

**FOREST INSECT AND DISEASE CONDITIONS  
BRITISH COLUMBIA AND YUKON — 1995**

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## Abstract

This summary of forest pest conditions in British Columbia and the Yukon Territory in 1995 highlights pests that are or may become major forest management problems. It was compiled from field reports and other records of nine Forest Insect and Disease Survey rangers with contributions from the forest industry, researchers, and other agencies. The status and impact of 33 major pests are described and some forecasts are made for 1996.

## Résumé

Ce résumé de l'état des insectes et des maladies des arbres en Colombie-Britannique et au Yukon en 1995 donne les grandes lignes de ce que sont ou pourraient être les grands problèmes d'aménagement forestier. Il a été compilé à partir de rapports et autres relevés effectués sur le terrain par les onze forestiers du Relevé des insectes et des maladies des arbres et des données fournies par l'industrie forestière et des chercheurs et des organismes oeuvrant dans ce domaine. Il décrit l'état et l'impact de plus de 33 insectes et maladies des arbres d'importance et présente certaines prévisions pour 1996.

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## Introduction

The Forest Insect and Disease Survey (FIDS) of the Canadian Forest Service is responsible for producing an annual national overview of important forest pest conditions and their implications. Additionally, surveys and records are maintained in support of quarantine programs, forest research projects, insect collections and herbaria. Surveys are conducted with the cooperation of the British Columbia Forest Service, the forest industry, other federal and provincial agencies, municipalities, educational centers, and research programs at the Pacific Forestry Centre and other Canadian Forest Service centers across Canada.

This regional report reviews the status and impact of major forest insects and diseases and the effects of environmental factors on coniferous and broadleaf forests in British Columbia and the Yukon Territory in 1995. Damage trends and expansion of infestations can be determined by comparison to previous years' reports. The status of 33 economically significant pests active in the Pacific and Yukon Region in 1995 is presented, with some forecasts for 1996. The summary was compiled from field reports of nine Forest Insect and Disease Survey rangers with contributions from the forest industry, researchers, and other government agencies.

The subjective terms 'light', 'moderate', and 'severe' are used throughout this report to describe levels of tree defoliation; these are defined as 1 to 25%, 26 to 65%, and 66% and more defoliated, respectively.

More detailed information on the status of forest pests is available in regional reports compiled by the following rangers:

Cariboo           - Bob Erickson  
Kamloops       - Peter Koot and Bob Ferris

Nelson           - Leo Unger and Alan Stewart  
Prince George   - Nick Humphreys, Alan Stewart,  
and               Bob Ferris, Rod Garbutt and John  
Rupert Prince   Vallentgoed  
Vancouver       - Rod Turnquist and Nick  
                    Humphreys  
Yukon Territory - Rod Garbutt

Other staff of the Forest Insect and Disease Survey (FIDS) project in 1995 were:

Allan Van Sickle - FIDS Head  
Brenda Callan   - Mycologist, Diagnostics and  
                    Herbarium Collection  
Dennis Clarke   - Technician, Geographic  
                    Information System (GIS)  
Bob Duncan      - Biologist, Insectary Diagnostics  
Lee Humble       - Entomologist, Insectary  
                    and Collection  
Fiona Ring       - Technician, Disease  
                    Diagnostics and Data Base  
Jane Seed        - Technician, Insectary Rearing and  
                    Data Base

As noted in the Preface, in 1995 the Canadian Forest Service faced a substantial reduction in resources and FIDS started the transition to a more nationally focused Forest Health Network. During the year we lost the services and experience of five long-term employees. Colin Wood retired as Chief Ranger, our supportive secretary, Mrs. Joan Strobbe, retired, and Janice Hodge left to form her own pest management firm. Alan Stewart will leave in March 1996 to also enter the consulting field and Bob Ferris has transferred within the lab to work with the ecosystem processes network. While we miss them and their combined experience of over three-quarters of a century, we wish them well in retirement or their new endeavors.

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## Summary

The most noteworthy changes in the status of major forest pests in 1995 included increasing populations of **mountain pine beetle**, **forest tent caterpillar**, **satin moth**, **phantom hemlock looper**, **balsam woolly adelgid**, **green-striped forest looper** and a higher incidence of **pine needle disease** and **drought-induced mortality**. Populations of **spruce beetle**, **black army cutworm**, **gypsy moth**, **European pine shoot moth**, **large aspen tortrix**, **birch leaf miners** and **European elm bark beetles** and incidences of **Scleroderris canker** continue to be found. Decreasing populations of **Douglas-fir beetle**, **balsam bark beetle**, **spruce budworms**, **western hemlock looper**, **Douglas-fir tussock moth**, **western blackheaded budworm** and **larch casebearer** were recorded.

The area of lodgepole pine and western white pine killed by **mountain pine beetle** was an estimated 40 000 ha, up slightly from 36 000 ha in 1994. In the Kamloops Forest Region almost 8 000 ha of mortality has been recorded mostly in the Merritt and Penticton districts. In the East Kootenay, infestations more than doubled to 4200 ha from north of Invermere to north of Golden, most notably in Kootenay National Park where over 2400 ha was affected. Reports to date indicate that around 15 000 ha of mortality has been recorded in the Prince George Forest Region, which is similar to the area affected last year. Discoloration and premature loss of year-old needles of lodgepole pine due to infection by **Lophodermella needle cast** was again severe and widespread in the Cariboo and Prince George forest regions. Lodgepole pine of all ages was infected over more than 600 000 ha up from 500 000 ha last year. However, declines were noted in the Kamloops, Nelson and Prince Rupert forest regions. Semi-mature trees, mainly lodgepole pine, killed by the 1994 **drought** were mapped over 2800 ha in the Nelson Forest Region from the United States border to just south of Kootenay National Park. Most mortality was on the west side of the Rocky Mountain Trench south of Cranbrook, with patches in the Moyie Lake and Matthew Creek to St. Mary Lake area. **Scleroderris canker** was collected near Castlegar for the first time since 1978.

