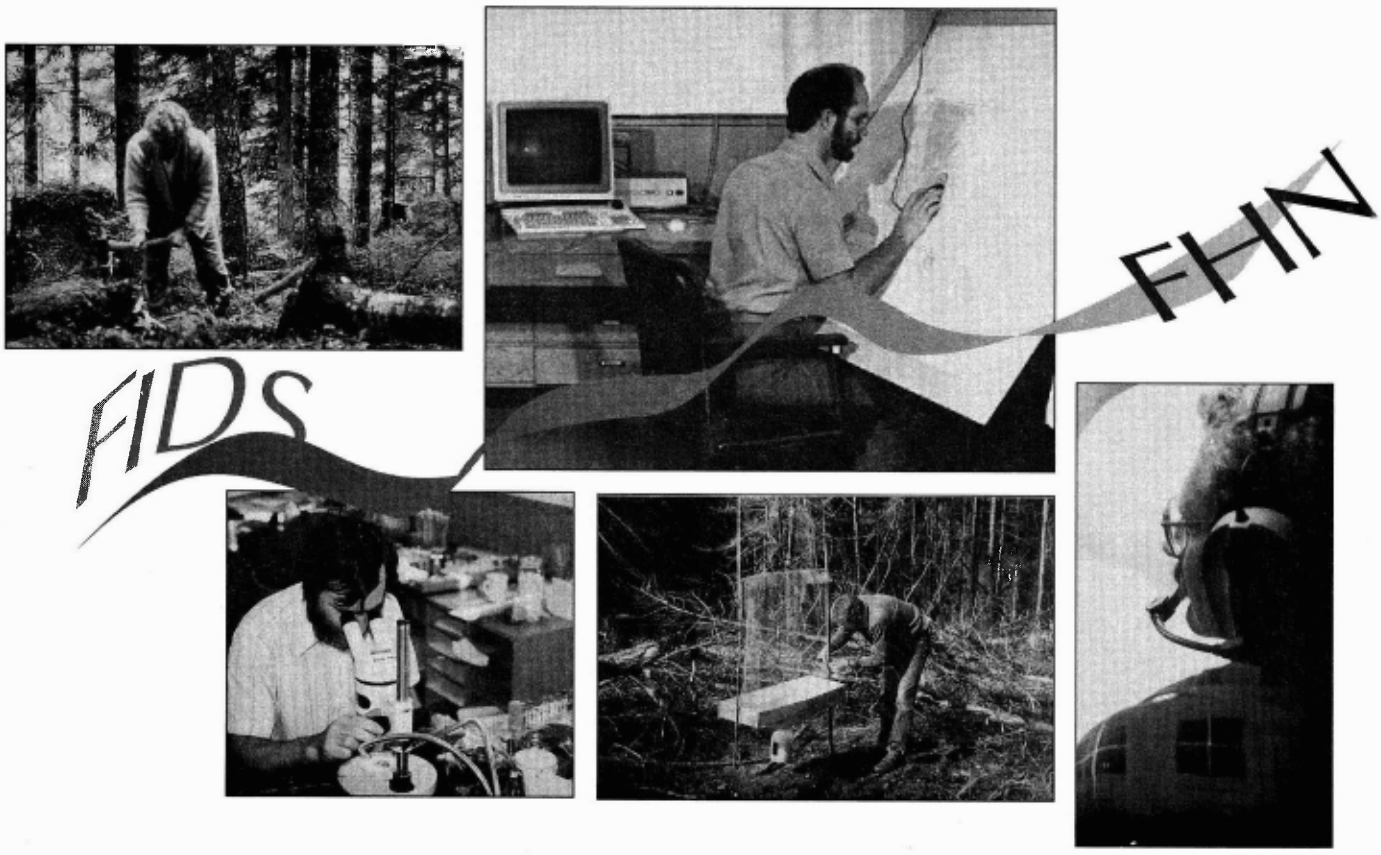
Forest Insect and Disease Conditions Kamloops Forest Region – 1995

Peter Koot and Bob Ferris

Pacific Forestry Centre • FIDS Report 96-2



Natural Resources Canada
Canadian Forest Service

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Preface

Canadian Forest Service
Transition of FIDS to Forest Health Network

As a result of the Canadian Forest Service (CFS) program review and reorganization announced in the February 1995 federal budget, the CFS had a substantial reduction in resources (37% reduction in staff) and modified its priorities to be more in concert with federal responsibilities in the forestry sector. Overall, the Canadian Forest Service will be reduced to five establishments focusing on science and technology development. Operational forestry activities such as growth and yield, applied silviculture, and the Forest Insect and Disease Survey have been reduced; in this latter case, however, a more nationally focused Forest Health Network (FHN) is being developed.

The Forest Health Network is one of ten Canadian Forest Service Science and Technology networks organized to integrate research among the establishments and seek partnerships with other agencies and stakeholder groups. These networks will promote sustainable forest development and responsible use of Canada's forest resources. The networks reflect the two themes of the Science and Technology program: the acquisition and aggregation of knowledge related to understanding forest ecosystems, and the development of strategies for advancing sustainable forest development. Some of the networks relevant to insects and fungi include: Forest Health, Biodiversity, Effects of Forestry Practices, Pest Management Methods, and Landscape Management.

Forest Health Network - National Priorities

1. To monitor and report on changes in national forest health using an expanded and enhanced, ecosystem-based series of plots.

2. To provide, in collaboration with provincial cooperators, national overviews of major forest disturbances due to air pollutants, insects and diseases, using nationally standardized monitoring systems with a quality assurance program. This will include national level input required by the Canadian Criteria and Indicators Process for Sustainable Forestry, such as:

   - area and severity of insect and disease attack;
   - occurrence and severity of exotic species detrimental to forests;
   - area of catastrophic forest depletion; and
   - indicators of biodiversity, climate change and forest health.

3. To maintain diagnostic expertise and working reference collections to provide the scientific foundation in support of forest biodiversity policies.

4. To maintain the national forest health database with access to all partners. Analysis of data and presentation of information in shared electronic formats will be undertaken.

5. To participate in the planning and conduct of surveys, and pest risk analysis for exotic forest pests in cooperation with Agriculture and Agri-Food Canada.

6. To maintain linkages with other client federal departments (Environment, Heritage-Parks Canada, Agriculture and Agri-Food Canada) as well as the collaborative efforts with Provinces, universities, industry and international agencies.

7. To develop, test, and standardize monitoring techniques, indicators and predictive models of forest health.

Forest Health Network - Pacific Forestry Centre

In 1996 the Forest Health Monitoring unit at CFS-Victoria will comprise seven senior Forest Health technicians. The insect and disease diagnostic capability along with the permanent reference collections and related databases will be retained, with increased emphasis on forest biodiversity aspects. The geographic information system (GIS) developed since 1984 and the associated historical database will continue to provide support to the Forest Health unit and the national database. The long-term plan is to have a total of six forest health technicians in the Forest Health Monitoring Unit.

The planned staff of the Canadian Forest Service-Victoria, Forest Health Monitoring Unit in 1996 will include:

Forest Health Technicians
Bob Erickson
Rod Garbutt
Nick Humphreys
Peter Koot
Rod Turnquist
Leo Unger
John Vallentgoed

Forest Health Unit Leader
Allan Van Sickle

Associated staff in the Biodiversity and Landscape Management - Decision Support System networks are:

Insectary:	Lee Humble, Bob Duncan, Jane Seed
Herbarium:	Brenda Callan
GIS:	Dennis Clarke

New Partnerships

At this time of transition, we would like to again recognize the very significant support and cooperation provided by many agencies in helping the Canadian Forest Service deliver the annual forest insect and disease conditions reports in British Columbia and the Yukon Territories for several decades. Without cooperation from employees of federal and provincial parks, Agriculture and Agri-Food Canada, the forest industry, and especially the British Columbia Ministry of Forests, the more than 50 years of insect and disease records affecting the nation's forest would not be as complete.

As the Forest Health Network evolves to fulfill the national aspects of the priorities noted above, we hope that this outstanding level of cooperation and partnership continues. We look forward to continued involvement with our clients in research and planning to help develop the Forest Health Network research direction. To this end, we are pleased that there is already agreement between the Canadian Forest Service and the British Columbia Ministry of Forests to undertake a cooperative approach to forest health monitoring that will best meet the needs at both the provincial and federal levels.

We look forward to working together with our partners in 1996 and beyond.

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Foreword

This annual report describes and summarizes the status of forest pests and the effects of environmental factors on forests in the Kamloops Forest Region in 1995 and attempts to forecast population trends and highlight pests that are capable of sudden damaging outbreaks with forest management implications. Pests are mentioned by host, in order of importance, and occasionally within the context of a management unit or Timber Supply Area (TSA).

