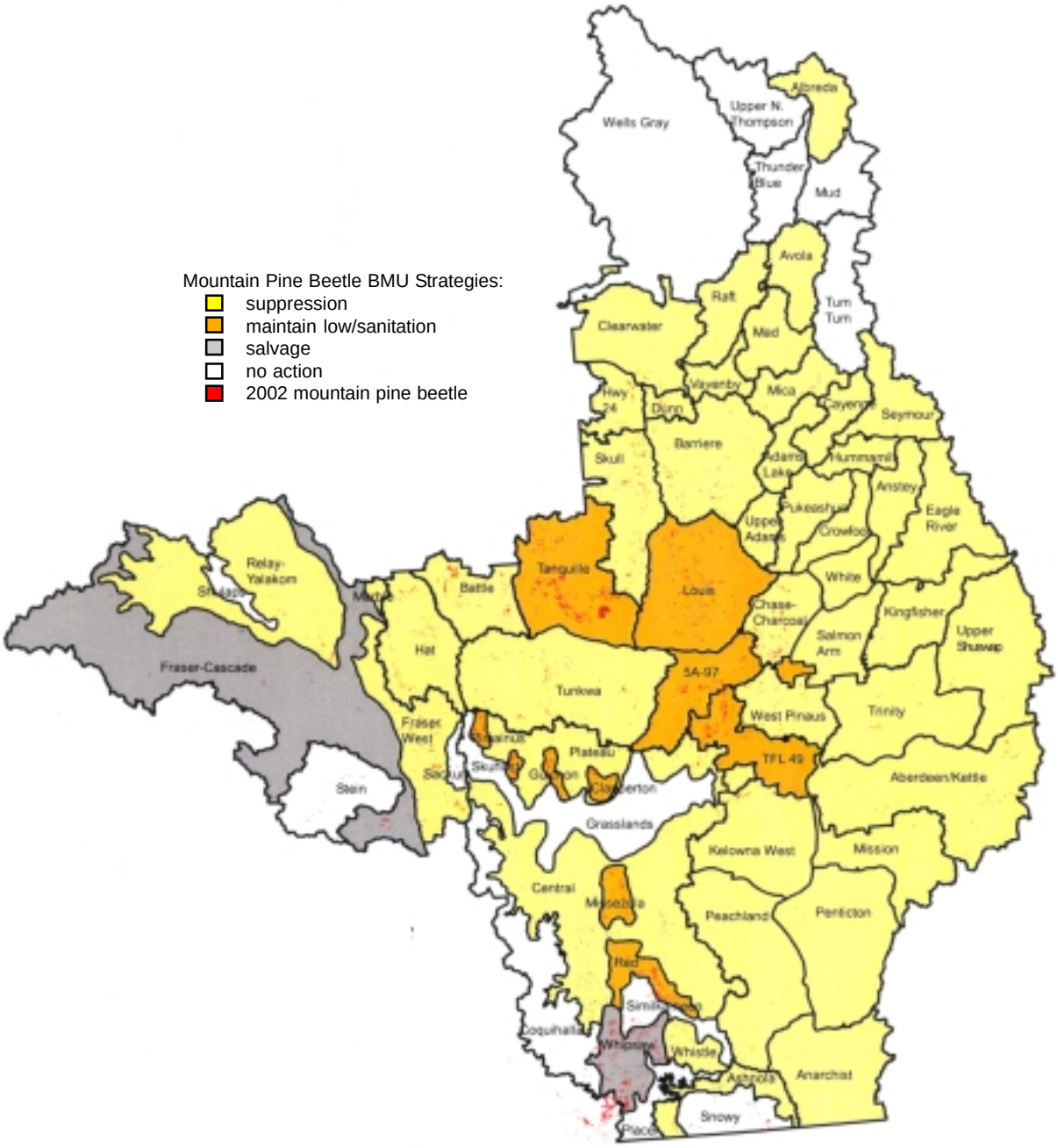


Figure 4. Beetle Management Units (BMU's) in the Kamloops Region, showing management strategies by colour theme and 2002 mountain pine beetle activity.

Two types of surveys can be conducted annually in areas of infestation to determine beetle population trends. MPB population trends can be estimated by calculating the ratio of currently attacked trees to one-year-old attacked trees (green:red ratio) (Table 3, Fig. 5). A ratio of >1 indicates an increasing population; a ratio of <1 indicates a declining population. Green:red ratios averaged 2.9:1 over the entire Region, a decrease from the 3.7:1 ratio reported in 2001. Individual sites varied greatly from as high as 8:1 to <1. However, values >2:1 represent outbreak populations and coupled with decreased host vigour in many sites due to moisture stress and other pest problems, the prognosis for 2003 is for continued population expansions.

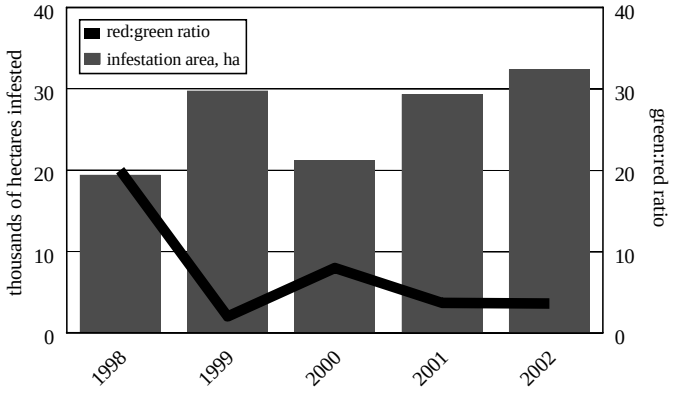


Figure 5. Mountain pine beetle infested area and average green:red ratios for the Kamloops Region, 1998-2002.

Table 3. Green:red mountain pine beetle ratios for the Kamloops Forest Region.

Forest District	Average Green:red Ratio
Clearwater	2.4:1
Kamloops	4:1
Salmon Arm	2:1
Vernon	3:1
Penticton	2.5:1
Merritt	3.5:1
Lillooet	3:1
Regional Average	3.0:1

The second type of population prediction tool uses the population trend ratio (R). This ratio may be calculated for each sampled tree as follows, with the sample consisting of a 20 cm x 20 cm square of bark:

$$\text{“R”} = \frac{a + b}{c}$$

where a = number of eggs and larvae
b = number of pupae and adults
c = number of galleries originating within sample area

Then, for each stand, the average “R” value is calculated. “R” values indicate whether beetle populations are static, increasing or decreasing in an affected area. Table 4 shows the R values for BMUs within the Kamloops District. All areas indicate increasing MPB populations and the weather was very conducive for their success through the winter of 2002-03. W e expect both expansions of existing populations and numerous new areas of infestation to appear in the 2003 overview. A particularly volatile area is in the south of the Region, in the Ashnola. Many spots and small patches were mapped in this area and subsequent ground check showed high green:red ratios (3:1) with asymptomatic attack, making ground detection difficult.

$$\text{“R”} = \frac{\text{sum(r) from all sampled trees}}{\text{number of trees sampled}}$$

“R” value	Population Trend
≤ 2.5	decreasing
2.6 - 4.0	static
≥ 4.0	increasing

Table 4. R values calculated for the mountain pine beetle in the Kamloops District. Samples were collected March 3-16, 2003, from priority Beetle Management Units (BMU’s).

Location	BMU Strategy	Elevation(m)	R value	Population Trend
Skull/Darlington	Suppression	1,200	38.7	increasing
Skull/Eakin Creek	Suppression	1,180	23.6	increasing
Louis Creek	Maintain Low	1,375	8.5	increasing
Scuitto/George Creek	Suppression	1,395	14.3	increasing
Scuitto/Smith Lake	Suppression	1,165	24.7	increasing
Tranquille	Maintain Low	1,195	23.7	increasing
Tunkwa Lake	Suppression	1,185	32.6	increasing
Hat Creek	Suppression	1,150	38.6	increasing
Lemieux Creek	Suppression	1,170	30.3	increasing
Average			**26.1**	

In 2002, a study (funded by the Forest Investment Account and Tolko Industries, Louis Creek Division) was initiated to compare the outbreak dynamics of mountain pine beetle in managed and unmanaged areas and to elucidate any differences in spatial and temporal progression of mountain pine beetle attack, outbreak duration, or brood vigour and dispersal. Two discrete project areas were delineated, one northwest of Kamloops and the other southwest of Princeton:

1) Manning Park (unmanaged) vs. W hipsaw Creek (managed)

2) Opax Mtn. (unmanaged) vs. Red Plateau (managed)

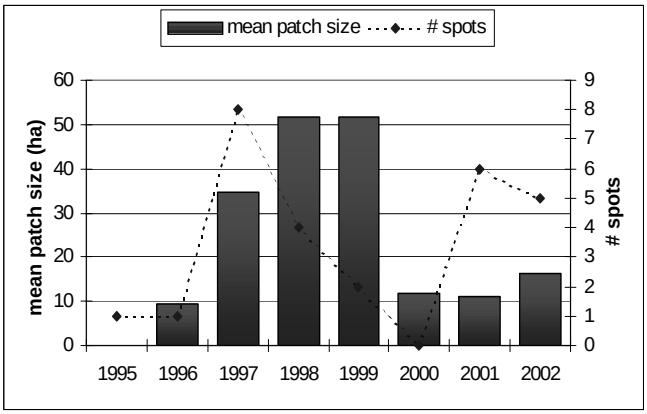
Mountain pine beetle attack in Manning Park

A GIS overlay analysis was performed looking at annual attack patterns, stand hazard and forest cover. Field sites in both the managed and unmanaged areas were stratified according to outbreak history, BEC, elevation, hazard class, and treatment history. A total of 23 sites, stratified among the IDFdk1, dk2 and MSdm2, were selected and 222 plots established (Table 5) located in early-, mid- and late-stage outbreak. A third project area was identified southwest of Penticton (Snehumption Creek, unmanaged vs. W illis Creek, managed) but only the GIS component of the study was performed on this area.

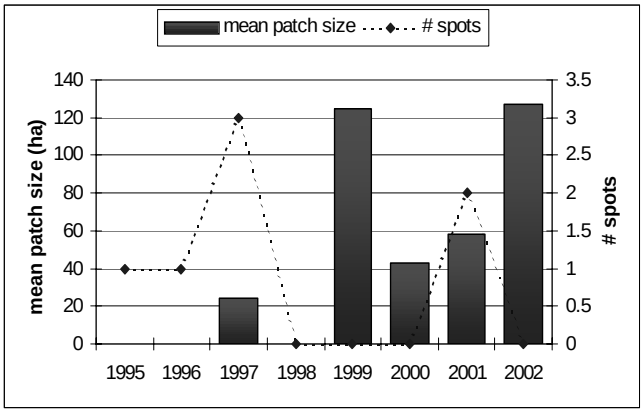
Table 5. Number of sites, plots, and lodgepole pine asessed in four areas of interest.

Area of Interest	# sites	# plots	# trees assessed
Manning	6	62	339
Opax	10	94	209
Red Plateau	3	30	166
W hipsaw	4	36	619
Total	23	222	1,333

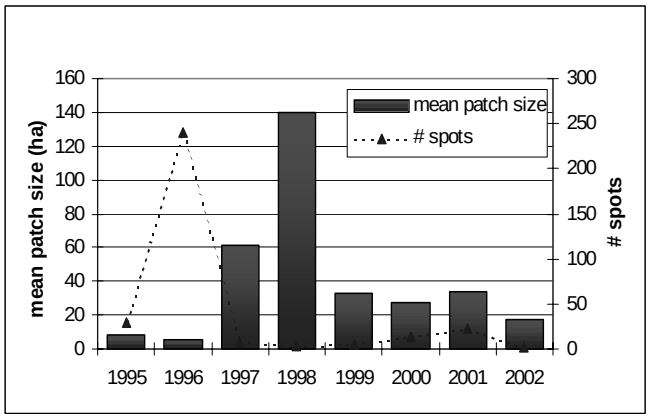
In general, a high level, or increasing number of spots and small patches of red trees indicate a building or pre-outbreak situation. In the areas of interest, with some exceptions, this was the trend. In the year or years prior to sustained, higher levels of red attack, the number of spots was higher (Fig. 6). Manning Park and Snehumption do not appear to follow this trend (Fig. 6), but in the case of Manning this could be due to the method of mapping. Manning Park was not always flown in detail until 1998. Prior to this, only a cursory flight was done and the larger areas of outbreak mapped. The mountain pine beetle outbreak in the Snehumption area began in the early 1990's and was well into a sustained outbreak mode by 1995.