Decreasing populations of **Douglas-fir beetle** were recorded over approximately 6500 ha, compared to 8800 last year; this was the second consecutive year

of decrease. For the third consecutive year, increased **phantom hemlock looper** populations defoliated semi-mature and mature Douglas-fir and some western hemlock, over about 10 city blocks in Burnaby. Compared to last year, defoliation of conifers by **western spruce budworm**, **eastern spruce budworm** and **two-year-cycle budworm** decreased to 2000 ha (from 14 000 ha), 27 000 ha (from 172 000 ha) and 70 000 ha (from 200 000 ha), respectively. For the second consecutive year there was no defoliation of Douglas-fir by **tussock moth**.

Forest pests which remained at levels similar to those in 1994 included **spruce beetle**, which infested mature spruce over approximately 105 000 ha. Infestations of spruce beetle mapped for the second consecutive year in southwest Yukon expanded by 45% to cover 47 000 ha with another 8000 ha mapped in the adjacent Tatshenshini Provincial Park. Mature alpine fir killed by the **balsam bark beetle** were mapped over 132 000 ha in all six forest regions, down from 180 000 ha last year.

Populations of **western hemlock looper** collapsed after five successive years of defoliation in the Interior Cedar Hemlock zone of British Columbia. **Western blackheaded budworm** populations collapsed in the Nelson and Kamloops forest regions. **Green-striped forest looper** severely defoliated western hemlock over 700 ha along the Skeena River.

**Black army cutworm** killed about 20% of the spruce in a 20-ha plantation on the Blackwater ridge north of Golden. The incidence of shoot and foliage diseases, including **larch needle cast** and **Sirococcus tip blight**, increased, probably encouraged by wet weather in August.

Defoliation of deciduous trees and shrubs by **forest tent caterpillar** in the interior of British Columbia expanded in area to about 102 000 ha compared to 93 000 ha last year, mostly in the Cariboo and Prince George forest regions. **Northern tent caterpillar** populations increased for a fourth consecutive year and defoliated various deciduous trees on Vancouver Island and in the Meziadin area of Prince Rupert Region. Defoliation of trembling aspen by the **large aspen tortrix** continued in the Yukon Territory and in the Prince George and Prince Rupert regions. Populations

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were also reported near the Alberta border west of Dawson Creek and Fort Nelson. **Satin moth** defoliated trembling aspen and cottonwood in the Prince George, Cariboo, Kamloops and Nelson forest regions over more than 13 000 ha, up from the estimated 5000 ha last year. The largest and most northerly infestations of satin moth on record occurred in the Robson Valley in conjunction with infestations of forest tent caterpillar. **Birch leaf miners** continued to defoliate white birch in the West Kootenay of the Nelson Region and in the Kamloops Region. Garry oaks on Vancouver Island were again discoloured by **jumping gall wasp** and by an introduced **oak leaf phylloxera**. The **western oak looper** killed Garry oak and Douglas-fir trees on the southern end of Saltspring Island.

Surveys to detect **pine shoot beetle**, recently introduced to North America, were negative for the fourth year. **European pine shoot moth** continued to infest exotic pine trees at low levels in mostly ornamental or Christmas tree plantations in the Fraser and Okanagan valleys. Infestations of the **balsam woolly adelgid** continue to be confirmed outside the northern boundary of the current quarantine zone on Vancouver Island and for the first time east of the Fraser River near Boston Bar. In surveys of 166 young managed stands across the province in 1995,

the most damaging and widespread problems continued to be **root diseases**, **terminal weevils**, **adelgids**, **climatic** and **mammal** damage. Special surveys to evaluate the potential for introduction of exotic pests associated with dunnage in and around ports have resulted in additional new records including **Asian ambrosia** and **powder post beetles**. In an effort to reduce damage levels of **apple** and **cherry ermine moth**, parasitoids were released at 13 sites on Southern Vancouver Island. **European elm bark beetles** were again captured in pheromone baited traps near Kelowna in the Okanagan Valley and at Grand Forks and Midway, but the Dutch elm disease fungus has not yet been detected in British Columbia. **Gypsy moth** pheromone trapping continued with 39 catches to date in the Vancouver to Hope area and on southern Vancouver Island. A total of 984 hybrid poplar trees were rated for three **foliage diseases** and **eriophyid mite** damage as part of a research project on poplar.

Two insects were collected for the first time in British Columbia, and three insect collections were significant extensions of known distributions and four insects were recorded for the first time on new hosts. Six species of fungi were collected for the first time and 10 diseases were recorded on new hosts.

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## Pine Pests

### Mountain pine beetle

*Dendroctonus ponderosae*

The area of lodgepole pine and western white pine killed by mountain pine beetle, one of the most damaging forest insects in British Columbia, increased slightly to about 40 000 ha (Figure 1), in over 8000 infestations. Surveys indicate slightly increasing beetle populations in 1996.