The Forest Insect and Disease Survey (FIDS) group is the national network within the Canadian Forest Service responsible for:

(1) producing an overview of forest pest conditions and their implications;

(2) maintaining records and surveys to support quarantines and facilitate predictions;

(3) supporting forestry research, and herbaria, insect collections and records;

(4) providing advice on forest insect and disease conditions; and,

(5) developing and testing survey techniques and conducting related biological studies.

Introduction

This report was compiled mostly from information derived from field observations and records collected during the field season, which extended from early June to the end of September. Insect and disease collections were submitted for identification and verification to the Pacific Forestry Centre (PFC). Some of these specimens were added to the extensive permanent collections in the PFC Insectary and Herbarium. Provincial government agencies, industry, and private sources submitted additional insect and disease collections. Approximately 250 contacts and on-site pest examinations were made personally with personnel from the British Columbia Forest Service (BCFS), other government agencies, the forest industry, educational institutions and private individuals. Their cooperation is essential to effectively fulfill these responsibilities and is greatly appreciated. Special thanks are extended to the BCFS for their participation in a cooperative survey and for the provision of 78 hours of fixed-wing and 6 hours of helicopter aerial survey time and assistance in producing preliminary regional sketch maps.

Definitions:

Throughout this report, defoliation intensity is defined as follows:

light - discolored foliage barely visible from the air, some upper crown and branch tip defoliation;

moderate - pronounced discoloration and noticeably thin foliage; top third of many trees severely defoliated, some completely stripped;

severe - top, plus many branches completely defoliated, most trees more than 50% defoliated.

Incidences of host trees killed by bark beetles are defined as:

light- 1-10% of host trees; **moderate**- 11-29%; **severe**- 30%+

Summary

While infestations of the **mountain pine beetle** are reduced from 1994, it continues to be the most destructive forest insect in the Kamloops Forest Region, killing more than one million lodgepole pine and white pine on 8865 ha. The majority (63%) of the infestation remains in the Penticton Forest District. **Ponderosa pine decline**, associated with the gouty pitch midge, continues to be a primary cause of ponderosa pine deformity in the South Okanagan. Damage characteristics include faded yellow or red drooping needles, chlorosis, and branch dieback. The **pine needle diseases**, including **pine needle cast**, and **Elytroderma needle disease**, continued to be prominent throughout their respective host ranges, but at reduced levels.

The area and intensity of **western spruce budworm** defoliation declined for the fourth consecutive year to only 2000 ha, down from 14 250 ha in 1994. Infestations were in mixed age-class Douglas-fir stands between Kamloops and Chase, in the Merritt area and near Peachland. After peaking at 1175 ha in 1993, **Douglas-fir beetle** outbreaks continued their decline to 545 patches covering 207 ha, mostly near Kamloops, Cache Creek, Lillooet, along the Fraser River, Louis Creek, Adams Lake and near Sicamous. Pockets of infestation generally contained from 5 to 30 trees each. Populations of **Douglas-fir tussock moth** remained at endemic levels and only a few scattered single trees were partially defoliated in urban areas of Kamloops. Continued low populations are expected in 1995. The **gouty pitch midge** continues to be a significant contributor to ponderosa pine decline and tree mortality in the Okanagan Valley. **Sirococcus shoot blight** caused up to 5% wilting and death of new shoots in scattered areas of an eight year old Douglas-fir plantation near Harbour Lakes, the first notable occurrence in many years.

Following three consecutive years of increase **spruce beetle** outbreaks declined to 1200 ha from 2500 ha in 1994. The majority of attack occurred in previously infested stands in the Merritt and Lillooet TSAs[1]. As 1995 was a non-flight year, only some minor larval feeding by **two-year cycle spruce budworm** was evident in the upper Kettle River drainage, in TFL 18 near Clearwater and in Wells Gray Park.

Recent infestations of **western balsam bark beetle** detected during aerial surveys declined to 2480 ha from 2870 ha in 1994, but the number of infested pockets doubled. Chronic infestation areas include Taweel Lake, and Tranquille, Chu Chua and Wentworth Creeks in Kamloops Forest District.

Larch casebearer populations declined, causing only light defoliation totalling 68 ha east of Armstrong and south of Coldstream near Vernon.

Black army cutworm populations remained relatively low for the seventh consecutive year and there were no reports or observations of damage to seedlings. Low populations are again predicted in 1995 in areas where pheromone traps were deployed.

[1] Timber Supply Area

Pests of Young Stands surveys were completed in 34 young stands, mostly treated under the FRDA II agreement. Pest occurrence and damage was assessed on 3827 trees in 366 plots. Nearly 6% of trees of all species were killed or affected by life threatening agents, while 66% of all trees examined were pest free. Two biomonitoring plots established in 1992 and an **acid rain monitoring** plot established in 1986, were re-examined and showed no damage associated with acid rain.

No male **gypsy moths** were caught in any of 42 pheromone-baited traps distributed in provincial parks throughout the Kamloops Forest Region. Defoliation of trembling aspen and black cottonwood by **satin moth** was restricted to only 30 ha near Larson Hill and in a few small patches near Barriere, down from 168 ha in 1994. **Birch leafminers** again discolored birch over several thousand hectares in scattered areas on both sides of Adams Lake and near Lumby.

Other noteworthy pests mentioned near the end of this report are those that have the potential to cause significant damage, but are presently at low levels or causing damage in small localized areas.

Pine Pests

Mountain pine beetle
Dendroctonus ponderosa

While the overall area of mountain pine beetle infestation decreased to 7882 ha from 8865 ha in 1994, it remains the most damaging forest insect in the Kamloops Forest Region. The beetle continues to have a major impact on harvesting schedules of lodgepole pine and on watershed, recreational, wildlife, and other resource values. As in recent years, the areas of greatest tree mortality occurred in the Penticton and Merritt Forest districts. Elsewhere, a twofold expansion in infestation area occurred in the Chase and Charcoal creeks areas in the Salmon Arm District and the Paxton Valley-Martin Mountain area in Kamloops District.

Beetles killed more than 1 000 000 mature lodgepole pine and white pine in the region in 1995 (Table 1, Figures 1 and 2). Pine volume losses totalled 407 200 m^3 in 1995, an 18% decrease from 1994 estimates.

Table 1. Recent pine[1] mortality (red attack) caused by mountain pine beetle as determined from aerial and ground surveys, Kamloops Forest Region, 1995.

TSA[2]/ District	Number of infestations	Area (ha)	Number of trees killed	Volume of trees killed (m^3)
Kamloops TSA				
Kamloops District	111	371	25 000	20 400
Clearwater District	84	563	16 000	14 000
Okanagan TSA				
Salmon Arm District	148	430	55 900	27 950
Vernon District	121	105	17 000	6 850
Penticton District	1102	4390	650 000	227 500
Merritt TSA				
Merritt District	609	1830	242 000	97 000
Lillooet TSA				
Lillooet District	59	193	33 700	13 500
Totals	2234	7882	1 039 600	407 200

1 - lodgepole pine, white pine.
2 - includes TFL's, parks and non-tenure areas.