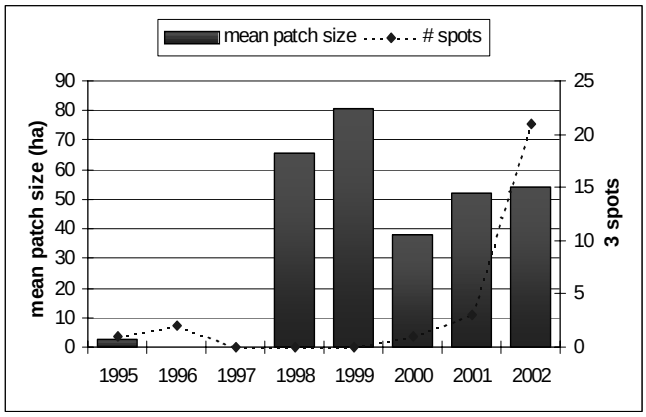
Red Plateau - managed



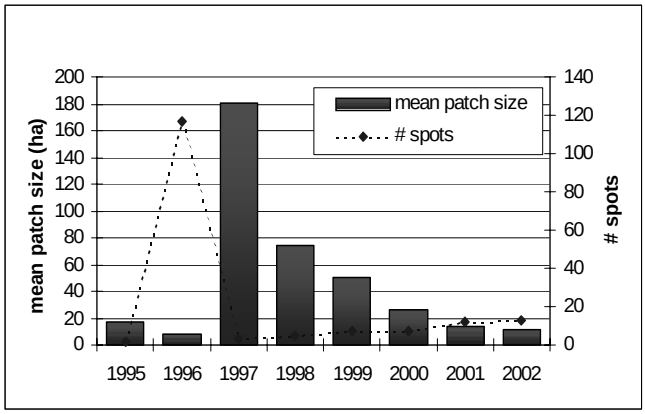
Opax Mtn. - unmanaged



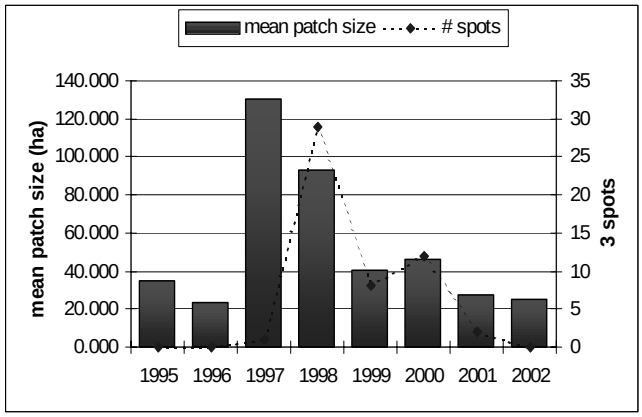
W hipsaw - managed



Manning Park - unmanaged



W illis - managed



Snehumption - unmanaged

Figure 6. Comparison of three managed (on left) and unmanaged (on right) areas of interest showing mean patch area (ha) and number of spots of mountain pine beetle attack from 1995-2002.

Plots were established throughout the unmanaged (parks) and managed areas (harvested blocks). In harvested blocks, stumps were assessed for evidence of MPB. On average, stands were harvested at about the 50:50 ratio of live to dead pine (Table 6). In the unmanaged stands there was a range of live:dead over stands sampled (Table 7) with the average being 60:40 live:dead. In each of the unmanaged areas studied, the percent of total area infested by mountain pine beetle increased fairly constantly and then tapered off (Fig. 7). Managed stands followed the same building trends but then were less regular in their growth pattern and tended to fluctuate up and down, more so than observed in the unmanaged stands. This study is to be completed in 2003.

Table 6. Distribution of live and dead lodgepole pine trees in plots established in managed stands. The plots were located in stands classified as early-, mid-, or late- phase in the outbreak.

Outbreak stage	Live pine	Dead pine	
		No attack	Attack
Early Total	43%	0%	57%
Mid Total	62%	6%	32%
Late Total	33%	0%	68%
Total	48%	2%	49%

Table 7. Distribution of live and dead lodgepole pine trees in plots established in unmanaged stands. The plots were located in stands classified as early, mid-, or late-phase in the outbreak.

Outbreak stage	Live pine	Dead pine		
		Mass	Strip	Unsuccessful/old
Early Total	42%	57%	2%	0%
Mid Total	59%	39%	2%	1%
Mid-Late Total	32%	64%	4%	0%
Late Total	70%	29%	0%	0%
Total	58%	40%	1%	0%

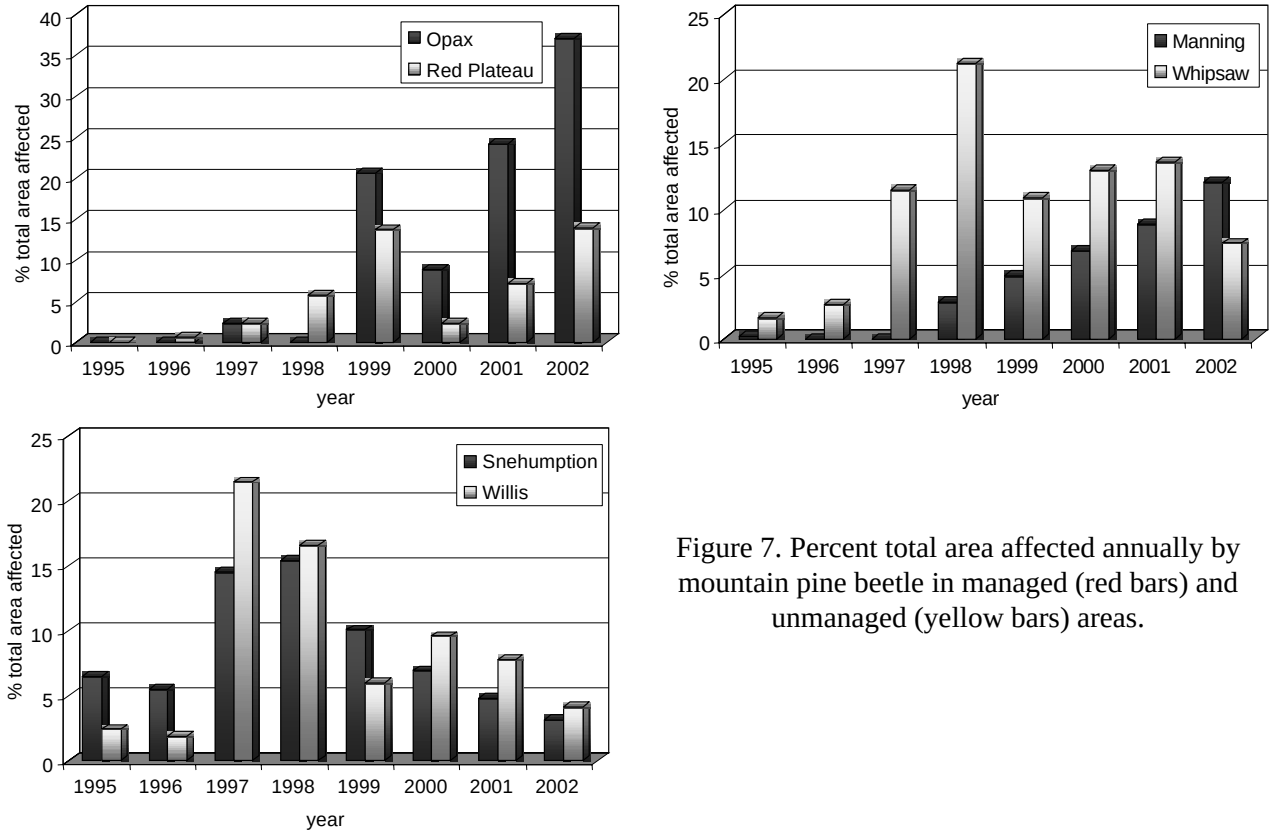


Figure 7. Percent total area affected annually by mountain pine beetle in managed (red bars) and unmanaged (yellow bars) areas.

Table 8. Area summaries for major damaging agents mapped during the 2002 aerial overview.

Forest District and pest type	Area of Infestation(ha)			
	Light	**Moderate**	**Severe**	**Total**
Mountain Pine Beetle				
Clearwater	489	111	0	600
Kamloops	6,118	5,412	2,464	13,994
Lillooet	1,197	693	147	2,037
Merritt	5,374	4,455	898	10,727
Vernon	887	685	856	2,428
Penticton	438	347	300	1,086
Salmon Arm	667	578	252	1,497
Manning Provincial Park	901	1,485	547	2,933
Total	**16,071**	**13,766**	**5,463**	**35,302**
Douglas-fir Beetle				
Clearwater	444	420	184	1,048
Kamloops	53	32	14	99
Lillooet	124	94	53	271
Merritt	148	22	0	170
Vernon	92	35	7	134
Penticton	180	51	37	268
Salmon Arm	169	22	7	198
Total	**1,210**	**676**	**302**	**2,189**
Spruce Beetle				
Clearwater	15	0	0	15
Kamloops	0	5	0	5
Lillooet	796	211	0	1,007
Total	**811**	**216**	**0**	**1,027**
Western Balsam Bark Beetle				
Clearwater	2,837	216	0	3,053
Kamloops	2,106	585	0	2,691
Lillooet	1,102	61	0	1,163
Merritt	2,614	1,498	0	4,112
Vernon	4,294	2,123	0	6,417
Penticton	3,287	418	0	3,705
Salmon Arm	3,724	0	0	3,724
Total	**19,964**	**4,901**	**0**	**24,865**
Western Spruce Budworm				
Lillooet	3,884	190	0	4,074
Kamloops	6,107	0	0	6,107
Merritt	58,295	1,915	0	60,210
Total	**68,286**	**2,105**	**0**	**70,391**
Western Hemlock Looper				
Clearwater	3,388	0	0	3,388
Kamloops	237	311	0	548
Salmon Arm	2,466	283	0	2,749
Vernon	548	154	0	702
Total	**6,639**	**748**	**0**	**7,387**
Two-Year Cycle Budworm				
Clearwater	62,402	474	0	62,876
Kamloops	1,299	0	0	1,299
Total	**63,701**	**474**	**0**	**64,175**

Western Spruce Budworm *Choristoneura occidentalis*

Western spruce budworm populations continued to expand in 2002; defoliation was recorded on 70,818 hectares, more than triple the area affected in 2001. Most of the defoliation occurred in the Merritt District; the largest expansions occurred in the areas around Kingsvale, Kane Valley, Aspen Grove, Kentucky-Alleyne Park, Clapperton Creek, Douglas Lake, and Glimpse Lake (Fig. 8). Defoliation in the Stump Lake/Peter Hope Lake area expanded northwards into Kamloops District to the Roche Lake area. Defoliation in the Princeton area expanded northwards along Highway #5A and Summers Creek as far north as Dry Lake. New infestations were observed at Gun Lake and near Seton Portage in Lillooet District, and at Peachland Creek and Trout Creek in Penticton District.

The Kamloops and Cariboo Regions (Southern Interior Region) have a fully integrated management plan for western spruce budworm that includes, as one tactic, direct control using a biological insecticide, *Bacillus thuringiensis* var. *kurstaki* (*B.t.k.*). Various formulations of *B.t.k.* have been used over the past 15 years and numerous research trials have been conducted to determine the most biologically effective, ecologically safe and cost effective techniques to reduce damage caused by the budworm (Alfaro and Maclauchlan 1992; Boulton and Maclauchlan 2001; Maclauchlan 2003).

References:

Afaro, R.I. and L.E. Maclauchlan. 1992. For. Ecol. and Management. 55:295-313.

Boulton, T.J. and L.E. Maclauchlan. 2001.