In the Cariboo Region the area of killed pine more than doubled to 3800 ha from 1660 ha last year (Map 1). The largest area of attack, covering 1750 ha, occurred in the Williams Lake TSA. The number of currently attacked trees increased compared to 1994 at half of the 10 sites surveyed in the Cariboo Region. The highest level of current attack, 30%, occurred in a pine stand at Jackson Lake in the Williams Lake Forest District. The largest increase in current attack, from 1% in 1994 to 19% in 1995, was recorded on the Chilcotin military block.

The mountain pine beetle continues to be the most destructive pest in the Kamloops Region with 7800 ha of infestations recorded, mostly in the Penticton and Merritt districts. Increases were also noted in the Salmon Arm, Kamloops, Lillooet and Clearwater districts. In the Prince Rupert Region the infested area increased by about 15% to more than 6000 ha, and significant increases occurred in the Morice TSA and Tweedsmuir Provincial Park.

In the Nelson Region, mortality was mapped over almost 6800 ha, up from 2750 ha last year. The most active infestations were in Kootenay National Park where mortality was recorded over 2400 ha. Increasing populations also occurred throughout the East Kootenay and along Arrow Lake. Mortality is expected to increase in 1996 as the percentage of currently-attacked trees exceeded that recorded last year at all five sites surveyed. The highest level of current attack, 52%, was recorded in a pine stand in Kootenay National Park. Assessments of beetle broods indicate increasing populations at all seven sites surveyed in three forest districts.

Reports to date indicate an increase in the number of recently killed red trees in the southwest area of the Prince George Forest District and continued

expansions in the Fort St. James and Robson Valley Forest districts. Almost 17 000 ha of pine mortality was recorded in the Prince George Region in 1994. In the Vancouver Region the area of mature lodgepole pine killed by the beetle increased by about 30% to almost 600 ha, mostly in the Soo TSA near Pemberton.

In the Cariboo Forest Region, the Canadian Forest Service and the British Columbia Ministry of Forests continued a cooperative project to attract secondary bark beetles into mountain pine beetle infested trees with pheromones. Attacks by the secondary bark beetles reduce survival of the mountain pine beetle broods. Beetle baits in addition to salvage harvests and cut and burn treatments were used extensively around the province to control beetle infestations.

### Drought damage

Mainly semi-mature lodgepole pine were killed by drought over 2800 ha in over 300 areas in the drier portions of the Cranbrook and Invermere forest districts. Tree mortality was greatest on the north and east slopes of the Rocky Mountain Trench from Mount Baker to Plumbob Mountain, and on Gold Mountain. Mortality was also mapped in patches near Moyie Lake, Matthew Creek to St. Mary Lake, and along Findlay Creek. Although much of the mortality occurred patches smaller than 10 ha along stand edges and on rocky knolls, a few stands up to several hundred hectares were also affected.

In addition to the mortality, roughly an equal number of trees are severely stressed. At Mount Baker a third of the lodgepole pine were dead, a further third had extensive branch and stem dieback but should survive, and the remaining trees were outwardly healthy. Both dead and stressed trees were under light attack by mountain pine and secondary beetles.

### Lophodermella needle cast

*Lophodermella concolor*

Discolouration and premature loss of year-old needles of lodgepole pine due to infection by *Lophodermella* needle cast was again severe and widespread in the province especially in the Cariboo Forest Region. Lodgepole pine of all ages were lightly and



moderately infected by pine needle cast over 556 000 ha in 70 large patches from the Chilcotin to Clinton. This was an increase from 495 300 ha in the same areas last year and it was the sixth consecutive year of infection and needle cast in the region. Some trees, especially those repeatedly infected, have lost nearly all their foliage. Defoliation averaged 52% (range 10-80%) at five plots located in representative severely defoliated areas.

Elsewhere, damage was widespread throughout the southwestern portion of the Prince George Forest District and the southern portion of the Vanderhoof Forest District, but was much reduced in the Kamloops, Nelson and Prince Rupert regions. For the

fourth consecutive year up to 80% of year-old needles were infected in mostly young lodgepole pine stands in the southeastern Yukon around Watson Lake.

### **Scleroderris canker**

*Gremmeniella abietina* var. *abietina*

Scleroderris canker, initially collected as a saprophyte on dead or dying branches of pine at four locations in British Columbia during 1975-78, was re-collected in 1995 at Nancy Greene Lake near Castlegar. Only one seedling was affected, presumably by the North American race of this fungus. Scleroderris canker was not present at 16 other sites surveyed.