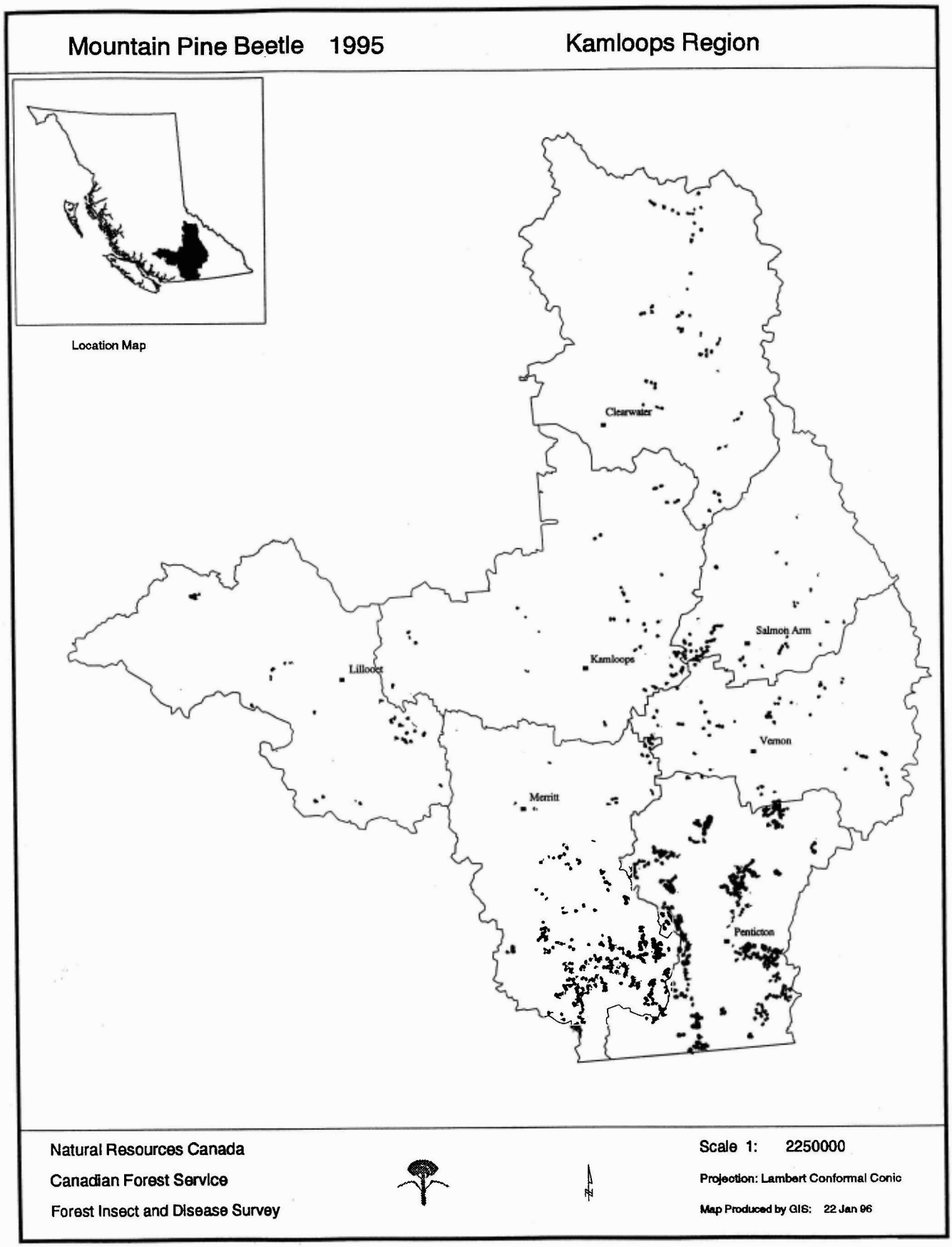

Figure 1. Areas of pine recently killed by mountain pine beetle as determined by aerial and ground surveys, 1995.

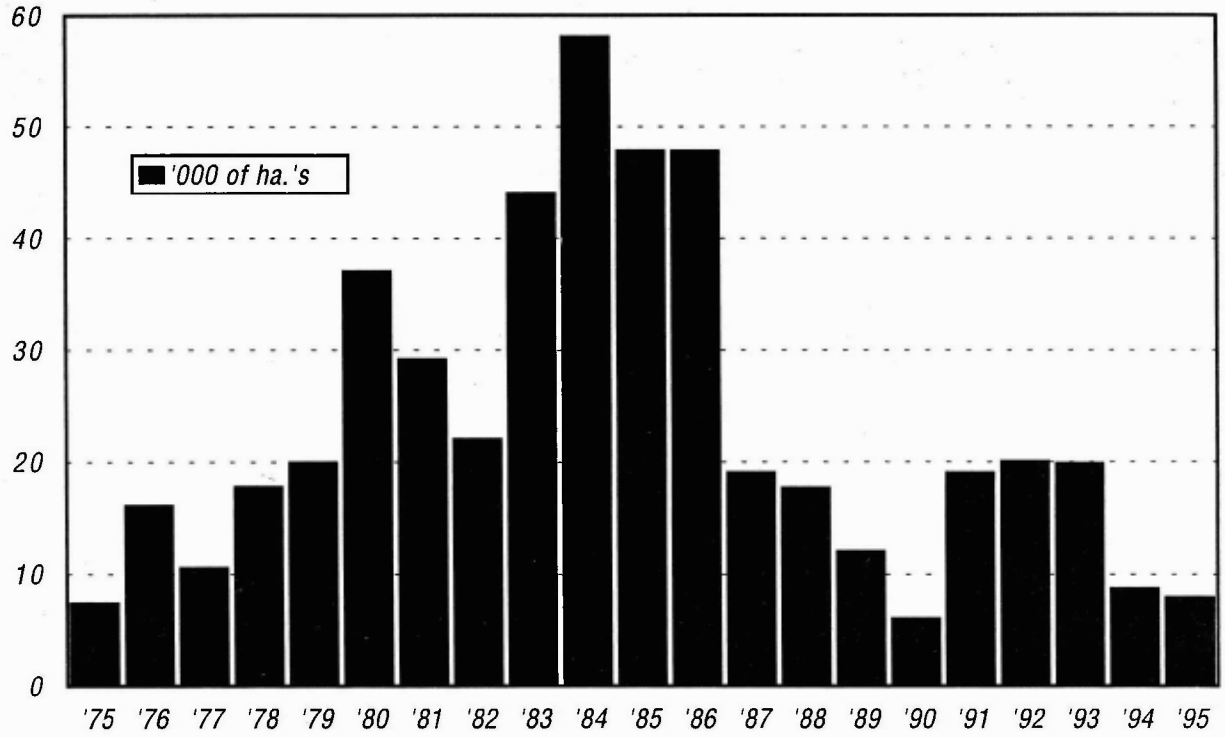

Figure 2. Area (ha) of mountain pine beetle infestation, 1975-1995, Kamloops Forest Region.

After several years of declining populations, beetle activity in **Kamloops TSA** in lodgepole and white pine stands nearly tripled in area to 934 ha (Table 1). Beetles killed an estimated 41 000 pine in 1995. Typical infestations were individual spots comprised of 5 to 100 trees each. The largest concentration of these in southern portions of the TSA, included nearly 250 ha of recent beetle-killed lodgepole pine in the Paxton Valley-Martin Mountain area and George Creek drainage. In more northern areas, notable increases occurred in stands containing white pine in the North Thompson Valley from Avola to Berry Creek and along the upper Adams River Valley between Gannett Lake and Sunset Creek. Small infestations did not change substantially over the past two years in white pine stands between Blue River and Albreda and in the Barriere Lakes area.

Continuing a declining trend, the area of active beetle infestation decreased in the **Okanagan TSA** to 4925 ha from 6520 ha in 1994. Aerial surveys revealed 1371 separate infestations, the majority of which were small patches of 0.25 to 5 ha each. Similar to previous years, most of the decline occurred on the east side of the Okanagan Valley from Osoyoos to Vernon, where beetles have been active for many years. Aggressive management strategies combined with lack of suitable host material and/or low brood survival were the primary ingredients for successful beetle reduction in this area. Despite the overall trend, specific increases in activity occurred, primarily in the Salmon Arm District, where infestations expanded more than twofold in the Chase and Charcoal creeks areas. Other areas of increase included Mara Lake to Enderby and Tappen to Skimikin Creek.

In the **Merritt TSA** the infestation area was reduced by 8% to 1830 ha in 1995, the second consecutive year of decline. Lodgepole pine volume losses involving an estimated 242 000 stems were calculated at 97 000 m^3. In spite of the overall reduction some increase did occur south and east of Princeton, mostly in the form of expansions to existing infestations. Elsewhere, infestations did not change enough to warrant alteration of the general management strategy for those areas. Tactics involving MSMA treatments, fell and burn, and semio-chemical baiting continue to be an integral part of pest management in the Merritt District, where underlying conditions such as stand age favour beetle development.

Beetle activity in lodgepole pine stands in the **Lillooet TSA** increased significantly. Infestations expanded from 40 ha in 1994 to nearly 200 ha in 1995. Most of this increase occurred where previously infested areas expanded from spot infestations in the Pasulko Lake and Murray and Laluwissin creeks areas. Several small pockets of lodgepole pine and occasionally white pine continue to be infested near Duffey Lake, and Cayoosh, Kwoiek, and Whitecap creeks, where control options are limited due to difficult access.

Due to declining resources in FIDS, limited annual brood assessments and fall cruises were conducted to determine volume losses, and estimate beetle population trends (Table 2).

Some limited surveys in the Paxton Valley-Martin Mtn and Charcoal Creek areas suggest continued static populations in lower elevation stands and moderate increases at higher levels in 1996. Large healthy beetle broods in the fall were observed in higher areas, while much smaller broods were evident at lower elevations. The poor beetle performance in lower areas was probably precipitated by an early flight, as May was the ninth sunniest in 100 years, followed by cooler and wetter conditions, which are not conducive to beetle production. At higher elevations broods usually take longer to mature, resulting in a later but normal flight under these conditions.