Maclauchlan, L.E. 2003. FRBC Year-End Report 2002-2003. B.C. Min. of Forests, Kamloops, B.C.

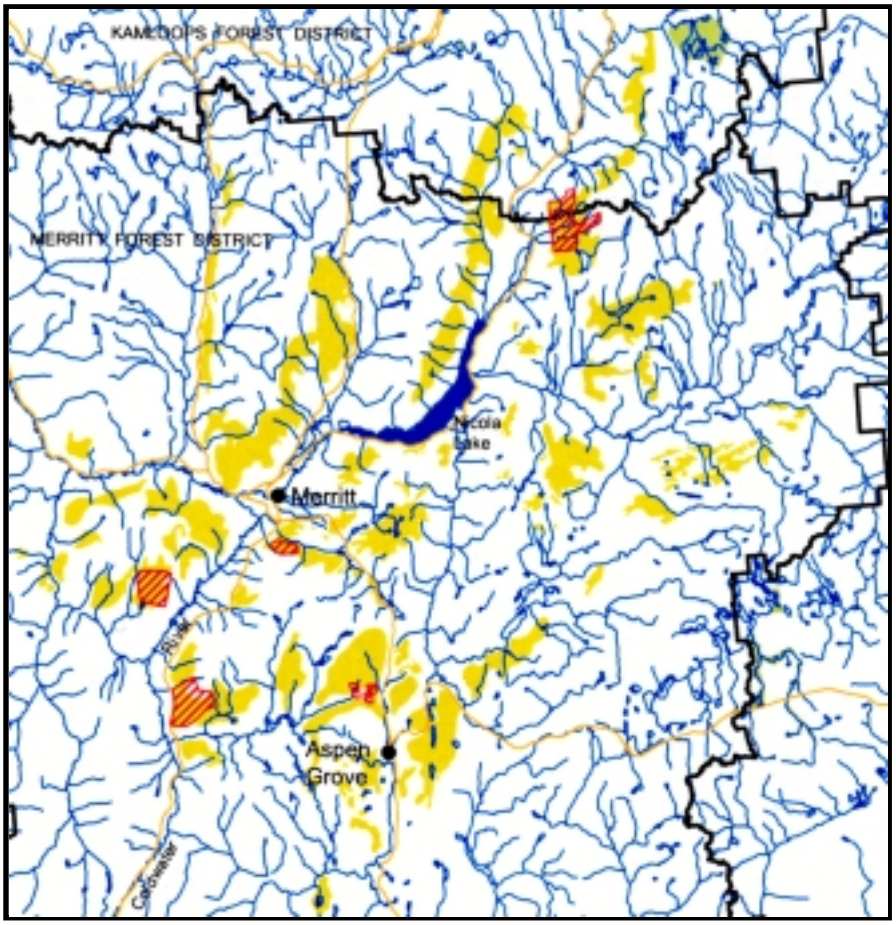


Figure 8. Western spruce budworm defoliation in the Merritt area, and 2002 spray block locations.

Since the inception of operational programs in 1991 (Table 9), *B.t.k.* has been applied neat at 2.4 litres per ha (30 BIU/ha). Spray aircraft (rotary wing or fixed wing) are equipped with a spray system having a minimum of four (4) nozzles capable of delivering droplets in the range of 100-120 median micron diameter at a constant rate and pressure over an even, unbroken swath (e.g. AU 4000 micronaires).

Table 9. History of pesticide treatment against the western spruce budworm in the Kamloops Region (1987-2002).

Year	Area treated (ha)	Product Name[2]
1987[1]	890	Thuricide
1988[1]	467	Thuricide
1989[1]	550	Dipel
1990	no program	
1991	4,000	Dipel 132
1992	35,918	Foray 48B
1993	33,945	Foray 48B
1994	14,695	Foray 48B
1995	7,600	Foray 48B
1996	no program	
1997	3,660	Foray 48B
1998	7,280	Foray 48B
1999	8,031	Foray 48B
2000	no program	
2001	9,804	Thuricide 48LV
2002	4,548	Thuricide 48LV, Foray 48B[3]
Total	**126,840**	

[1]1987-1989 - research trials
[2]Active ingredient of all products was *B.t.k.* and was applied at 30 BIU per hectare unless part of a research project.
[3] 391 ha were treated with a double application of new formulation Foray 48B and select operational blocks received double applications of Thuricide.

Various criteria must be met when planning a control program for western spruce budworm:

1. **Damage Criteria:** stand has suffered a minimum of 1-year defoliation and defoliation predictions are moderate to high for the coming season.

2. **Insect Criteria:** populations are increasing in density and expanding in range.

3. **Stand Attributes:** areas considered for treatment must meet one or more of the following factors:
   - stand is in a historic area of chronic budworm activity (Hodge 2000);
   - located in a woodlot;
   - silviculture investment, such as spacing, pruning, thinning;
   - recent partial cutting;
   - moderate to high density in L3 and L4 layers (understorey layers); and/or
   - priority ecosystems include IDFxh and IDFdk. (ICH stands endure very short-lived outbreak cycles and trees rebound quickly, so do not warrant direct control efforts).

2002 Program and 2003 Predictions

In 2002, a small area (4,548 ha) of priority Douglas-fir forest was treated with *B.t.k.* Part of this treatment included an operational trial with a new formulation of Foray 48B, applied twice at 2.4 litres per ha. The efficacy of the double application of Foray was compared to a double application of Thuricide and areas receiving no treatment. All treatment areas were south of Merritt, B.C. (Table 10) (Fig. 8). A Lama helicopter from W estern Aerial Applications was used and treatments were done June 26-27, 2002.

Table 10. Location of 2002 spray blocks noting hectares sprayed, litres *B.t.k.* applied and product used.

		B.t.k.	
Block location	Ha sprayed	Litres	Product
Lindley Lake	979	2,350	Thuricide 48LV
Kingsvale Creek[a]	1,346	3,230	Thuricide 48LV
W oodlot 390	252	605	Thuricide 48LV
Peter Hope Lake[a]	1,580	3,792	Thuricide 48LV
Research Blocks[b]:			
Aspen Grove 1	126	302	Foray 48B
Aspen Grove 2	130	312	Foray 48B
Aspen Grove 3	135	324	Foray 48B

[a] Double application of Thuricide 48LV
[b] Double application of Foray 48B

To assess efficacy, six plots with six trees per plot were selected and marked prior to treatment in all research blocks, 3 control blocks, and within blocks receiving double and single applications of Thuricide. A total of 360 trees were sampled pre- and post-spray. One day prior to treatment (pre-spray), two 45 cm branches were clipped from each tree at mid-crown and the number and stage of budworm recorded. W hen the majority of insects (>50%) were pupated (post-spray), two branches per tree were collected and placed in paper bags for rearing. The total number of budworm moths per tree was calculated and compared to the pre-spray number and those in control areas to determine spray efficacy (Table 11). The highest efficacy was realized in the Kingsvale and Peter Hope blocks which were treated with a double application (2.4 L/ha x 2) of Thuricide 48LV (Table 11). Abbott's corrected mortality was over 98% for both areas. The double application of Foray was effective but variable. Fairly high natural mortality occurred on some sites (i.e. Peter Hope, Table 11).

Lama helicopter spraying B.t.k.

Table 11. Efficacy assessment of 2002 *B.t.k.* spray program showing average number of moths per m^2 of foliage, average level of current defoliation (Fettes), average percent mortality and Abbott's corrected mortality.

Block location	Product and treatment	Average # moths/m^2	Average fettes defoliation	Average % mortality	Abbott's corrected mortality[a]
Aspen 1	Foray 48B x 2	14.6	6.5	78.7	51.4
Aspen 2	Foray 48B x 2	15.5	6.6	88.4	83.8
Aspen 3	Foray 48B x 2	16.6	5.4	84.8	78.7
Res-control 1	no treatment	31.3	6.2	56.2	
Res-control 2	no treatment	54.0	5.5	28.3	
Res-control 3	no treatment	54.3	5.7	28.9	
Kingsvale	Thuricide x 2	0.4	6.4	99.7	98.8
Peterhope	Thuricide x 2	0.4	3.4	99.6	98.0
Kingsvale	no treatment	21.7	1.8	65.8	
Pete Hope	no treatment	23.9	4.7	71.8	

[a] Abbott's corrected mortality (%) = $\frac{\text{(treated \% mortality)-(control \% mortality) x 100}}{\text{100-(control \% mortality)}}$

In the fall of 2002, 144 sites were sampled for western spruce budworm egg masses. Of the sites sampled, 63 were light, 79 moderate, 1 severe and 1 nil (Table 12). The budworm population is building and expanding slowly into areas that have not been defoliated in recent history. Many of the stands in the Aspen Grove - Princeton area are now being impacted by budworm, but do not meet the criteria for treatment (see page 11); at this time the budworm population and stand impacts in this area will be monitored. No spray program is planned in the Merritt or Kamloops Districts for 2003. In the W illiams Lake and 100 Mile House Districts (old Cariboo Region), approximately 15,000 ha are planned for treatment in 2003.

Table 12. Summary of Kamloops Forest Region fall 2002 western spruce budworm egg mass sampling results, showing predicted 2003 defoliation.

	Number of sites in each defoliation category					
District	**Nil**	**Light**	**Moderate**	**Severe**	**Total Number of sites**	**Average # egg masses/10m^2 foliage**
Kamloops	1	6	14	0	21	63.3
Merritt	0	47	60	1	108	63.2
Lillooet	0	5	1	0	6	30.0
Penticton	0	5	4	0	9	56.2

Nil= no egg masses found
Light= 1-50 egg masses/10 m^2 foliage
Moderate= 51-150 egg masses/10m^2 foliage
Severe= >150 egg masses/10m^2 foliage

Douglas-fir Beetle, *Dendroctonus pseudotsugae*

Douglas-fir beetle mortality was mapped on 2,189 hectares in 2002, down from over 4,000 hectares in 2001. Infestation areas fell in the three Okanagan TSA Districts, and in Lillooet District. The infestation in the southern portion of W ells Gray Park continued to result in high levels of mortality. The number of spot infestations, and the number of trees killed in spot infestations, remained relatively unchanged from 2001 levels, with 6,265 trees killed in 870 spots (Table 13).

Table 13. Number of "spot" infestations of Douglas-fir beetle in the Kamloops Forest Region, by District.

District	# spots	# trees
Clearwater	93	690
Kamloops	157	1,115
Salmon Arm	123	845
Vernon	96	615
Penticton	154	1,110
Merritt	69	490
Lillooet	178	1,400
Total	870	6,265

Western balsam bark beetle attack near Spius Creek

Western Balsam Bark Beetle, *Dryocoetes confusus*

W estern Balsam Bark Beetle continues to be active across most high elevation areas of the Kamloops Region. Mortality occurred on 24,864 ha in 2002, up slightly from 2001 levels. W hile the most extensive areas suffering from above average attack levels continue to be in the Buck Hills - W innifred Creek area in Vernon and Penticton Districts, significant mortality occurred in almost all geographic areas of the Region. The infestation in the upper Spius Creek area expanded considerably, while mortality in the upper Bridge River and other areas in the western portion of Lillooet District declined. A new and vigorous infestation was observed in the Chu Chua Creek – Birk Creek area in Kamloops District.

Spruce Beetle, *Dendroctonus rufipennis*

Spruce Beetle mortality fell from 1,800 hectares to 1,027 hectares. The majority of the visible mortality occurred in the Lillooet District, in the Truax Creek, Bobb Creek, Tommy Creek, Lost Valley Creek, and Downton Creek areas. Some populations are building in the Lumby/ Monashee Mtns. area.

Spruce beetle mortality

Two-Year Cycle Budworm *Choristoneura biennis*

Defoliation was recorded on 64,174 hectares, the majority of which was in the Clearwater District. Populations in the North Thompson River north of Blue River appear to have declined, with a corresponding reduction in defoliation. Increased defoliation was observed in the TFL 18 – Taweel Lake area, and in the central area of Wells Gray Park between Murtle Lake and Azure Lake. Egg mass sampling from the TFL indicated moderate defoliation could again be expected in 2004.