## **MOUNTAIN PINE BEETLE IN BRITISH COLUMBIA 1974-1995**

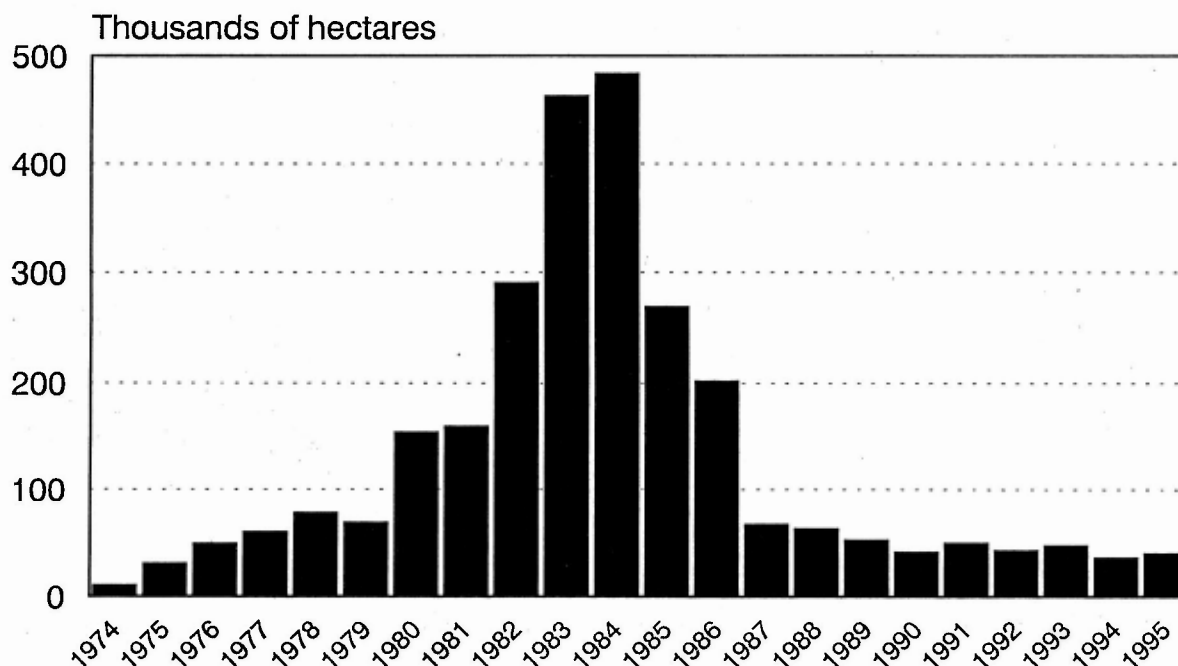
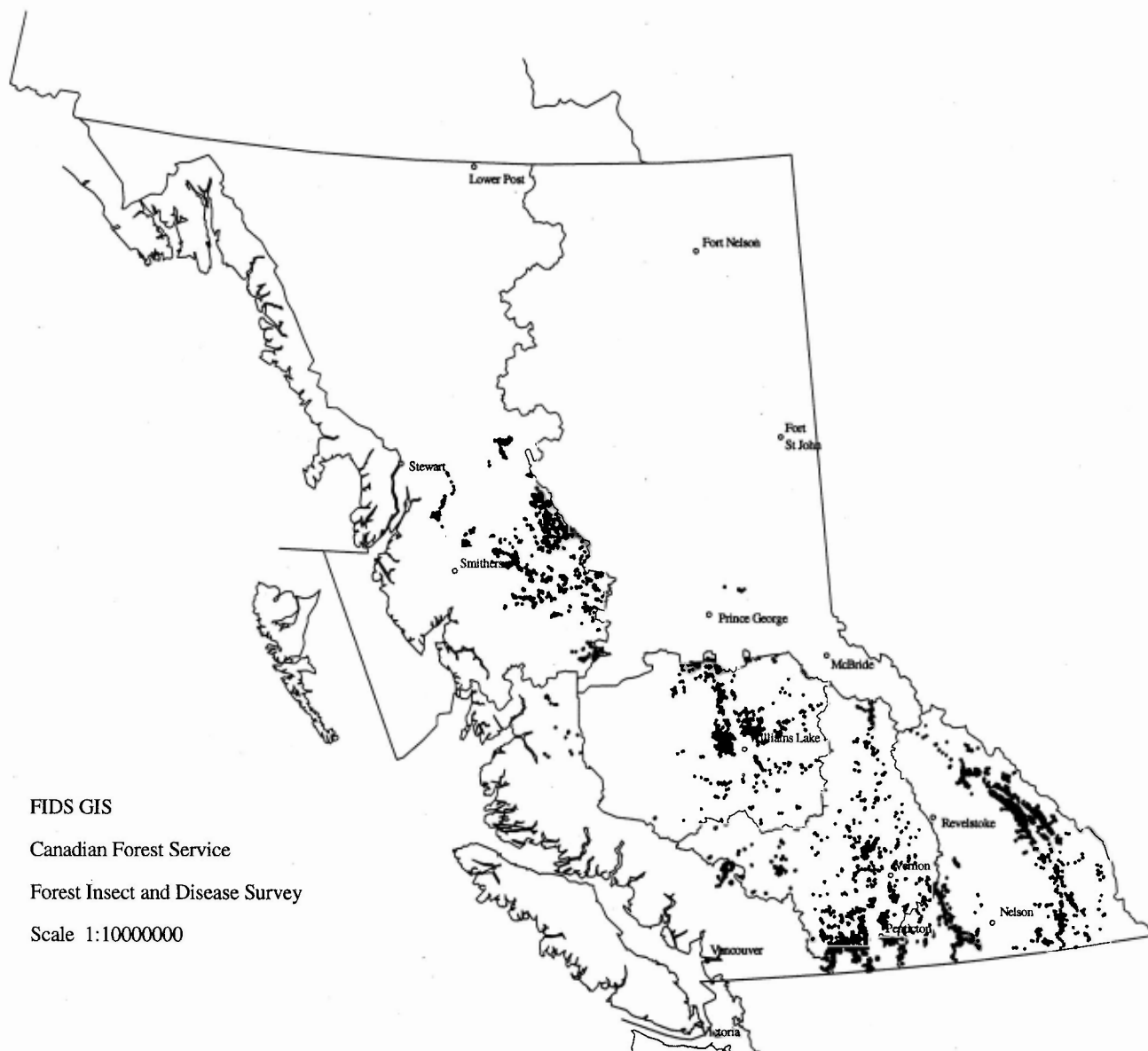


Figure 1. Area of mountain pine beetle infestations in British Columbia as established from aerial surveys, 1974-1995.