Table 2. Mountain pine beetle cruise data, Kamloops Forest Region, 1995.

	Percent (%) pine attacked					
TSA/Location	Healthy	Current attack (1995)	Partial attack (1995)	Red (1994)	Grey (pre-1993)	Total
Kamloops TSA						
Mail Creek	9	42	12	9	28	100
Ivor Creek	52	12	10	20	6	100
Okanagan TSA						
Charcoal Creek	61	15	10	7	7	100

Ponderosa pine decline

The gouty pitch midge *Cecidomyia piniinopis* continues to be a significant contributor to ponderosa pine deformity and decline in vigor in the Bunchgrass Biogeoclimatic Zone. It occurs throughout many areas of the South Okanagan Valley and in at least one area in the South Thompson Valley near Pritchard. Occasional tree mortality, faded, yellow or red drooping needles, chlorosis, and branch dieback have been reported since 1991. Numerous other pests such as scale insects on needles, pitch moths, sawflies, gall rust, pine moth, bark beetles and Elytroderma needle disease were frequently found in association with the gouty pitch midge. The damage is first noticed in early summer when new shoots fade, droop, and die. On some trees north of Pritchard, nearly every new shoot was affected, and typical attacks were on open growing pines. Damage is difficult to predict as populations fluctuate widely from year to year due to natural factors such as environmental conditions and predators.

Pine needle diseases
Lophodermella concolor
Hendersonia pinicola
Elytroderma deformans

Discoloration from pine needle diseases was much less prominent in 1995 throughout the host range of lodgepole pine, and to a lesser extent ponderosa pine in the Kamloops Region.

Aerially discernible discoloration of lodgepole pine caused by *L. concolor*, frequently in association with a secondary fungus, *H. pinicola*, declined in area to only 3100 ha from more than 148 000 ha in 1994. The large reduction in area estimation is due to lower levels of infection in conjunction with the masking effect of new foliage as observed during aerial surveys. Most of the stands were comprised of immature lodgepole pine, many of which were previously infected. The largest areas of damage were mapped in the upper Deadman Creek area in the Kamloops District. Elsewhere, one or two patches of 200 to 500 ha each of light discoloration were visible along the Bonaparte Plateau, near McLure, Knouff Lake and at Vaseux Creek. Several damaged stands included those that were highly managed spaced, thinned, pruned or fertilized for optimum growth.

The present epidemic originated from moist conditions in late spring and early summer of 1993, which was conducive to inoculum build-up that resulted in large areas of discoloration in 1994. High moisture levels were not as common in 1994 and helped to reduce inoculum spread and foliage discoloration in 1995. While precipitation in 1995 was below normal in May, average moisture conditions predominated in late spring and early summer and should result in a continued reduction in overall incidence of infection and foliage discoloration in 1996. Increment loss can be expected in stands with chronic foliage loss due to successive years of infection.

Elytroderma needle disease, caused by *Elytroderma deformans*, continued to be widespread on ponderosa pine, adversely affecting its growth throughout the Ponderosa Pine and Bunchgrass biogeoclimatic zones in the Region. Affected trees usually display prominent witches' brooms and needle browning and make little perceptible growth. Severely diseased pines may be susceptible to attacks by red turpentine beetle. Areas of chronic disease occurrence include stands southwest of Princeton, along Durand Creek, near Savona, Bridge River, Hat Creek, Paul Lake and Pritchard. Up to 80% of the foliage was affected on trees in these areas.

Douglas-fir Pests

Western spruce budworm
Choristoneura occidentalis

Following a major reduction in defoliation of Douglas-fir in 1994, a further decline in aerially observable defoliation occurred in 1995 to 2100 ha from 14 250 ha (Figures 3,4). Moderate defoliation was recorded on 200 ha near Barnhartvale, with the remaining 1900 ha lightly defoliated. This is the fourth successive year of reduction in area and in defoliation intensity. The majority of feeding was in mixed-age Douglas-fir stands in the Kamloops, Merritt and Okanagan TSA's. Trace to light levels of defoliation not visible during aerial surveys were observed from the ground in many stands previously infested.

Damage

The extent of defoliation in the **Kamloops TSA** declined to 800 ha from 2000 ha in 1994, the lowest level since 1978. Only nine distinct areas of defoliation were recorded in the TSA, of which 600 ha were light, mostly in the immediate Kamloops area at Sugarloaf and Iron Mask Hills, west of Aberdeen, Barnhartvale, and further east at Buse Lake and Robbins Range. One pocket of nearly 150 ha of light defoliation was also recorded along Gallagher Creek west of Cache Creek. Some scattered light feeding of the 1995 foliage not visible from the air was evident in many Douglas-fir stands between Hat Creek and Chase.

In **Merritt TSA** defoliation was reduced to only 550 ha from 5550 ha in 1994, all of which was light. The three largest areas of more than 100 ha of discoloration each, were observed west of Moore Creek, and near Peter Hope and Glimpse lakes. Smaller pocket up to 40 ha each were found along lower Guichon Creek, south of Douglas Lake, and north of Minnie Lake.

Light defoliation in the **Okanagan TSA** was restricted to 750 ha in seven areas between Peachland and Summerland and in three areas near Little Shuswap Lake. This is down from 5150 ha of light to severe discoloration in 1994. Extensive light to moderate feeding damage along Trepanier Creek in early summer was no longer evident during aerial surveys in early August, and neither was defoliation in several areas noted earlier along the Nicola River and near Merritt.

While aerial surveys of **Lillooet TSA** detected no new defoliation, ground surveys did note trace to light defoliation of some stands including several locations in Fountain Valley, Della Creek, Pavilion Lake and Marshall Creek. Douglas-fir beetle attacks were common in some chronically defoliated stands along Fountain Valley and along the Fraser River between Lillooet and Lytton.

Sampling

For the ninth consecutive year adult males were monitored at four locations with low populations and a history of outbreaks. Counts averaged 190 adults per location (range 4-307), up from 89 adults in 1994. Trap counts indicate the potential for light defoliation at Stump Lake and Adams River in 1996, but not in the other two areas monitored at Darke Lake and Mabel Lake.