2-year cycle budworm defoliation in Clearwater Forest District

Western Hemlock Looper, *Lambdina fiscellaria lugubrosa*

Western hemlock looper defoliation was observed on 7,387 hectares; most of this was in the Clearwater and Salmon Arm Districts, along Azure and Hobson Lakes in Wells Gray Park, and in the Seymour River, Perry River, Malakwa, and Larch Hills areas. Additionally, several areas in low elevation, dry-belt Douglas fir in the Kamloops area sustained moderate to severe defoliation as a result of western hemlock looper activity. This species has not previously been known to build to outbreak levels outside the range of its' principal host, western hemlock. Ground surveys revealed that in much of this area, western hemlock looper populations were mixed with significant levels of false hemlock looper. Limited mortality of Douglas-fir was noticed within the areas of heaviest defoliation.

In 2002, plasitc canister "Unitraps" were used for western hemlock looper 6-trap clusters , rather than the sticky paper "Wing" traps used previously. The limited trapping surface of the Wing traps quickly became saturated with moths, which decreased their sensitivity in areas with high populations. The Unitraps utilise a removable canister that has a capacity for several thousand moths, preventing trap saturation and significantly improving trap sensitivity. Trap catches were highest at the sites closest to mapped defoliation (the two Perry River sites, Kingfisher Creek, and Scotch Creek). Moderately high catches were also obtained at the 2 sites near Blue River (Mud Lake and Murtle Lake Road) (Table 15). Tree beatings were conducted during July at all of the 6-trap cluster locations, to ascertain relative larval abundance. Beatings were done prior to the completion of the Overview flights for these areas; therefore it was difficult to position additional samples close to areas of current defoliation. As a result, few larvae were found; positive collections were recorded at 9 of 18 sites, with the highest collection numbers near Tum Tum Lake, Scotch Creek, and Crazy Creek.

Adults were observed in large numbers throughout the Kamloops area; additionally, in low elevation Douglas-fir stands near Barnhartvale, Pritchard, Westsyde, Dairy Creek, Lac Du Bois, Six Mile, Battle Creek, Criss Creek, McLean Lake, Trapp lake, and Stump Lake in the Kamloops District, and near Clapperton Creek, Midday Creek, Kentucky-Alleyne Park, Midday Creek, Peter Hope Lake, and Glimpse Lake in the Merritt District.

Landscape level egg surveys were initiated in November 2002. The sampling was targeted at all areas with current defoliation, as well as near permanent trapping sites that had significant moth catches. Egg surveys were also conducted in several low elevation IDF stands in the Kamloops District. Population estimates from these surveys will be used to predict next years' defoliation, and to plan control activities in 2003 (Table 14). Dr. Imre Otvos, Canadian Forest Service, Pacific Forestry Centre, processed the egg samples for us and provided an indication of parasitism, egg viability and expected 2003 defoliation levels. The predicted defoliation is based upon the number of viable eggs found in 100 grams of lichen as indicated in the footnote of Table 14.

The western hemlock looper was just recently added to the label of Foray 48B (*Bacillus thuringiensis* var. *kurstaki*). Therefore, some operational trials and treatment areas are planned for 2003. Two fully replicated trials will be conducted at Inks Lake (Douglas-fir) and in the Columbia drainage near Revelstoke (western hemlock). In each trial, 2 treatment regimes and a control area will be compared. The treatments are:

1) early instar application @3.2 litres/ha (40 BIU/ha)
2) early instar application plus a second application 10-14 days later each @3.2 litres/ha (40 BIU/ha)
3) no treatment.

At each site three blocks of each treatment will be delineated. At Inks Lake approximately 500 ha will receive one application and 450 ha will receive a double application of *B.t.k.* In Revelstoke approximately 3,100 ha will receive one application and 2,800 ha will receive a double application of *B.t.k.*

Table 14. Summary of Kamloops and Nelson Forest Region western hemlock looper egg sampling results (fall 2002), showing predicted 2003 defoliation.

	Number of sites in each defoliation category					
Location	**Nil**	**Light**	**Moderate**	**Severe**	**Total number of sites**	**Average # eggs /100 g lichen**
Kamloops Region						
Inks Lake	0	0	0	4	4	1,177
Dam Lake	0	1	0	4	5	360
Duffy Lake - Six Mile	0	2	2	5	9	67
Vidette Lake	1	0	1	2	4	422
Lower Deadman River	0	2	0	0	2	6
Criss Crk - Sabiston Crk	0	2	1	3	6	99
Lac Du Bois - O'Connor Lk	2	2	1	0	5	14
Badger Creek	2	0	0	0	2	0
Heffley Creek	0	2	0	0	2	5
Scuitto - Campbell Lake	0	3	0	0	3	7
Larch Hills	4	1	1	1	7	80
Hidden Lake	1	0	0	2	3	92
Ireland Creek	2	0	0	0	2	0
Tsuius Creek	0	1	0	1	2	104
Perry River - Eagle River	0	0	2	2	4	119
Kamloops Total	**12**	**16**	**8**	**24**	**60**	
Nelson Region						
Bigmouth	0	0	0	1	1	69
Trout Lake	0	1	0	0	1	9
W oolsey	0	1	0	0	1	2
Martha Creek	0	0	1	0	1	49
La Forme	0	0	0	1	1	98
Pitt	0	0	0	1	1	222
Downie	0	0	0	1	1	612
Goldstream	0	0	0	1	1	1022
Begbie	0	0	1	0	1	47
Beaver River	0	0	1	9	10	156
Nelson Total	**0**	**2**	**3**	**14**	**19**	

Nil= 0-4 eggs/100grams dry weight lichen
Light= 5-26 eggs/100 grams dry weight lichen
Moderate= 27-59 eggs/100 grams dry weight lichen
Severe= 60+ eggs/100 grams dry weight lichen

False hemlock looper

Western hemlock looper

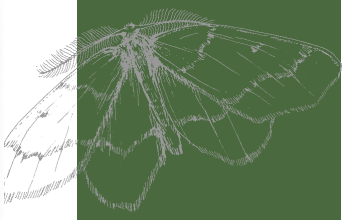
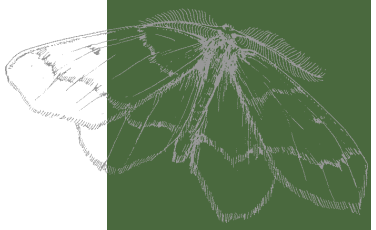


Table 15. Average number of western hemlock looper moths caught per 6-trap cluster over time in the Kamloops Forest Region.

Site	Location	2000 average trap catches	2001 average trap catches	2002 average trap catches[1]
1	Serpentine	4	19	156
2	Thunder River	13	33	172
3	Mud Lake	25	34	505
4	Murtle Lake Road	22	32	433
5	Finn Creek	39	34	271
6	Tumtum	36	40	207
7	Scotch Creek	35	30	954
8	Yard Creek	25	29	273
9	Crazy Creek	34	23	315
10	Perry River	43	38	1,294
11	Three Valley Gap	33	27	375
12	Perry River	36	29	1,084
13	Kingfisher Creek	32	32	1,203
14	Noisy/Kingfisher Creek	36	36	128
15	Shuswap River	31	34	347
16	Greenbush Lake	43	38	302
17	Adams River	39	34	189
	Average for all sites	**31**	**32**	**483**

[1]Traps were changed in 2002 to plastic Unitraps, which have a much higher capacity than the traps used in previous years.

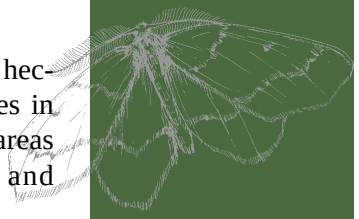


Birch Leaf Miner, *Fenusa pusilla*

Birch leaf miner defoliation was recorded on 9,720 hectares in 2002, more than double the area mapped in 2001. Most activity was in the Vernon and Kamloops Districts, with the largest expansions in the Cherryville – Sugar Lake area, and near Louis Creek and Fadear Creek.

Satin Moth, *Leucoma salicis*

Area defoliated by Satin Moth fell to 324 hectares in 2002, down from 2,000 hectares in 2001, and was limited to a few scattered areas in Clearwater, Penticton, Merritt, and Kamloops Districts.



DOUGLAS-FIR TUSSOCK MOTH, *ORGYIA PSEUDOTSUGATA*

Defoliation expanded slightly to 92 hectares in 2002, from 49 hectares in 2001, in a few small areas north of Cache Creek. Six-trap pheromone trapping sites caught an average of only 6.4 moths per trap, down from 18 in 2001; only 2 of 21 sites experienced an increase (Table 16). Average catches at most sites fell to typically low between-outbreak levels, especially in the Okanagan and Similkameen areas. Catches at single trap sites increased, however, in all Districts (Table 17). The reason for this apparent discrepancy is unknown, but may be related to the lower sensitivity of single-trap sites versus multiple-trap sites. Tree beatings were conducted in July at several locations to ascertain relative larval abundance; positive collections were only made at 3 sites around Maiden Creek and Veasy Lake in the Kamloops District.

Table 16. Average number of Douglas-fir tussock moths caught per 6-trap cluster over time in the Kamloops Forest Region.

		average trap catches			
Site	**Location**	**1999**	**2000**	**2001**	**2002**
1	McLure	2	0	1	1
2	Heffley Creek	4	2	14	7
3	Cherry Creek	2	0	10	8
4	Six Mile	2	2	8	4
5	Battle Creek	1	1	17	11
6	Barnes Lake	1	5	39	10
7	Carquille/Veasey Lk.	13	5	57	16
8	Pavilion	16	2	18	1
9	Stump Lake	7	2	4	0
10	Robbin's Range/Monte Creek	1	1	6	4
11	Chase	0	6	14	28
12	Yankee Flats	1	1	1	2
13	Vernon	11	4	20	29
14	W infield/W ood Lake	14	7	7	1
15	Kelowna	33	34	6	1
16	Summerland	25	8	17	2
17	Kaleden	28	6	N/A	1
18	Blue Lake	8	1	4	3
19	Stemwinder Park	33	18	49	2.5
20	Ashnola River	27	19	47	1
21	Spences Bridge	5	1	20	1
	Regional Average	**11.1**	**6.0**	**18.0**	**6.4**

Table 17. Average number of Douglas-fir tussock moths caught per trap (single trap per site) over time in the Kamloops Forest Region.

	Forest District				
Year	**Kamloops** (±100 traps)	**Vernon** (±46 traps)	**Penticton** (27-30 traps)	**Merritt** (±30 traps)	**Lillooet** (15 traps)
1998	25.8	10.6	24.4	25.8	4.9
1999	4.8	6.8	27.0	19.7	2.5
2000	3.6	5.9	19.3	17.0	2.0
2001	3.1	1.9	4.9	4.8	1.0
2002	15.2	5.4	6.6	13.8	2.4

KAMLOOPS TSA

CLEARWATER FOREST DISTRICT

Douglas-fir Beetle

Douglas fir beetle mortality was mapped on 1,048 hectares in 2002, down slightly from 2001 levels of 1,300 hectares; however, the number of spot infestations increased from 66 to 93 (Fig. 9). Significant levels of mortality continue to occur in the Helmcken Falls – Placid Lake area of Wells Gray Park, although the supply of suitable, large diameter Douglas-fir is declining. An increase in mortality was observed along both sides of Canim Lake, where several small pockets of attack were noted. Mortality declined along the North Thompson River between Clearwater and Avola, largely due to aggressive control activities.

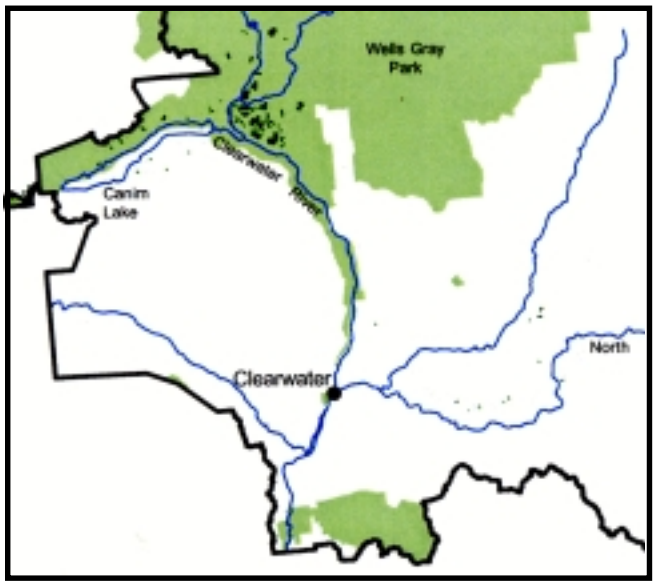


Figure 9. Douglas-fir beetle in Clearwater District.