Map 1. Area where recent tree mortality due to mountain pine beetle was detected during aerial surveys in 1995.

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## Douglas-fir Pests

### Douglas-fir beetle

*Dendroctonus pseudotsugae*

Mature Douglas-fir killed by the Douglas-fir beetle covered about 6500 ha in 1900 infestations (Map 2); this is down from 8800 ha in 1994, and 1995 was the second consecutive year of decrease. In the Cariboo Region, Douglas-fir trees were recently killed over 2930 ha in 604 infestations, down from 5200 ha last year. Nearly 90% of the infested area in the region was in the Chilcotin Military Block near Riske Creek. Decreases were also noted in the Nelson and Kamloops regions where 180 and 400 ha were infested, respectively. Most of the Nelson Region mortality occurred in the Invermere District.

In the Prince George Forest Region attacks were decreased near Prince George but were increased in the Fort St. James and McBride forest districts; the total estimated area of attack for the region was unchanged at approximately 2000 ha. The area of attack in the Vancouver Region increased to over 800 ha. The main area of new attack was 350 ha in the Sunshine Coast TSA.

Trap trees, both lethal and non-lethal, in conjunction with baits and funnel traps were used in both the Cariboo and Prince George Forest regions to manage populations of Douglas-fir beetle.

### Western spruce budworm

*Choristoneura occidentalis*

Western spruce budworm populations virtually collapsed across the province to their lowest level in the last 20 years (Figure 2, Map 3). After a major reduction in 1994, populations continued to decline, only causing mostly light defoliation on 2000 ha in 27 infestations in the Kamloops Region. Defoliation was mapped in widely scattered areas near Barnhartvale, Kamloops, Chase, Merritt, and Peachland. In the Vancouver Region, populations collapsed following six consecutive years of defoliation mainly in the Nahatlatch River area north of Boston Bar. Ground assessments in the Cariboo Region detected only trace defoliation around Big Bar and Kelly lakes northwest of Clinton.

Western spruce budworm pheromone trapping continued at nine sites in four regions using a 0.03% aldehyde pheromone supplied by the Pacific Forestry Centre. An average 90 moths per multipher trap (range 1-307) were trapped, up slightly from an average of 82 in 1994. Moth catches in 1994 and 1995 have been the lowest of the last decade, and have been only 30% of the catches recorded during the peak of outbreak. Accordingly, budworm populations are expected to remain below outbreak levels during 1996.

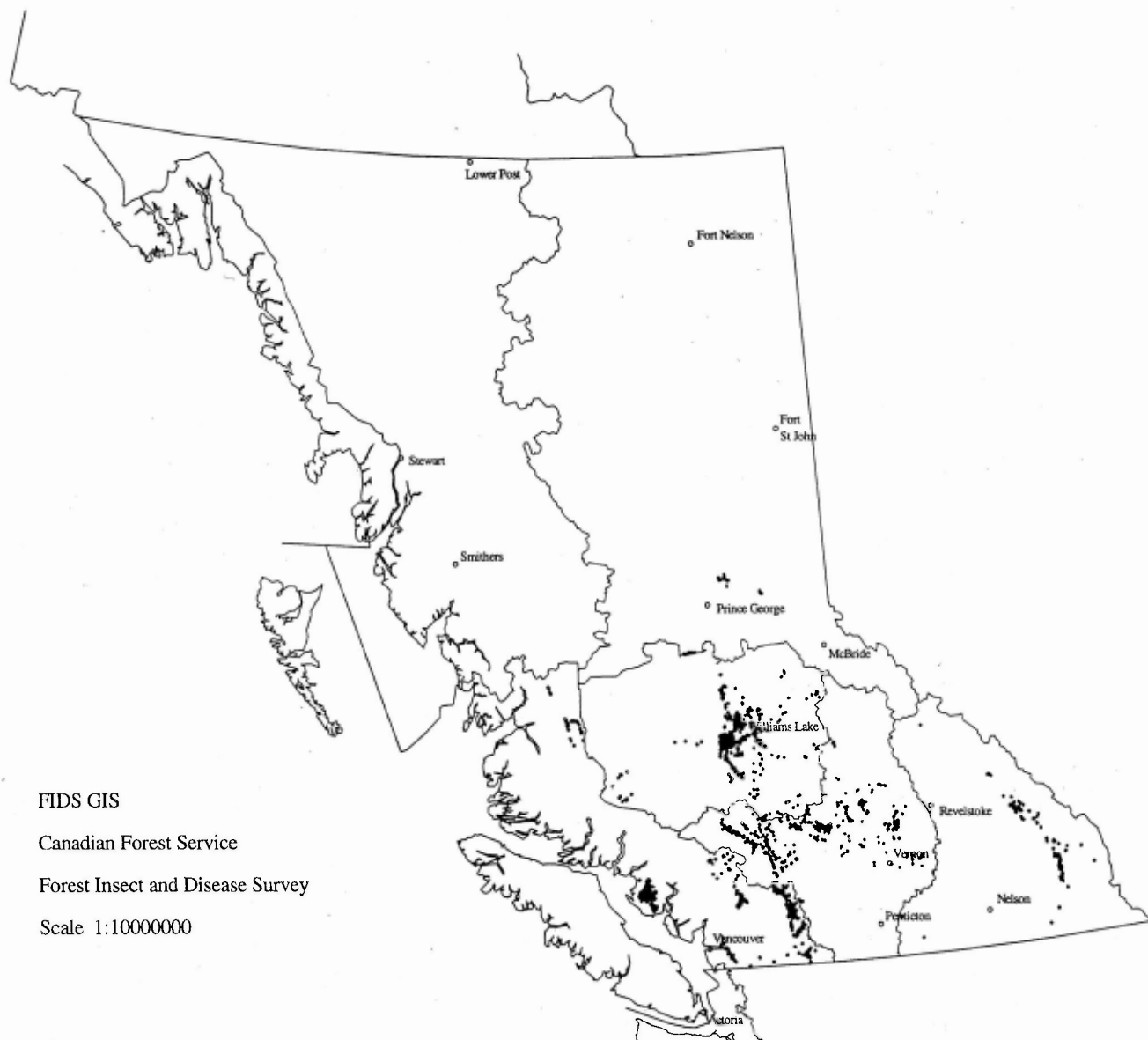
An experimental trial with *Bacillus thuringiensis* var. *kurstaki* was repeated in the Merritt area against western spruce budworm. Dipel 76AF®, at 60 BIU/ha in 3.0 L/ha, Dipel 48AF® at 50 BIU/ha in 3.9L/ha, and Foray 48B® at 60 BIU/ha in 4.8L/ha were applied to different 50-ha plots and replicated three times. This higher dose and volume may be necessary for the more mountainous terrain, taller trees and probable larger foliage mass.