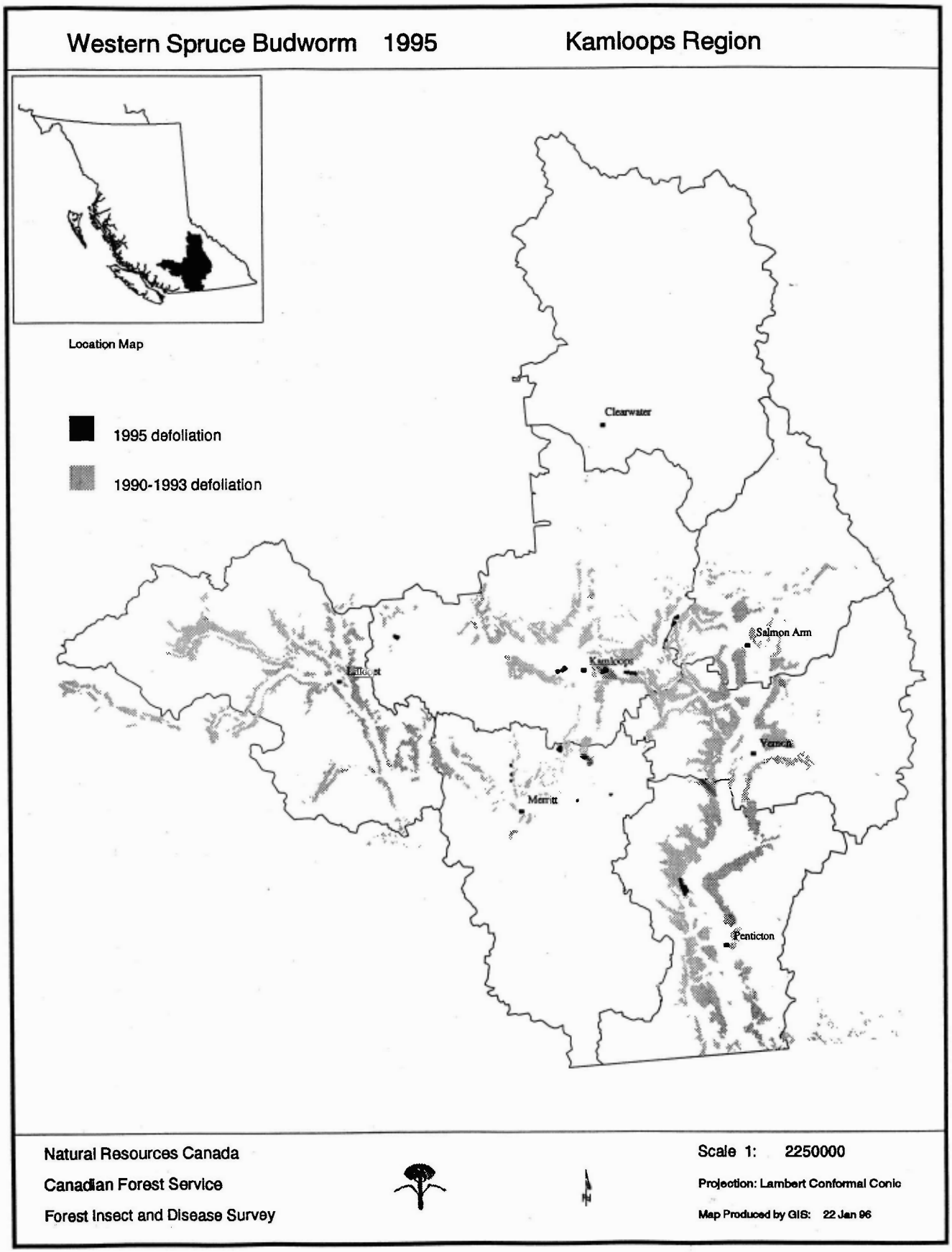

Figure 3. Defoliation by western spruce budworm detected by aerial surveys in 1995, compared to the maximum area covered previously.

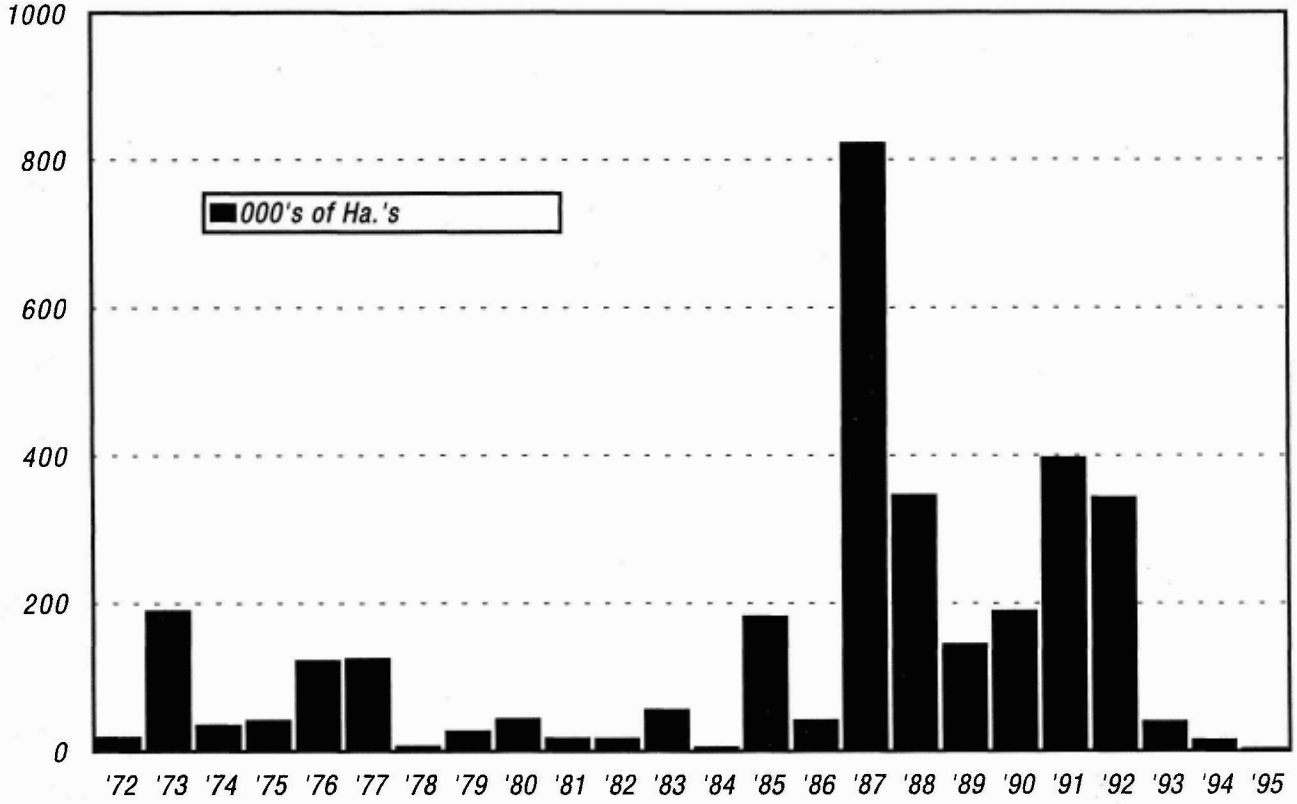

Figure 4. Area (ha) of western spruce budworm infestation, 1972-1995, Kamloops Forest Region, 1995.

Biological Control

No aerial applications of biological insecticides were done on an operational basis in 1995, but 450 ha of Douglas-fir were experimentally sprayed by the Canadian Forest Service near Merritt under the direction of Dr. Imre Otvos. Tests were conducted to obtain efficacy data for extension of registration of Foray 48B, Dipel 76AF and Dipel 48AF (formulations containing *Bacillus thuringiensis* var. *kurstaki)* for control of the western spruce budworm. Preliminary findings indicate mixed results regarding larval control among the three treatments, with population reductions varying from a high of 88% to only 39%.

In another trial, three research plots containing light to moderate budworm populations near Merritt were treated with synthetic pheromone by Dr. Michael Hulme and Mr. Tom Gray to disrupt mating in 1995. The pheromone, in saturated polyvinyl chloride beads, was applied by helicopter at 40 grams per hectare in early July. Preliminary analysis of male trapping data indicates that control of 85 to 95 % was achieved. Additional trials are anticipated in 1996.

Impact

Successive years of severe defoliation have resulted in tree mortality, top-kill, increment loss, and tree deformity in many parts of the IDF zone, although amounts vary by site. The budworm impact is most severe in uneven-aged stands in the drier ecozones. Analysis of annual data from 64 research plots in young stands of Douglas-fir in the Kamloops District indicates an average annual increase in tree mortality of approximately 1%. Cumulative tree mortality since 1986 is now 14%.

Due to the exclusion of fire and the use of selective harvesting methods, many Douglas-fir stands are uneven-aged with a dense understory of Douglas-fir, which favors budworm budworm feeding and population buildup. Even-aged stand management should be encouraged where it is an option in historically active budworm areas.

Douglas-fir beetle
Dendroctonus pseudotsugae

Douglas-fir beetle outbreaks continued to decline in 1995. Only 545 patches of infested Douglas-fir were recorded on 207 ha compared to 775 patches covering 600 ha in 1994, mostly near Lillooet, Kamloops and Sicamous. As in previous years, individual outbreaks were generally small, comprising 5 to 30 trees each, with occasional pockets containing 100 trees. To facilitate pest management operations in Kamloops District, virtually every pocket of beetle infestation was photographed and sketch mapped during aerial surveys.

The largest concentration of beetles continues in stands previously infested by western spruce budworm along Tranquille River in the **Kamloops District**, where more than 50 pockets of infestation occurred, but at reduced intensity. Other notable concentrations in the District include Louis Creek, lower Adams Lake and the Cache Creek-Pass Valley area. Major reductions in beetle activity in many of these areas is directly related to the control activities by the forest companies and the B.C. Ministry of Forests with the use of trap trees, pheromone baits and timely extraction of infested wood.

After small increases in 1994, populations declined in the **Lillooet District**, with pockets of 5 to 10 trees common along the Fraser River from Lillooet to Kwoiek Creek, along Cayoosh Creek, Carpenter Lake and Fountain Valley. Many of these infestations are associated with successive years of moderate to severe spruce budworm feeding damage in mature Douglas-fir stands, particularly along Fountain Valley, Marshall Creek and the Fraser River.

Spot infestations continued at reduced levels in the **Salmon Arm District** in the Sicamous-Mara Lake area, near Salmon Arm, and along Shuswap Lake near Annis Bay and in Tree Farm Licence 33. Fewer infested trees were also noted near Humamilt Lake. Elsewhere, small infestations of 5 to 10 trees each continued at reduced intensity in **Clearwater District** near Momich Lake, and along the Clearwater River in Wells Gray Provincial Park. Attacks to single trees, occasional small groups, and windfall continued throughout the host range of Douglas-fir in the Okanagan and Similkameen valleys and south of Merritt.