Mountain Pine Beetle

Mountain pine beetle mortality increased to 600 hectares, from 143 in 2001. A further 500 trees were killed in 59 spot infestations. The largest areas of mortality were observed near Joseph Creek and Halymore Lake, and in the Mann Creek area. Significant levels of attack were also observed along the Adams River between Sunset Creek and Adams Lake, at Gollen Creek, and in scattered areas along Adams Lake and in the Raft River area.

Western Hemlock Looper

Light defoliation was observed on 3,338 hectares in the District. Most of the defoliation was mapped in Wells Gray Park, in the vicinity of Hobson, Azure, and Clearwater Lakes. Small pockets of defoliation were also observed in the West Raft River near Silence Lake (22 ha), in the Mad River (17 ha), and at Cayenne Creek (40 ha). Moderately high moth catches were obtained at the permanent trapping sites near Mud Lake and Blue River; numbers were lower at permanent trapping sites near Thunder River, Serpentine Creek, Finn Creek, and Tum Tum Lake (Fig. 11).

Western Balsam Bark Beetle

WBBB mortality was mapped on 3,053 ha in 2002, down slightly from 2001 levels. Increases were observed in the vicinity of Vavenby Mountain, Trophy Mountain, Finn Creek, and the upper end of the Mad and Raft Rivers. Mortality levels dropped in TFL #18.

Two-Year Cycle Budworm

Two-year cycle budworm defoliation covered 62,875 ha in the District, down slightly from 74,000 ha in the last "on" year (2000) in this insects' feeding cycle. The majority of the defoliation was classed as light. Defoliation decreased in most areas in the North Thompson River north of Avola. Increased defoliation was observed in Wells Gray Park near Murtle Lake, Kostal Lake, Falls Creek, Ivor Creek, Azure Lake, and Hobson Lake; in the Raft River area; and on TFL #18 (Slocan Forest Products) (Fig. 10).

Douglas-fir beetle mortality in Wells Gray Park

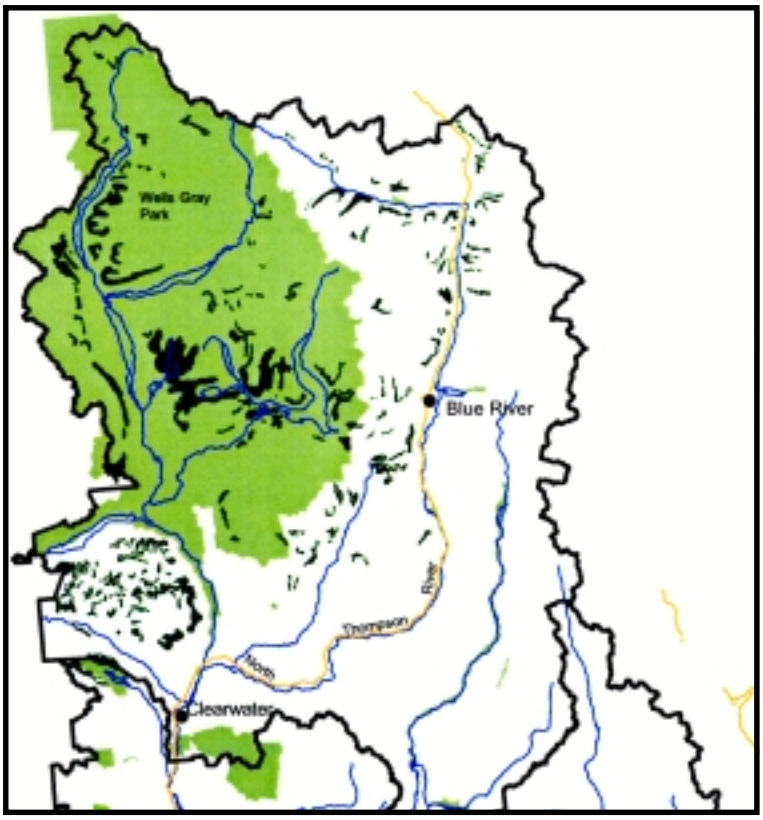


Figure 10. Two-year cycle budworm defoliation in Clearwater District.

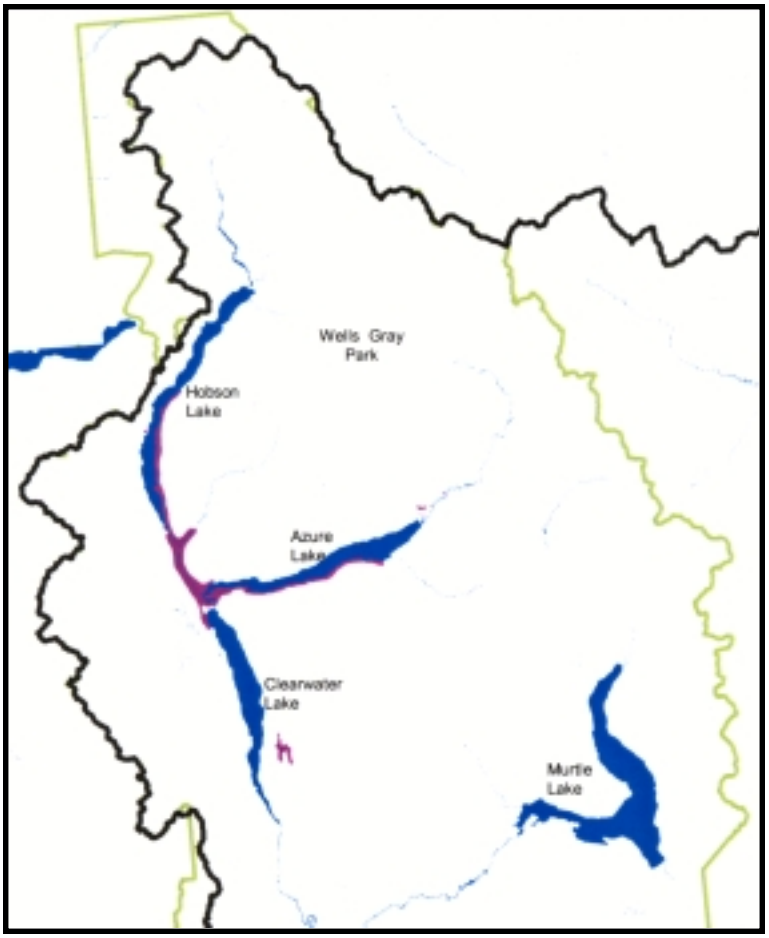


Figure 11. W estern hemlock looper defoliation in W ells Gray Park.

Mountain Pine Beetle

Mountain pine beetle mortality continued to expand in 2002, with nearly 14,000 hectares infested, well over half of which sustained moderate or severe mortality. This is an increase of almost 40% from 2001 levels. Additionally, 5,140 (85% increase from 2001) trees were killed in 483 (51% increase from 2001) spot infestations. The greatest expansions were seen at Scottie Creek, Battle Creek, Tunkwa Lake, Barnes Creek, Red Plateau, Criss Creek, W atching Creek/Noble Lake, Blomley Creek/East Barriere Lake, the Sun Peaks area, Georges Creek, Lemieux Creek, the Logan Lake – Highland Valley areas, and the Bonaparte Plateau between Peterson Creek and Little Fort. Significant reductions in infestation area were seen at Allen Creek, Pinantan Lake, and in the Pritchard – Mount Martin area (Fig. 12).

Green:red ratios at 66 sites in the District ranged from 1.0:1 to 8.5:1, and averaged 2.5:1. Considerable movement of beetle populations into largely unattacked stands was noted in several areas; green:red ratio data was recorded only for stands with both red and green attack present. Therefore, actual population expansion/vigour was likely greater than indicated by the ratios.

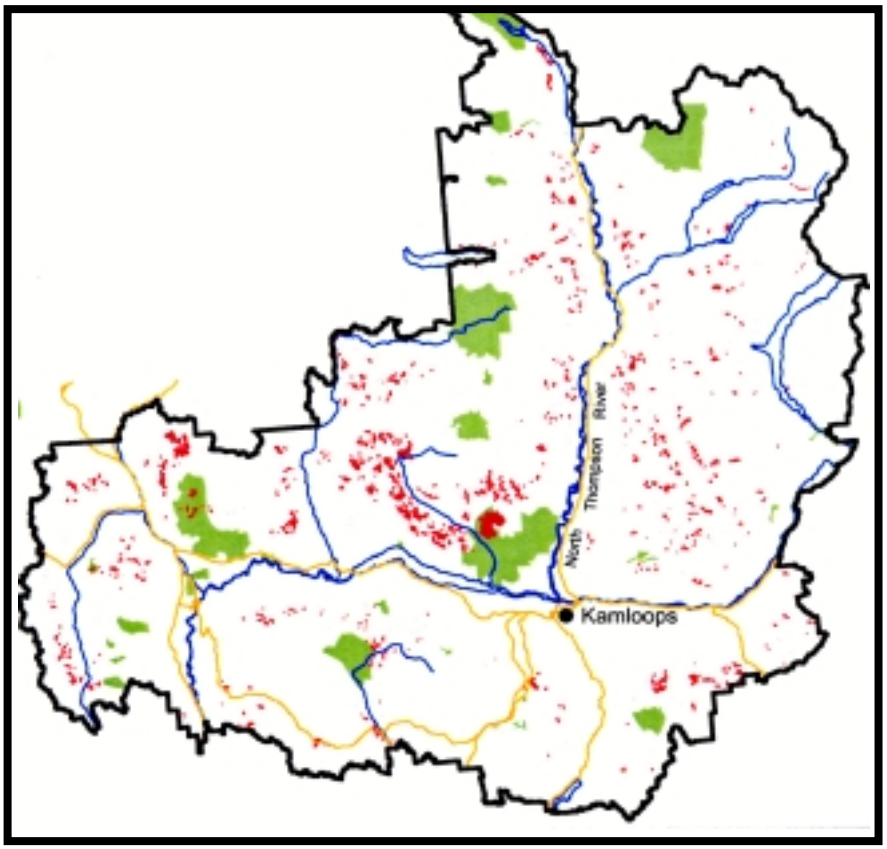


Figure 12. Mountain pine beetle in the Kamloops District.

Western Balsam Bark Beetle

Significant mortality was mapped on 2,691 hectares, up from 2001 levels of 1,760 ha. Most activity continued to be scattered across the Thompson Plateau north of Kamloops. New infestations of considerable size (600 ha) were observed in the Birk Creek – Chu Chua Creek area.

Douglas-fir Beetle

Douglas-fir beetle activity continues to be relatively minor. Mortality was recorded on 99 hectares, a slight decrease from 2001 levels; however, spot infestations increased, with 1,115 trees killed in 157 spot infestations. Most of this increase was in the area around Hat Creek, Two Springs Creek, and Oregon Jack Creek.

Western Spruce Budworm

Defoliated area more than doubled from 2001 levels, to 6,107 hectares. Infestations in the Cache Creek – Medicine Creek and Logan Lake areas collapsed, but there were significant expansions from the Stump Lake area north to Roche Lake and Droppingwater Creek, and new infestations at the west end of Highland Valley. Eggmass sampling conducted in the fall of 2002 indicated that populations in these areas are at a low to moderate level, but with a wide-spread distribution. Expansion is expected to continue in 2003.