Also, three Canadian Forest Service research plots near Merritt were treated with synthetic pheromone in a mating disruption trial. The saturated polyvinyl chloride beads were applied by helicopter in early July. Preliminary analysis of male trapping data indicates that a reduction of 80 to 95 percent was achieved.

### Douglas-fir tussock moth

*Orgyia pseudotsugata*

There was no defoliation of Douglas-fir by tussock moth for the second consecutive year in the Kamloops Region. The collapse was attributed to naturally occurring infection by the nuclear polyhedrosis virus. At the 18 permanent pheromone monitoring sites in the southern interior, moth trap catches averaged only 11 adults per sticky trap (range 1-55) using ketone lures manufactured at the Pacific Forestry Centre. This is about half the annual average of the last 10 years and is below the threshold of expected damage. No moths were caught in five traps placed in the southern Cariboo. This is the lowest number of moths caught since 1987. Nonetheless, at Monte Lake and Heffley Creek the traps captured an average of 55 and 54 moths, respectively, indicating the possibility of defoliation in these areas in 1996.



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Forest Insect and Disease Survey

Scale 1:10000000

Map 2. Area where recent tree mortality due to Douglas-fir beetle was detected during aerial surveys in 1995.

### Phantom hemlock looper

*Nepytia phantasmaria*

For the third consecutive year, increased phantom hemlock looper populations severely defoliated semi-mature and mature Douglas-fir and some western hemlock over about 10 city blocks in Burnaby. In this residential area, larvae were crawling on houses, cars, fences and patios and insect droppings formed a layer

up to several centimeters deep on sidewalks and boulevards. Douglas-fir mortality and top-kill has been noted at several locations in the area.

Although laboratory rearings demonstrated the presence of increased levels of disease and parasitism, large moth flights were reported in the area in late September indicating the possibility of continued infestation levels for 1996.