The judicious use of trap trees and associated pheromone baiting combined with timely harvesting, should help to reduce the impact of expanding infestations and keep them in check. Those stands with recent windthrow containing mature and overmature Douglas-fir and those repeatedly defoliated by spruce budworm, will require extra vigilance.

Douglas-fir tussock moth
Orgyia pseudotsugata

Populations of Douglas-fir tussock moth remained at endemic levels throughout the Interior Douglas-fir (IDF) Biogeoclimatic Zone and its transition with the Ponderosa Pine (PP) and Bunchgrass (BG) zones in the Kamloops Forest Region. However, there was some light defoliation of single Douglas-fir and spruce in urban settings in North Kamloops, and at Black Pines and Vinsulla.

Male moth captures in pheromone-baited sticky traps at **monitoring** sites decreased for the third consecutive year in Douglas-fir stands selected for the greatest historical frequency of outbreaks. Counts at 16 sites averaged 12 moths per trap (6 traps per location), down from 18 in 1994, and 27 in 1993. Except for the occasional infestation of ornamental trees in urban settings, the decreasing trend of adult populations indicates that no defoliation of Douglas-fir is likely in forested areas in 1996. Despite high counts of 54 and 55 adults per trap at Heffley Creek and Monte Creek respectively, the absence of egg masses suggests that defoliation is not likely in these areas in 1996. Due to low populations, no experimental control programs were initiated in 1995.

A Douglas-fir needle midge
Contarinia pseudotsugae

Douglas-fir needle midges severely discolored immature Douglas-fir along roadsides and in plantations between Little Fort and Vavenby, mostly on the drier south-facing slopes. In severe infestations up to 75% of the foliage was affected, with both needle surfaces discolored yellow, pink or purple by end July. Needle drop was evident in the fall, with trees expected to exhibit heavily thinned foliage next spring where discoloration was severe. A shoot blight caused by *Sirococcus conigenus* was responsible for occasional shoot and top-kill in several of the same infested stands in the Clearwater area.

Similar damage may occur in 1996, as infestations usually continue for several years before declining.

Sirococcus shoot blight
Sirococcus conigenus

Sirococcus shoot blight caused wilting and death of new shoots resulting in crooks on branch tips and terminals of 8-year-old planted Douglas-fir near Harbour Lakes in the Clearwater Forest District. Incidence of infection was rarely more than 5% in several areas examined and usually no more than one or two branches (or a terminal) were affected on individual trees. Similar damage intensities were found on immature roadside and planted Douglas-fir near Clearwater, concurrent with Douglas-fir needle midge damage.

Symptoms of this disease are similar to those of frost damage, though shoots killed by *S. conigenus* are usually scattered and fewer in number than the more uniform pattern of injury associated with frost. When infection occurs in the area of shoot elongation, the restricted growth causes the tip to curl over and form a crook. As a canker develops, fruit bodies that form on the dead shoots produce large numbers of spores which can spread to nearby susceptible hosts by rain splash. Under favorable humidity and mild temperatures the spores germinate to infect current year's shoots.

Spruce Pests

Spruce beetle
Dendroctonus rufipennis

The area of mature spruce recently killed by spruce beetle in the region declined to 1200 ha from 2500 in 1994, the first reduction in four years. The majority of infestations were associated with previously infested stands, primarily in the Merritt and Lillooet TSA's. Several new pockets were scattered in other areas of the region.

In the **Merritt TSA** an aggressive detection program followed by harvesting has reduced the area of new infestations to only 350 ha. These newly infested spruce are generally in or near previously infested sites along the Tulameen River Drainage, along the Lawless, Britton, Illal, Skwum, Holm, Pioneer, Podunk and Railroad creeks, Murphy Lakes, Mt. Thynne, Lodestone Mountain and the adjacent valleys of Granite and Arrastra creeks. Recorded for the first time were several spot infestations in upper Podunk and Railroad creeks and in the upper Coldwater River area along the Coquihalla Highway. Management strategies aimed at further reducing the beetle hazard continue to be used, including placement of pheromones and conventional and lethal trap trees.

The total area of infestation in the **Lillooet TSA** remained similar to 1994 with 650 ha recorded by aerial surveys. Much of the area was comprised of continued attacks in longstanding outbreaks in mature spruce in the Noel, Cadwallader, McGillivray, Connel, and Whitecap creeks drainages. Scattered infestations along Paradise and Relay creeks were reduced to 60 ha through progressive harvesting over the past several years. Elsewhere, smaller infestations of 0.5 to 10 ha were recorded along North Kwoiek, Van Horlick, and Casper creeks, Duffey Lake and north of Pavilion Lake. Control emphasis in several of the older infestations is now directed at primarily using new fringe blowdown and felled spruce as trap trees in infested stands and not harvesting beetle-kill until a wind firm edge has been attained. This change was adopted because chronic high winds in some locations promoted extensive fringe blowdown which resulted in increased spruce beetle populations.

In the **Okanagan TSA** three new infestations detected south of Salmon Arm near Silver Creek resulted from blowdown associated with previous logging. Up to 90% of spruce were attacked in scattered pockets, of which approximately 20% to 30% was current attack. Proposed control efforts include using trap trees to absorb the 1996 beetle flight, followed by harvesting of infested stems.

Spruce beetle occurrence in the **Kamloops TSA** was mostly restricted to previously known spot infestations of 1 to 10 ha each at Cahilty Creek, west of Niskonlith Lake, Tsikwustum Lake, Clearwater Peak and Helmcken Falls. The largest infestation near Blue Earth Lake declined in size and recent attacks were observed on 10% of spruce over 100 ha.

Spruce beetle infestations most frequently result from populations building in windthrow and slash, including high stumps. This is typically followed by attacks to standing mature spruce. While the beetle's normal life cycle takes two years, a one year-cycle can be initiated by extended warm weather, thus accelerating the attack interval and limiting management options. Beetle control is usually achieved by one or a combination of management practices such as slash reduction, sanitation logging, the use of trap trees, or pheromone baiting. Natural population control can also occur as a result of host depletion and extended severe winter temperatures. Identification of infested standing trees and windfall, and monitoring of cutblock boundaries for blowdown will help keep spruce beetle activity to a minimum.

Two-year-cycle spruce budworm
Choristoneura biennis

No aerially discernible defoliation of spruce and alpine fir forests occurred in the Kamloops Forest Region in 1995, a non-flight year when only immature larvae are present. Some minor feeding was evident from the ground in the upper Kettle River drainage near Keefer and Holmes lakes in Vernon District, in TFL 18 in Clearwater District, and on the west side of Clearwater Lake in Wells Gray Provincial Park.

Based on historical trends, more defoliation of alpine fir-spruce stands may be expected in 1996 when the budworm larvae will mature. Areas of chronic infestation in Wells Gray Provincial Park and in the upper North Thompson Valley are likely to sustain at least light defoliation in 1996.

While the impact of budworm defoliation in alpine fir-spruce stands has not been fully researched, observations in areas of chronic infestation indicate the presence of bud mortality, occasional branch dieback, and some top-kill. Stress from chronic foliage loss may also be a factor in the increased incidence of Armillaria root disease and attacks by secondary pests in infested stands.

Alpine Fir Pests

Western balsam bark beetle
Dryocoetes confusus

The area of recent western balsam bark beetle infestations in 1995 declined to 2480 ha from 2870 ha in 1994, however the number of pockets doubled. There is generally little significant variation in area affected from year to year, with tree mortality of 1 to 5% occurring annually.

The most noticeable increase occurred in the upper Hurley River area, where up to 10% of alpine fir were recently attacked on 170 ha. The number of infested patches also increased in the Okanagan Valley, where numerous scattered pockets were recorded in drainages on the west side of Okanagan Lake from Vernon to Falkland, and east of Vernon in the Sugar Lake-Mabel Lake area, upper Kettle River, and south of Lumby. Light infestations also continued over large areas in upper Scotch Creek, south of Momich River and in the upper Mad River.

Long-standing infestations in the Wentworth Creek-Tranquille Lake area continued unchanged on 200 to 300 ha, while one of the most chronic outbreaks near Taweel Lake declined in intensity, covering some 1100 ha. While the area and intensity of attack does not fluctuate dramatically from year to year, consistent and accurate mapping is difficult due to retention of red foliage for up to five years. Once established, beetles continue to selectively attack small groups of trees.

Western Larch Pests

Larch casebearer
Coleophora laricella

Larch casebearer populations declined to only 68 ha of light defoliation from 300 ha of moderate defoliation in 1994. Two areas of equal size were discolored, one at Joyce Creek near Armstrong and the other south of Vernon along the road to King Edward Lake, which has been intermittently defoliated for many years. Some light defoliation was also evident on immature larch along Shuttleworth Creek, but was not discernible during aerial surveys.