Western Hemlock Looper

W estern hemlock looper defoliated 585 hectares of dry, low-elevation Douglas-fir near Kamloops. The largest areas were in the vicinity of Inks Lake, where light to moderate defoliation was mapped on 512 hectares. Small pockets of moderate to severe defoliation were also observed near Six Mile (30 ha) and Mowich Lake (40 ha). A mix of defoliator species was found at the Inks Lake outbreak, where false hemlock looper made up approximately 25-50% of the larval population. Subsequent walk-throughs indicated that continued larval feeding after the overview flights resulted in a larger area of severe defoliation than was initially recorded. Several of the more severely defoliated areas will likely sustain significant mortality (up to 75% in the most severely defoliated sites). Egg sampling in the fall of 2002 indicated extremely high population levels and relatively low parasitism in the area (see Table 14); extensive severe defoliation and associated mortality is expected in 2003. A treatment program is planned for 2003, involving the aerial application of *B.t.k.* on approximately 955 hectares in the Inks Lake area, and 5,925 hectares in the Revelstoke area.

Western hemlock looper defoliation near Inks Lake

Western hemlock looper defoliation on Douglas-fir near Mowich Lake

During the flight period (September), adult moths were observed in large numbers in low elevation Douglas-fir stands throughout Kamloops and several surrounding areas; as well, moths were observed as incidental catches in many of the Douglas-fir tussock moth single traps in the Kamloops and Merritt Districts. New areas of defoliation are expected in 2003 in many of these areas.

Douglas-fir Tussock Moth
Defoliation expanded slightly to 92 hectares in 2002, from 49 hectares in 2001, in a small area north of Cache Creek. Populations in the area where defoliation was first observed in 2001 are already beginning to decline due to NPV infection and high parasitism rates. Lower catches at nearby 6-trap pheromone trapping sites indicate that the population in the area is declining.

Satin Moth
Satin moth defoliation was observed on only 20 hectares in the district, in 3 small infestations near Niskonlith Lake, Peterson Creek, and Deadman River.

Birch Leaf Miner
Defoliation more than doubled to 3,547 hectares; most infestations were between Adams Lake and the North Thompson River, near Fadear Creek, Sinmax Creek, Louis Creek, and the Barriere River.

Other forest health factors in the Kamloops District included small areas of spruce beetle and wildfire.

Okanagan TSA

Salmon Arm Forest District

Mountain Pine Beetle
Mountain pine beetle mortality dropped slightly to 1,500 hectares, from 2,000 hectares in 2001; however, more than half of the infested areas sustained moderate or severe mortality. The number of spot infestations increased by 70% to 46 (400 trees). Most activity continued to be in the Chase Creek, Charcoal Creek, Miller Lake, Skimikin Creek, and Squilax mountain areas (Fig. 13).

Western Balsam Bark Beetle
W estern balsam bark beetle activity increased considerably in 2002, with infested area more than doubling from 2001 levels to 3,725 hectares. Infestations in the Celista Creek, Mt. Fowler, and Hunters' Range areas experienced the greatest expansions.

Douglas-fir Beetle
Area infested by Douglas-fir beetle fell to 200 hectares from 485 hectares in 2001. 845 trees were killed in 123 spot infestations. Most of this decrease was in the Mara Lake - Enderby Hills area; infestations in other areas, such as the site of the 1998 Silver Creek Fire, continued to cause variable and scattered mortality.

Western Hemlock Looper
As expected, western hemlock looper populations increased to outbreak levels this year. Light and moderate defoliation totaling 2,750 hectares occurred in several areas of the District; most occurred along the north side of the Eagle River, and along the Perry and Seymour Rivers (Figure 14). Defoliation was also observed at Cooke Creek, Scotch Creek, Humamilt Lake, Myoff Creek, and in the Larch Hills area, which is a very popular cross-country ski area during the winter. Moth catches at permanent 6-trap pheromone trapping sites were generally high, especialy at the sites near Scotch Creek, Perry River,and Kingfisher Creek (Table 14). Egg sampling results from the fall of 2002 also indicate that moderate to severe defoliation will occur in 2003 in these areas, as well as in the Larch Hills area (Table 14).

Western hemlock looper defoliation of western hemlock in the Perry River area

Other forest health factors observed included 265 hectares of birch leaf miner defoliation south of Sorrento, and 57 hectares of windthrow near the north end of Seymour Arm.

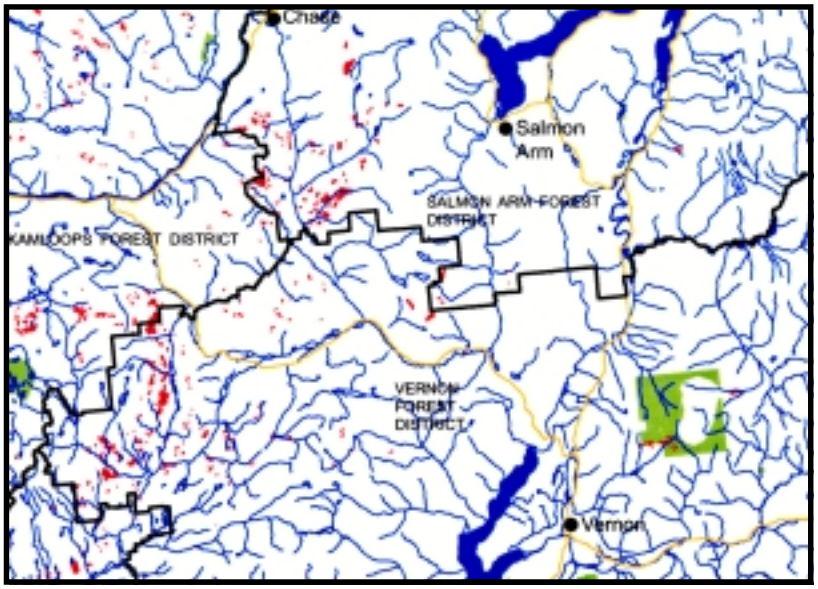


Figure 13. Mountain pine beetle mortality in Salmon Arm and Vernon Districts.

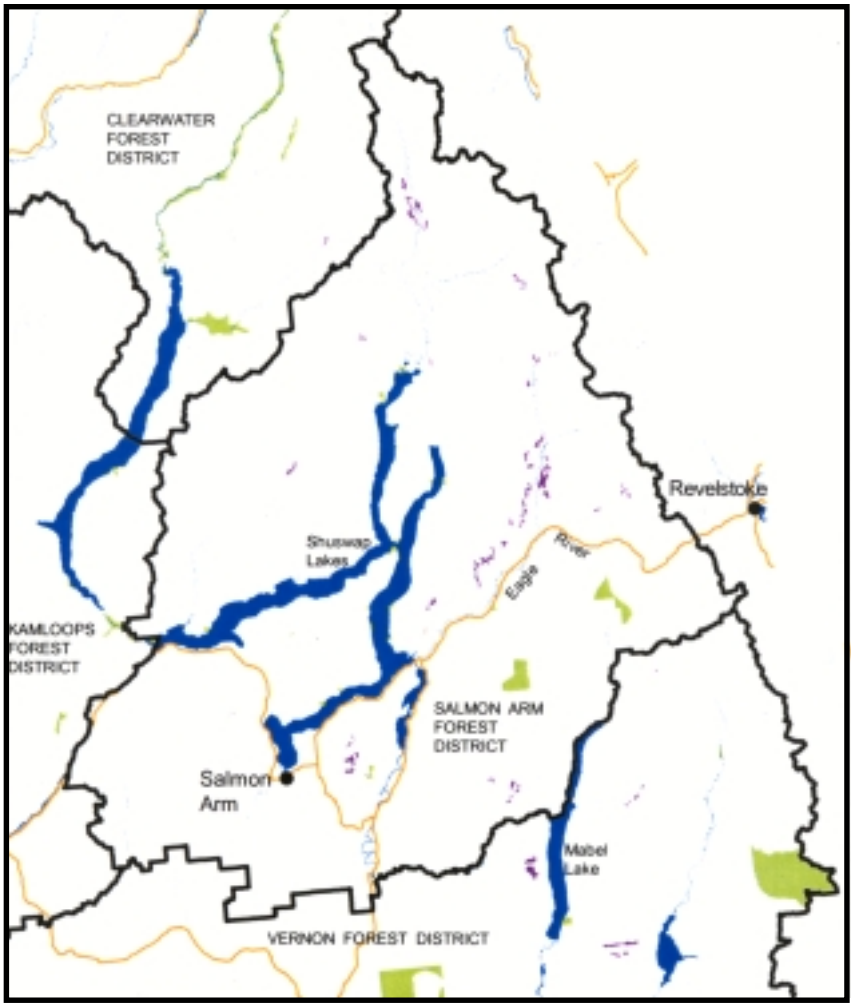


Figure 14. Western hemlock looper defoliation in Salmon Arm District.

VERNON FOREST DISTRICT

Mountain Pine Beetle

Mountain pine beetle mortality dropped slightly to 2,430 hectares, down from 2,700 hectares in 2001. However, almost 2/3 of the area mapped sustained moderate or severe mortality, and the number of spot infestations rose, to 138 (1,130 trees killed), from 104 (1,065 trees killed) in 2001. Most of the mortality continued to be on TFL #49, in the Monte Creek – Salmon River area; significant expansions in the W eyman Creek area of the TFL were observed. Infested area decreased in the Paxton Valley and Sawmill Lake areas.

Western Balsam Bark Beetle

W estern balsam bark beetle mortality fell slightly to 6,417 hectares, down from 7,700 hectares in 2001. Most of the activity continued to be in the Buck Hills, upper Kettle River, W innifred Creek, Bolean Lake, and Boleau Lake areas (Fig. 15).

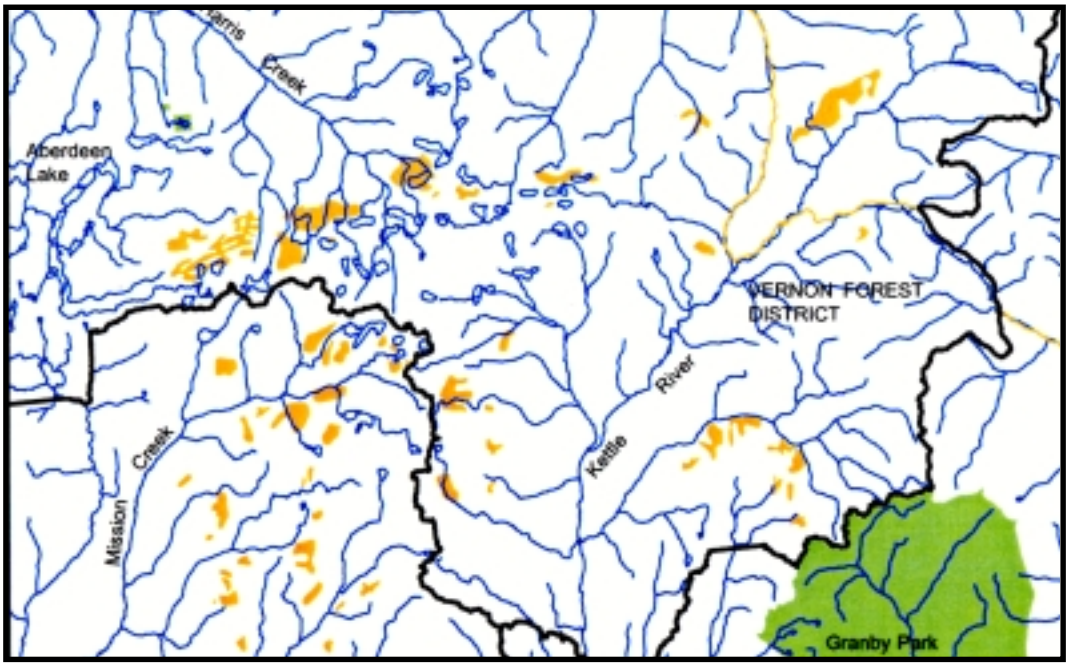


Figure 15. W estern balsam bark beetle in the Buck Hills - Mission Creek area of Vernon and Penticton Districts.

Douglas-fir Beetle

Area affected by the Douglas-fir beetle fell to 134 hectares, down from over 700 hectares in 2001. The number of spot infestations also fell, to 96 (615 trees). The most significant decreases were seen along the west side of Okanagan Lake, Harris Creek, and in the Mabel Lake – Trinity Hills area.