## WESTERN SPRUCE BUDWORM IN BRITISH COLUMBIA 1975-1995

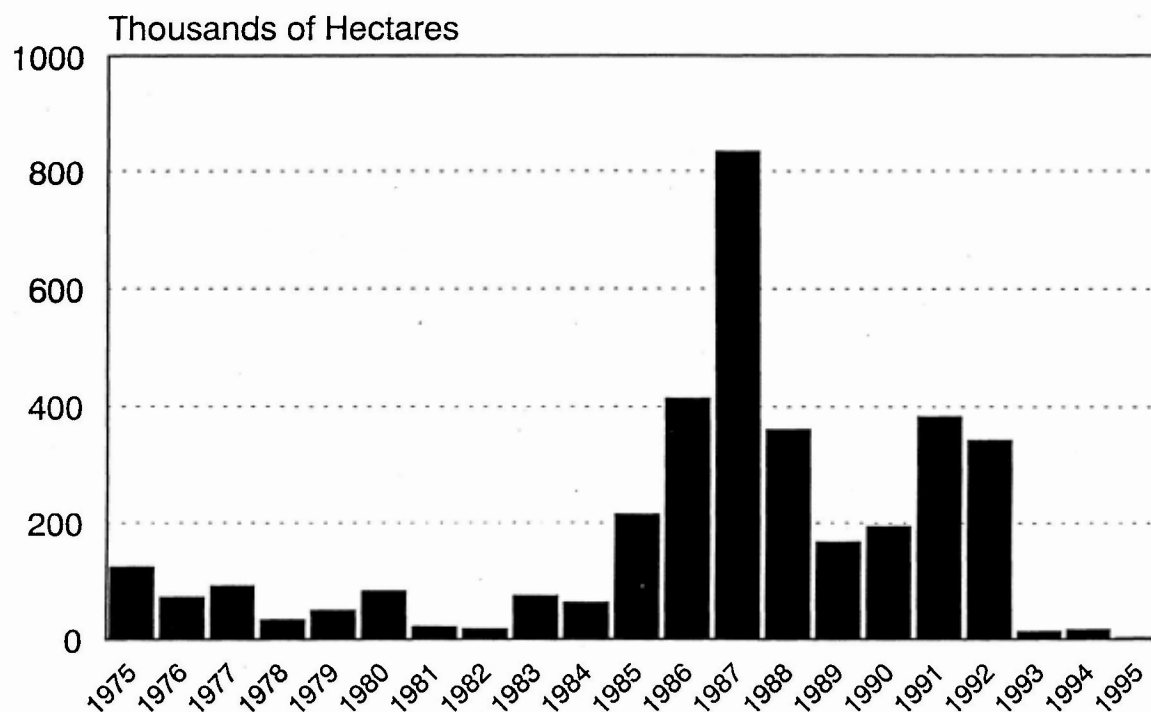
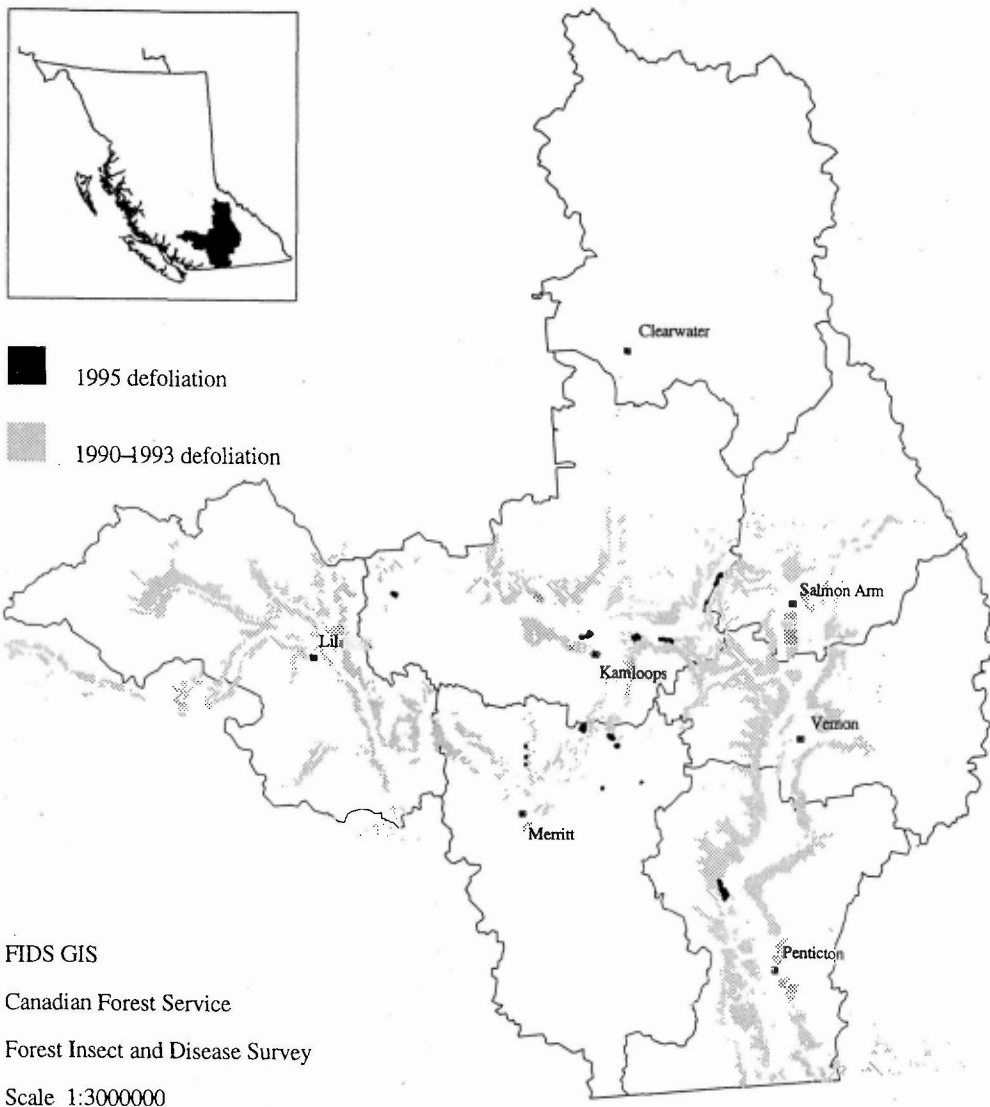


Figure 2. Area of Douglas-fir defoliated by western spruce budworm as determined by aerial surveys, 1974-1995.



Map 3. Defoliation by western spruce budworm detected by aerial surveys in 1995, compared with the maximum extent reached earlier during the infestation.

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## Spruce Pests

### Spruce beetle

*Dendroctonus rufipennis*

The area of mature white and Engelmann spruce killed by spruce beetle in British Columbia and Yukon in 1995 remained at approximately 105 000 ha over almost 900 infestations. While the total area of damage was similar to that in 1994, the major infestations shifted from the Prince George Region to the Prince Rupert Region and Yukon Territory (Map 4). Infestations of spruce beetle mapped for the second consecutive year in southwest Yukon expanded by 45% to cover 47 000 ha in 1995. As in 1994, activity was centered primarily in the Alsek River Valley north of Goathead Mountain, and in the Shawkak Valley between Haines Junction and Kluane Lake National Park. Sixty percent of the infested stands were within Kluane Lake National Park. In some stands all of the mature trees have now been killed. Outbreaks in the Prince Rupert Region increased almost ten fold to over 16 000 ha. The first aerial survey within the newly declared Tatshenshini Provincial Park found active infestations over more than 8000 ha in scattered patches of mature timber along the Tatshenshini River, from Detour Creek, south, almost to the Alsek River. Numerous patches of recent mortality totalling nearly 5000 ha were mapped

near the border between British Columbia and Alaska in "Rainy Hollow" and in the upper Flemer and Kelsall river valleys. An additional 1300 ha of attack was recorded southeast of Atlin along the Sutlahine and Inklin rivers, and 1700 ha of recent mortality was mapped in the Morice River corridor south of Houston.