Since no overwintering larval assessments were completed, 1996 population predictions can not be made.

Multiple Host Pest

Black army cutworm
Actebia fennica

There were no reports or observations of cutworm damage to planted seedlings in the region; however, some larvae and feeding damage were noted on herbaceous ground cover in upper Manteau Creek in Clearwater District. Pheromone trap counts located in two 1994 broadcast burns in this area averaged 30 moths per trap, too low to cause potential defoliation in 1996. No damaging outbreaks are expected to develop when fewer than 600 moths per trap are caught the previous year.

Deciduous Pests

Gypsy moth
Lymantria dispar

No male gypsy moths were caught in 42 phereomone-baited traps distributed in provincial parks throughout the Kamloops Forest Region by FIDS staff. This is part of a cooperative program to help detect the introduction of this pest in the region. Only 39 moths were recovered in British Columbia in 1995, the same number as was recovered 1994, but down from 141 in 1993. Most of the positive catches were from previously active areas in the Lower Mainland and on Vancouver Island. Aerial and ground applications of *Bacillus thuringiensis* var. *kurstaki* were completed in spring 1995 near Chilliwack on 370 ha, in an effort to eradicate populations. To date no moths have been recovered following treatment.

Satin moth
Leucoma salicis

Moderate to severe defoliation of trembling aspen occurred in several patches on 30 ha near Larson Hill along the Coquihalla Highway. By the end of the summer trees had nearly refoliated, as did those up to 50% defoliated in small scattered areas north of Barriere. Populations declined south of Salmon Arm, and in several areas near Osoyoos. No moth flights were reported or observed to indicate potential areas for defoliation in 1996.

Birch leafminers
Lyonetia speculella
Fenusa pusilla

A birch leafminer, *L. speculella,* again discolored large areas of birch along Adams Lake. Nearly 1600 ha of birch exhibited a scorched appearance, including areas near Stukamapten Lake, Bugcamp Creek, Johnson Lake, Barriere River, and Gollen Creek. These areas of moderate to severe discoloration were still visible at the time of aerial surveys. Actual feeding damage was more extensive than indicated, as many stands had partially refoliated before aerial mapping was completed in mid-summer.

Another birch leafminer, *F. pusilla,* caused moderate foliage discoloration to 600 ha of birch stands scattered for 22 km along Creighton Valley Road, east of Lumby. This is the first year of substantial damage to birch in this area.

European elm bark beetle
Scolytus multistriatus

European elm bark beetles were again captured in pheromone-baited traps in the Okanagan Valley at Westbank. The beetle is a vector of the fungus causing Dutch Elm disease. Surveys for Dutch elm disease have been negative to-date. As one of only a few areas to be free of the disease in North America, British Columbia exports more than 10 000 elm saplings yearly.

Special Surveys

Pests of Young Stands

Forest health surveys were completed to provide an overview of pest problems in young stands, most of which were treated under Forest Research and Development Agreement (FRDA II). The survey was conducted as part of the forest health component (activity #1.523) of the Forest Resource Inventory Subprogram of FRDA II. The survey methodology consisted of identifying and quantifying pests by assigning them a field code based on the level and type of damage of each. A minimum of 100 trees were assessed in 10 or more fixed-radius plots located between fixed intervals along transect lines in each location. In stands greater than 10 years old, strip surveys (5M) were conducted between plots to quantify root diseases. Stratified site selection reflected Forest District, biogeoclimatic zone, and type of treatment. Stands examined, were selected from the BCFS Silviculture lists or Major Licensees Silviculture Information Systems (MLSIS).

Pest occurrence and damage was assessed in 34 young stands on 3827 trees in 366 plots. The majority of stands examined were in the Interior Douglas-fir (IDF) and Montane Spruce (MS) zones, with the most common treatment being juvenile spacing. In 1995, 66% of trees examined were pest free, compared to the five-year average of 58% (Figure 5). Nearly 6% of trees of all species were either recently killed or affected by life threatening agents such as root diseases, white pine blister rust, western gall rust, western spruce budworm, mammal damage, and ice/snow damage. Damage resulting in significant growth reduction or volume loss affected 5% of trees and was caused by white pine and pine terminal weevils, mammals, dwarf mistletoes, western spruce budworm, and atypical growth which resulted in forks, crooks, multiple tops and other deformities. Significant loss of current growth potential was found in 12% of trees and was due to such pests as foliage diseases, Adelgids, pitch moths, rust cankers on branches, and other problems such as poor tree form. Minor damage having negligible impact occurred on 11% of trees. Causal agents were Adelgids, needle rusts and casts, mammals, and western spruce budworm.

The most common pest encountered was western gall rust on lodgepole pine, affecting 1%-38% of stands examined (or 8% of all trees surveyed). The second most common group of pests were needle diseases on Douglas-fir and lodgepole pine, accounting for 6% of all trees examined, followed by mammals, aphids, western spruce budworm and tree deformities at 5% each. All other notable pests affected less than 2% of trees surveyed, including dwarf mistletoes at 1% and Armillaria root rot, 0.5%. The preceding incidence rates should not be construed as a balanced representation of pest incidence in general. Many stands were selected by treatment type, which favours certain tree species and associated pests. Table 3 summarizes specific pests according to host and provides a range of intensity levels recorded.

Table 3. Summary of surveys in recently treated young stands, by host, Kamloops Forest Region, 1995

Host/Pest	No. stands affected	% of host trees affected[1]			Severity Index[2]
		Avg	Min	Max	
Lodgepole pine - 2265 trees in 30 stands, 66% were pest free					
Western gall rust	17	7	1	51	6,5,3
Mammal damage	9	27	1	79	6,5,4,3,2
Pine dwarf mistletoe	4	12	1	50	5,4
Stem rust	2	9	1	25	5,3
Poor form (fork, crook, broken top, multi-top)	14	9	2	27	4,3,2
Pine needle cast	7	26	3	84	3,2
Sequoia pitch moth	4	9	1	25	3
Douglas-fir - 1146 trees in 17 stands, 66% were pest free					
Armillaria root disease	1	11	-	-	6,5
Western spruce budworm	6	17	1	78	6,5,4,3,2
Mammal damage	3	7	1	20	6,5,4,3
Abiotic (snow, ice, wind)	1	2	-	-	6,3
Poor form (fork, crook, broken top, multi-top)	11	14	2	47	5,4,3
Conifer-cottonwood rust	2	10	3	21	3,2
Adelgids	5	10	2	25	3,2
Western white pine - 12 trees in 3 stands, 42% were pest free					
White pine blister rust	1	88	-	-	6,5
Ponderosa pine - 29 trees in 2 stands, 76% were pest free					
Poor form (fork, crook, broken top, multi-top)	2	7	6	8	6,5,4,3
Elytroderma needle disease	1	15	-	-	4
Spruce - 186 trees in 17 stands, 33% were pest free					
Adelgidae - *Adelges cooleyi*	13	61	8	100	3,2
- *Pineus* sp	2	19	5	33	3,2
Spruce - labrador-tea rust	1	25	-	-	2
Alpine fir - 85 trees in 10 stands, 92% were pest free					
Fir-fireweed rust	2	31	17	43	3,2
Poplar - 39 trees in 5 stands, 96% were pest free					
Mammal damage	2	4	3	6	3

1 Percent of trees affected includes only trees from stands in which pest occurred.

2 Severity index:
1 -pest free
2 -minor damage, minimal impact
3 -significant loss of current growth potential
4 -net volume loss or significant long-term loss of growth potential
5 -life threatening or severely deforming
6 -dead or dying