Western Hemlock Looper

W estern hemlock looper defoliation was mapped on 702 hectares. Light and moderate defoliation was observed at Ireland Creek, and south of Hidden Lake; a few pockets of light defoliation were seen at Latewhos Creek. Defoliation is expected to spread and intensify next year in these areas; as well, populations are high in the Shuswap River area, and visible defoliation is expected to appear next year. Egg sampling results indicate that populations will expand in all areas where damage occurred in 2002 (Table 14).

Birch Leaf Miner

Birch leaf miner caused widespread light and moderate defoliation of paper birch. 4,760 hectares of defoliation were observed in the eastern portion of the district, near Cherryville, Echo Lake, Creighton Valley, Cherry Creek, Monashee Creek, Seymour River, and Sugar Lake. Damage is expected to be mainly a visual/aesthetic concern, and no control activities are planned.

Penticton Forest District

Mountain Pine Beetle

Area attacked by mountain pine beetle fell slightly to 1,186 ha, down from 1,283 ha in 2001. The number of spot infestations increased to 122, with 955 trees killed. Most activity continued to be in the area around the Ashnola River and Cathedral-Snowy Park, where relatively high expansion ratios, and an increase in the number of small spot infestations indicate a vigorous population. Other significant beetle activity continued at Beak Creek and Shorts Creek. Infested area declined near Crater Mountain, and the ongoing infestation in Snehumption Creek continued to decline.

Western Balsam Bark Beetle

W estern balsam bark beetle infestation status remained fairly static in the district, with mortality occurring on 3,705 ha. Mortality declined near Mount Gottfriedsen, and increased in the Pearson Creek – W est Kettle River area. Infestations in other areas (mainly in the upper Mission Creek area) remained relatively unchanged.

Douglas-fir Beetle

The expansion of Douglas-fir beetle seen over the last few years was reversed in 2002, with affected area dropping almost 60% to 268 hectares. The number of spot infestations remained nearly unchanged, however, with 1,110 trees killed in 154 spot infestations. Mortality fell around Chute Lake, Naramata, and Darke Lake, where most of the mortality had occurred in 2001. Scattered mortality continued to occur in several areas of the District in the form of small patches and spot infestations, near Mount Kobau, Inkaneep Creek, Shuttleworth Creek, Keremeos Creek, Joe Rich Creek, KLO Creek, and McDougall Creek.

Western Spruce Budworm

W estern spruce budworm defoliation was observed for the first time in the District since 1998, and was mapped on 425 hectares. Light defoliation was observed at Peachland Creek, west of Summerland along Trout Creek, and west of Okanagan Falls.

Other forest health factors included 440 ha of pine needle cast near Inkaneep Creek and Vaseaux Creek, and 62 ha of satin moth defoliation near Greata Creek and Crater Mountain.

Merritt TSA

Merritt Forest District

Mountain Pine Beetle

Mountain pine beetle mortality fell slightly in the District in 2002, to 10,727 hectares, from 11,870 hectares in 2001. Severely attacked areas shrank from 2,700 hectares, to just under 900 hectares. The number of spot infestations also fell by 20% to 357, with 3,470 trees killed. Infestations in the southern portion of the District are beginning to decline slightly in area and severity, especially in the W hipsaw salvage BMU and in the W illis Creek area (Fig. 16). The infestations in the Pimainus Creek, Skuhost Creek, and Red Creek/Hayes Creek areas experienced some expansion, and new infestations were observed in the W hiterock Lake area. Infestations in most other areas of the District remained relatively unchanged.

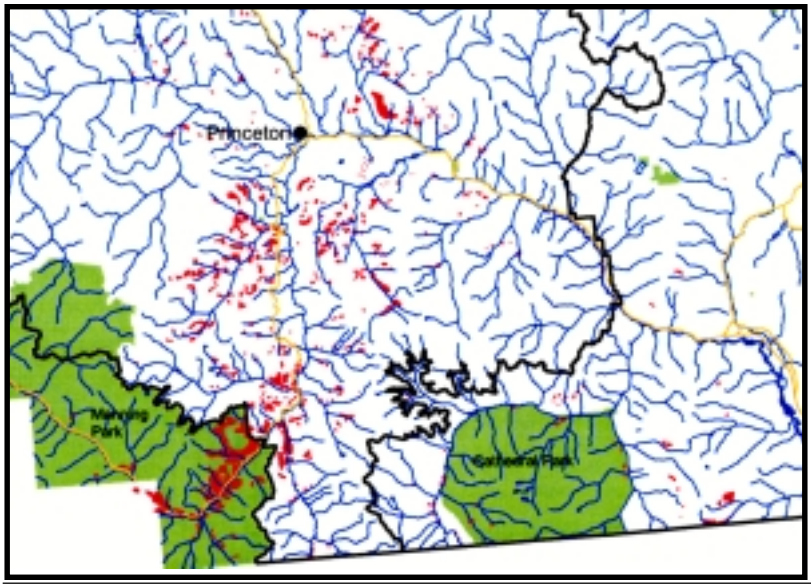


Figure 16. Mountain pine beetle activity in the Princeton - Manning Park area.

Manning Park (which is within the Vancouver Forest Region) experienced a 40% increase in area of attack, to 2,933 hectares. The average polygon size in Manning Park remained high at 52.4 hectares, while the overall average for the Merritt District and Kamloops Region declined. This reflects the effects of control efforts on beetle spread.

Western Balsam Bark Beetle

W estern balsam bark beetle activity continued to increase, with mortality increasing from 2,466 hectares in 2001 to 4,112 hectares in 2002. Most of the expansions were in the Stoyoma Mountain – upper Spius Creek area, where an infestation has been ongoing for several years (Fig. 17). Mortality in the Lodestone Mountain area declined to endemic levels. Scattered infestations continued in several other areas of the District, including Bob Lake, and at higher elevations near Juliet Creek, Dillard Creek, and upper McNulty Creek.

Douglas-fir Beetle

Mortality increased from 2001 levels to 170 hectares. A further 490 trees were killed in 69 spot infestations. Most activity was concentrated in the northwest portion of the District, in the Soap Lake – Skuhun Creek area, with smaller spot infestations scattered in other low elevation areas, mainly in the Ashnola, Tulameen, and upper Nicola Rivers.

Western Spruce Budworm

Defoliation expanded by over 250% from 2001 levels to just over 60,000 hectares. Most defoliation was light, with the only moderate defoliation occurring in a few lower elevation areas. Defoliation is now extensive in many areas of the District, including Kirby Creek, Swakum Mountain, Nicola Lake, Stump Lake, the Peter Hope Lake - Glimpse Lake area, Spahomin Creek, Mount Hamilton, Sugarloaf Mountain, Godey Creek, Midday Creek, the Kingsvale – Aspen Grove area, and Thalia Lake. Defoliation has also expanded north of Princeton, along Allison Creek and Summers Creek. The greatest expansions were into higher elevations, where budworm is not a chronic problem, or has never been recorded.

Approximately 4,548 ha were treated in June 2002 with *B.t.k.* Although mapped defoliation showed an expanding range covered by the budworm, egg mass sampling results had only 60 of 110 sites predicting moderate defoliation. Many of the sites in which budworm is now active are mixed species stands and do not warrant treatment at this time.

Other forest health factors included small areas of satin moth (76 ha), and pine needle cast (30 ha).

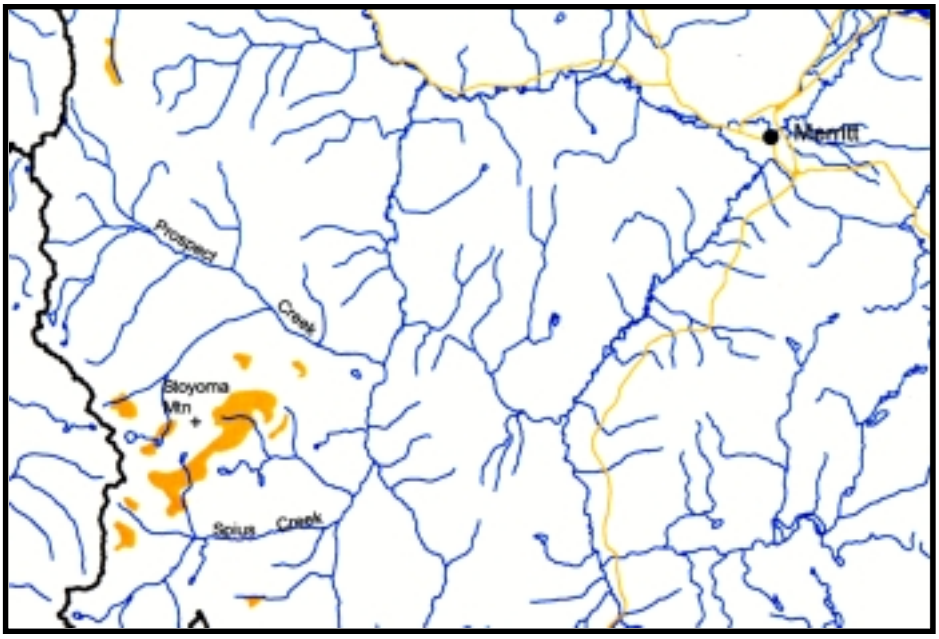


Figure 17. W estern balsam bark beetle in the Spius Creek area of Merritt District.

LILLOOET TSA

LILLOOET FOREST DISTRICT

Mountain Pine Beetle
Mountain pine beetle continued to expand in 2002, to 2,040 hectares, up from 1,380 in 2001. A further 1,475 trees were killed in 171 spot infestations. Expansions were observed in the Nicoamen River, Sleetsis Creek, Murray Creek and Dickey Creek (Lillooet watershed) areas (Fig. 18). Ongoing infestations in the Lost Valley Creek and Tyaughton Creek areas began to decline. Mortality in Kwoiek Creek remained largely unchanged in area or severity. Small infestations continued to be observed scattered in the Bridge River, Stein River, Fraser River, and Fountain Valley areas.

Western Balsam Bark Beetle
Balsam bark beetle was mapped on 1,160 hectares in 2002, down from 2,270 hectares in 2001, mainly due to declining mortality in the western portion of the District, where infestations in the upper Bridge River, Gun Creek, and Hurley River decreased in area.

Douglas-fir Beetle
Douglas fir beetle mortality was mapped on 270 hectares, down from 700 hectares in 2001. Infestations in most areas were in the form of scattered spot infestations, where 1,400 trees were killed in 178 spots. Mortality continued to occur throughout most of the dry, low elevation areas of the District, along the Fraser River, Thompson River, Stein River, and Pavilion Lake. Several spot infestations were also observed along the south side of Carpenter Lake, and in the Yalakom River area.

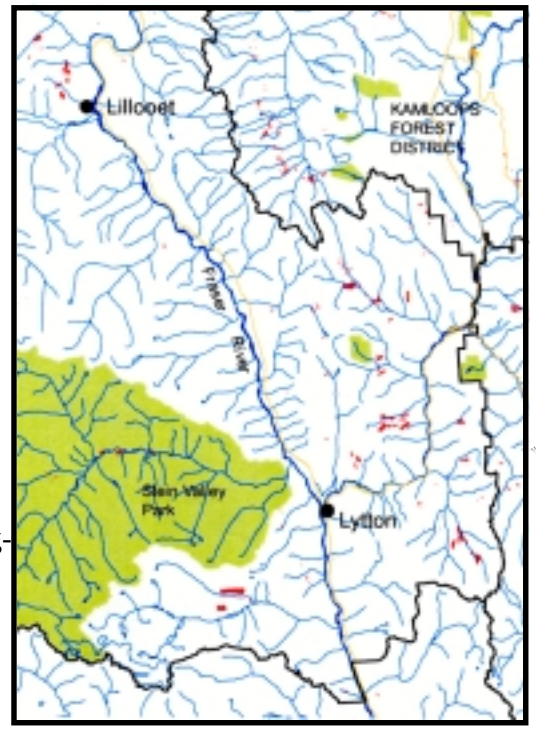
Spruce Beetle
Spruce beetle mortality was mapped on just over 1,000 hectares in the District in 2002. W hile most infestations declined in area, significant mortality still occurred in Tommy Creek, Bob Creek, Truax Creek, Lost Valley Creek, Conell Creek, and Downton Creek.

Western Spruce Budworm
Defoliation expanded for the third year in a row, to 4,074 hectares, from 2001 levels of 2,579 hectares. Expansions were seen along the Fraser River south of Kwoiek Creek, and new defoliation was observed in the Gun Lake area, and in scattered areas near Seton Portage and along Anderson Lake. Extensive, moderate to severe defoliation was observed in the Nahatlatch River area, in the Chilliwack Forest District. Egg mass sampling results indicate that populations appear to be very high in this area, and defoliation is expected to expand north along the Fraser River in 2003.

Wildfire
A large wildfire covering 1,400 hectares occurred early in the summer, on the south side of Seton Lake, between Spider and Machute Creeks. The only forest health concerns in the area were a few small patches of Douglas-fir beetle.

Other forest health factors included 26 hectares of birch leaf miner in the Yalakom River.

Figure 18. Mountain pine beetle in the Lillooet District.



RESEARCH UPDATE

PERMANENT SAMPLE PLOT ESTABLISHMENT TO STUDY SUCCESSIONAL ATTACK DYNAMICS OF WESTERN BALSAM BARK BEETLE, *DRYOCOETES CONFUSUS*, IN ESSF FORESTS

As part of an ongoing research project, three 1 ha permanent sample plots were established in 2002 (2 funded by FIA, Tolko Louis Creek, and one established in-house). Two plots were located in Spius Creek (Merritt TSA) and one in Scotch Creek (Okanagan TSA). All plots were located within areas that have current and historic records of western balsam bark beetle, *Dryocoetes confusus*. These data will complete a 10-plot database intended to provide information on the attack dynamics and impact of *D. confusus*, the number one mortality-causing agent in high elevation subalpine fir forests.

Stands within the ESSFwc, ESSFmw, and ESSFxc were categorized as early, mid- and late-phase in the successional dynamics of *D. confusus* and subalpine fir. Between 1998-2002, plots were established in stands representing these successional phases of stand and insect population dynamics. Plots have been assessed annually, new *D. confusus* attack recorded, and previously attacked trees re-assessed for insect development, crown symptoms and tree status (standing/down) (Refer to 2000 Overview of Forest Health In The Kamloops Forest Region for more information).

Three plots are classified as early-phase, four as mid-phase and three as late-phase (Table 1). The density of subalpine fir ranges from 429 stems per hectare (sph) (Cherry Ridge, late-phase) to over 1,200 sph (Buck Mtn, mid-phase). In general, late phase stands have fewer subalpine fir per hectare than the early and mid-phase stands (Table 1). Subalpine fir mortality was greater than 30% in all plots, except in the new Spius Creek 2 plot. The highest subalpine fir mortality was seen at Cherry Ridge, Sicamous Creek (both ESSFwc2) and Home Lake 1 (ESSFxc) (Table 1).

Generally, early to mid-phase plots have a greater number of trees in the smaller dbh classes with fewer in the larger classes compared to late phase plots (Fig. 1). Mid-phase plots have both early- and late-phase stand succession attributes, because they are in transition. Mid- to late-phase plots have a mix of tree sizes more evenly spread over both small and large diameter classes. Tree diameter and age are usually correlated, with the oldest trees in a stand being the largest. Therefore, the increase in susceptibility of subalpine fir to attack by western balsam bark beetle with tree age may be due in part to the effect of diameter as well as senescence. Three plots established in 2002 in early and mid-phase stands are shown in Fig. 2. The snag category represents the first trees in a stand to be attacked by *D. confusus* (>6 to 10 years ago) and 2002 attack represents the most recently killed trees.

Table 1. Biogeoclimatic classification, successional phase, stems per ha (sph) and tally of dead subalpine fir in ten 1 ha plots. Dead includes W BBB and mortality due to other causes.

Location	BEC	Phase	Bl per ha	sph	Elevation (m)	% dead Bl
Martin Creek	ESSFwc2	early	1,161	1,417	1,675	30.2%
Scotch Creek	ESSFwc2	early	664	722	1,575	50. 5%
Spius Creek #2	ESSFmw	early	676	844	1,610	17.0%
Spius Creek #1	ESSFmw	mid	615	785	1,470	39.5%
Buck Mtn.	ESSFxc	mid	1,217	1,319	1,725	48.4%
Home Lake #1	ESSFxc	mid	842	998	1,800	60.9%
Home Lake #2	ESSFxc	mid	1,153	1,313	1,750	57.1%
Torrent Creek	ESSFwc2	late	514	597	1,750	34.6%
Sicamous Creek	ESSFwc2	late	732	930	1,650	61.5%
Cherry Ridge	ESSFwc4	late	429	496	1,650	64.6%

Many criteria are evaluated when classifying a stand as early-, mid- or late-phase. Some of the criteria include percent of dead subalpine fir, the distribution of beetle-killed trees in each attack category (Fig. 1) and an estimate of old beetle attack that is now on the ground (greys and snags that have fallen). Both Spius Creek plots have a fairly high number of trees classified as snags compared to the Scotch Creek plot (early-phase), but less recent attack (except in 2002). In contrast, the Scotch Creek plot has experienced fairly high and sustained levels of attack for the past six years with little evidence of old attack, thereby clearly placing it into the early-phase category of succession.

Much of the western balsam bark beetle research will be completed this summer and a final report will be prepared in 2003-04.

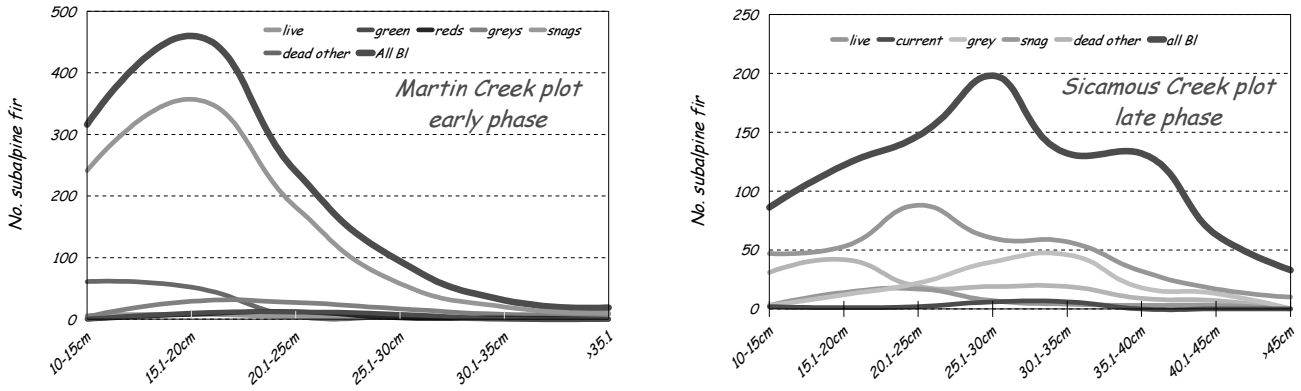
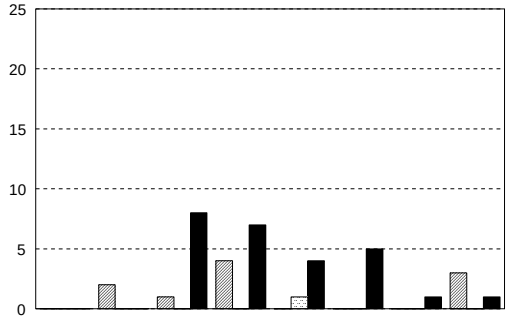
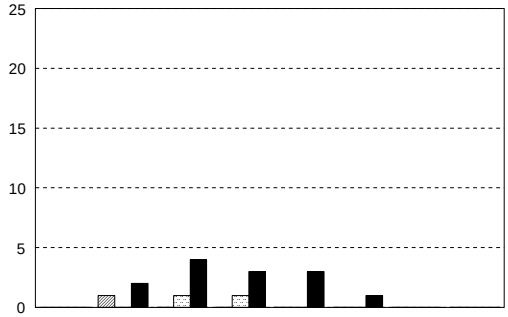


Figure 1. Plot statistics from an early phase (left) and late phase (right), Martin and Sicamous Creek, respectively. Distribution of subalpine fir by 5 cm diameter classes grouped by attack status of tree.



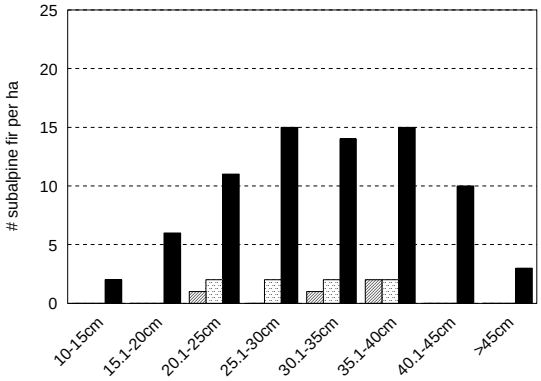
Snags: losing bark, often decayed

Dull red: 2-3 year old attack



Old greys: no fine needles; bark still intact

Bright red: 1 year old attack



Recent greys: 4+ years since attack

Current (2002) attack

Figure 1. Six graphs showing from top to bottom, left to right the six stages of subalpine fir following attack by D. confusus, snags having been dead for the longest time. Each graph compares attacked trees in the 3 plots established in 2002, divided by 5 cm diameter classes.

HISTORY OF W ESTERN SPRUCE BUDW ORM OUTBREAKS IN SOUTHERN B.C.

Historically, most western spruce budworm (W SBW), *Choristoneura occidentalis*, outbreaks have occurred in three IDF subzones common to the southern portions of B.C.: the IDFdk (dry cool interior Douglas-fir), the IDFdm (dry mild interior Douglas-fir), and the IDFxh (very dry hot interior Douglas-fir). From the early 1900's to present, the IDF ecosystem has been most impacted by the western spruce budworm, with the IDFdk and IDFxh subzones showing the largest areas of defoliation. Budworm also occurs in other ecosystems such as the interior cedar hemlock (ICH), but outbreaks there seem to be of a shorter frequency and intensity. Several hundred thousand hectares within the IDF are periodically at risk to western spruce budworm.

The budworm can cause significant damage to Douglas-fir by larval feeding on buds and new foliage. Budworm defoliation causes tree mortality, reduction of growth rates and reduced lumber quality. Because of the budworm's preferential feeding on the current year's buds and foliage, height growth is severely reduced or eliminated during each year of defoliation. In addition, severe defoliation over several years often causes mortality of the upper crown, known as top-kill, and may lead to the formation of stem defects (Van Sickle *et al*. 1983; Alfaro and Maclauchlan 1992). In uneven-aged stands, budworm has different impacts on the various canopy layers.

A historic overlay analysis of the extent and frequency of western spruce budworm outbreaks in susceptible forest types within the Kamloops Region was completed in 2000 (Hodge 2000; Maclauchlan 2000). Overlay maps and data files were created showing maximum consecutive and total number of years defoliated for all forest polygons that had some record of defoliation. The historic overlay was then used to delineate areas of chronic budworm activity; periodic activity and areas that had no record of budworm, yet contained susceptible stands. Plots were established in stands covering a cross-section of these criteria, covering the range of historic defoliation to determine tree and stand impact and to build a hazard rating system. (refer to 2001 Overview of Forest Health In The Kamloops Forest Region for more information).

In 2002, 39 impact assessment plots were established and 644 cores were collected for analyses from interior Douglas-fir sites in the Kamloops Region. The tree ring collection and analyses complete a data set that has been compiled over the past 3 years. These data will be used to determine impact and historic outbreak patterns of western spruce budworm, throughout its range in the Kamloops Region. W ith this information, it will be possible to estimate growth gains and losses, and to further define outbreak periodicity.

Based on preliminary data analysis, there were 8 outbreak periods identified in the tree ring chronologies over a number of sites. Outbreak duration was between 5 to 8 years and the number of years between outbreak periods ranged from 10 to 48 years. Not all sites experienced each of these outbreaks; therefore, outbreak periodicity would vary from site to site. Further analysis of the data collected during this study will assist in making biological and economic stand management decisions throughout the range of western spruce budworm.

This project was funded in part by FIA, Tolko Louis Creek Division, and FIA/FII research funds.

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