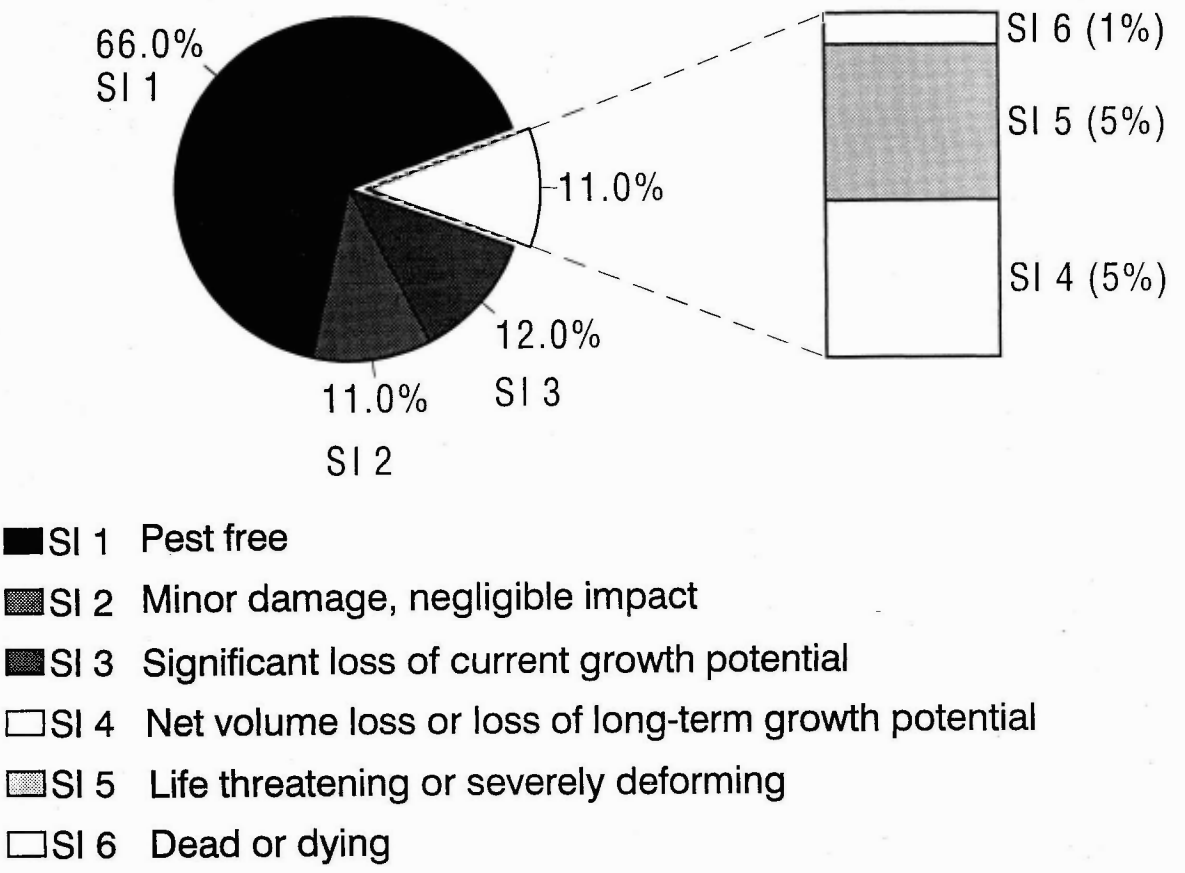

Figure 5. Summary of pests of young stands by severity index, Kamloops Forest Region, 1995

Acid rain monitoring

In order to identify changes in forest vegetation and tree vigor related to air pollutants or acid rain, 15 Acid Rain National Early Warning System (ARNEWS) plots were established in British Columbia between 1984 and 1986. Baseline data was obtained for analysis of a number of parameters including conifer foliar chemistry, soils, ground cover species including lichens and mosses, natural regeneration and forest pests. In 1992 an additional 12 plots were established throughout the province to better represent the biodiversity of the various biogeoclimatic zones and some of the tree species under-represented in existing plots. In Kamloops Forest Region two new plots were established, one representing a very dry forested zone (Ponderosa Pine) in B.C., located near Monte Creek. The other represented a deciduous forest and was located in a trembling aspen stand at Lambly Creek, near Kelowna.

Visual assessments of plot trees, and ground cover and foliage analysis were made at both recently established plots and the previously established Twin Lakes plot. No symptoms of acid or toxic rain or air pollutants were found at any of the sites. Only some minor feeding by conifer sawfly larvae was evident on two ponderosa pine at the Monte Creek site. At the Lambly Creek site, Cytospora canker, caused by *Valsa sordida,* was found colonizing stem tissue on 43% of the trembling aspen in the plot, mostly associated with wounding. No obvious pests were found at the Twin Lakes site. Monitoring at all three sites will continue in 1996.

Other Noteworthy Pests
Currently Active in the Kamloops Forest Region, 1995

Host and Pest	Location	Remarks
Lodgepole Pine		
Bears	Hurley River	Severe debarking of up to 10% of stems in spaced stands.
Comandra blister rust *Cronartium comandrae*	Dardanelles Lake	Occasional infected stems in immature stands.
Lodgepole pine terminal weevil *Pissodes terminalis*	King Edward Lake	Less than 5% of terminals attacked.
Pine needle sheath miner *Zelleria haimbachi*	widespread	Low populations. Occasional light feeding in scattered stands.
Porcupine	Grayback Lake	Severe; 50% incidence of debarking in immature managed stands.
Scleroderris canker *Gremmeniella abietina*	Mt. Lolo, Lambly Creek, Grayback and Otter lakes`	No cankers found in special surveys of pine stands.
Sequoia pitch moth *Synanthedon sequoiae*	Gwyneth Lake	Scattered stem attacks in immature stands. Potential for stem breakage.
Squirrels	George Creek	Mostly old basal debarking damage on up to 55% of spaced trees.
Stalactiform blister rust *Cronartium coleosporioides f. coleosporioides*	Logan Lake, Dardanelles Lake	Causing large stem cankers in isolated pockets.
Western gall rust *Endocronartium harknessii*	Monte, Streak, Raymer, Grayback Dardanelles, and Cameron lakes	Common in immature stands; up to 35% incidence on stems and branches.
Western White Pine		
White pine blister rust *Cronartium ribicola*	Seymour Arm	Up to 10% of stems infected in spaced stands.

Host and Pest	Location	Remarks
Douglas-fir		
Bears	Seymour Arm	Severe scarring on up to 10% of stems in one young stand.
Conifer-aspen rust *Melampsora medusae*	Pavilion Lake	Common in low spots in immature stands.
Conifer-cottonwood rust *Melampsora occidentalis*	Marble Canyon	Up to 30% foliage discoloration on 20% of young trees.
Needle cast of Douglas-fir *Rhabdocline weirii*	Logan Lake	Average 30% foliage infected in scattered immature stands.
Spruce		
Spruce gall adelgid *Pineus similis*	Sinmax Creek	Causing deformity and stunting in young managed stands. Common in Region.
Spruce-Labrador-tea rust *Chrysomyxa ledicola*	Mayson Lake	Light discoloration of new growth on majority of mixed-age trees.
Western Hemlock		
Conifer sawflies *Neodiprion* spp.	North Thompson Valley	Increasing. Common in low numbers. No visible damage.
Western blackheaded budworm *Acleris gloverana*	Eagle River, Wap Creek	Populations collapsed; no apparent defoliation.
Western hemlock looper *Lambdina f. lugubrosa*	North Thompson Valley, Wells Gray Park	Low adult counts in pheromone-baited traps, indicating low populations in 1996.
Alpine Fir		
Fir-fireweed rust *Pucciniastrum epilobii*	Mayson Lake	Decrease. Light incidence of infection in regeneration.
Western Larch		
Larch needle cast *Meria laricis*	Lumby	Decrease. Light foliage discoloration in scattered areas.
Larch needle blight *Hypodermella laricis*	host range	Light discoloration in patches.

Host and Pest	Location	Remarks
Poplars		
Cytospora canker *Valsa sordida*	Lambly Creek	Common on immature aspen and cottonwood associated with wounds.
Poplar borer *Saperda calcarata*	Bear Creek	Up to 40% of trembling aspen attacked.
Elms		
Elm leaf beetle *Xanthogaleruca luteola*	Kamloops, Penticton	Causing light to moderate defoliation in parks.
European elm scale *Gossyparia spuria*	Kamloops	Causing twig dieback of mature trees in parks.
Other Deciduous Hosts		
Aspen leafminer *Phyllocnistis populiella*	Adams Lake, Adams R. Valley	Populations declined; only occasional light discoloration.
Fall webworm *Hyphantria cunea*	widespread	Scattered light to moderate and occasional severe defoliation on deciduous roadside trees and shrubs.

Appendix

The following appendices are available upon request from Natural Resources Canada, Pacific Forestry Centre, 506 West Burnside Road, Victoria B.C. V8Z 1M5.

I. Maps of beetle and defoliator infestations in Kamloops Forest Region, 1995.

II. Summary of pest problems in provincial parks within the Kamloops Forest Region, 1995.

III. Details of pheromone trap programs, Kamloops Forest Region, 1995.

IV. ARNEWS and biomonitoring surveys data, Kamloops Forest Region, 1995.

V. Pest Reports:

- Summary of forest pest conditions in the Kamloops Forest Region, 1995. P. Koot and R. Ferris

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Additional copies of this report or related publications such as provincial and national pest survey overviews, forest pest leaflets, and regional forest pest histories, can be obtained from the above address.