In the Prince George Forest Region the area of mortality caused by spruce beetle is down to an estimated 40000 ha from the 1994 level of over 70 000 ha. Most of the attack, 30 000 ha, again occurred in the Mackenzie Forest District, mostly in the Clearwater River drainage northeast of Mackenzie, around Burden Lake, and along Manson River. Decreases also occurred in the Prince George Forest District where currently attacked trees were rare. Increases were noted in the Ft. St. James and Robson Valley forest districts.

In the Vancouver, Cariboo, Nelson and Kamloops forest regions, mortality was mapped over 80, 65, 186 and 800 ha, respectively. Trap trees in conjunction with spruce beetle baits and salvage harvests were used extensively throughout the province by the forest industry to help manage beetle populations.

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## True fir pests

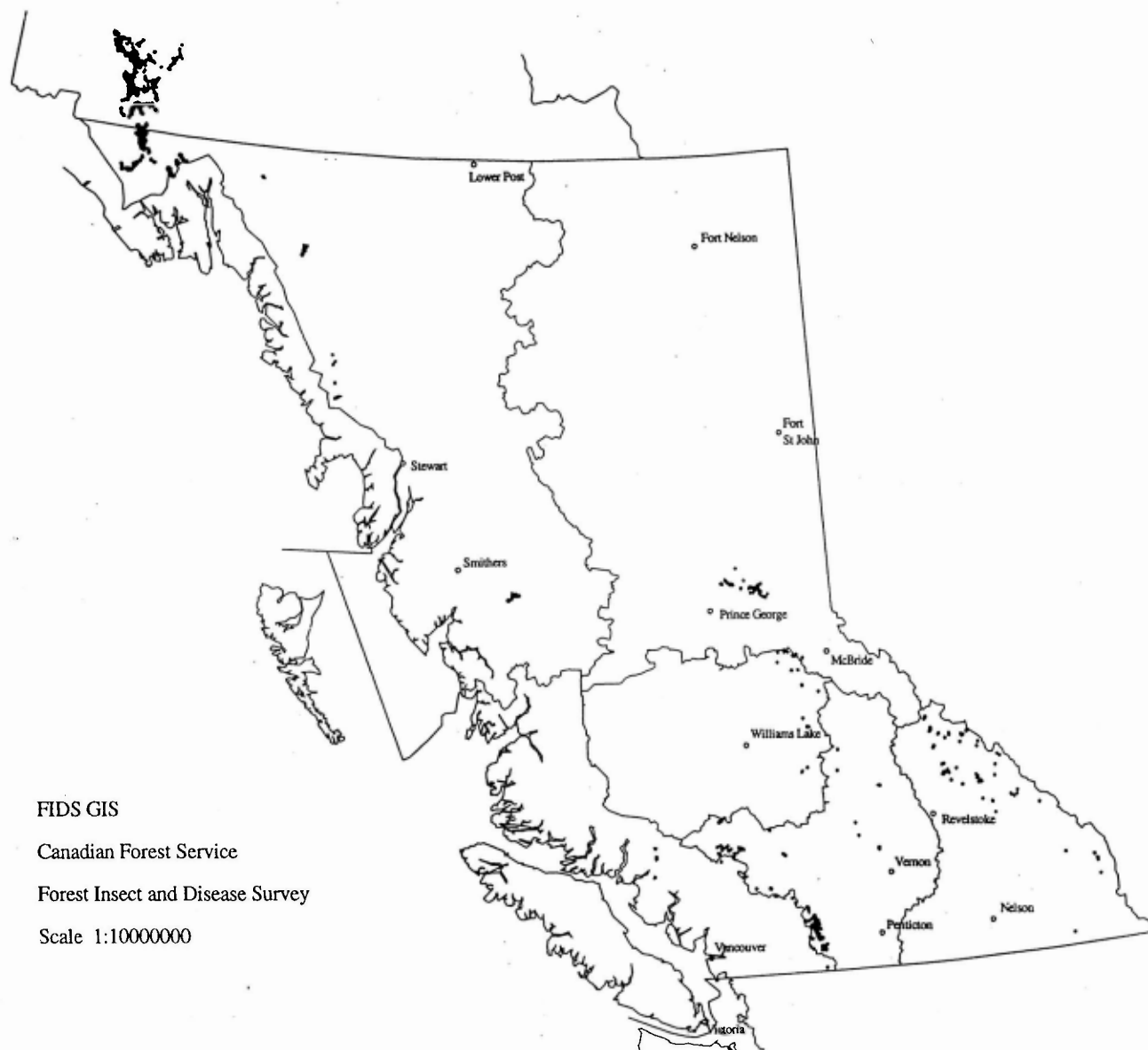
### Budworms

*Choristoneura spp.*

Eastern spruce budworm populations, as predicted by egg sampling, decreased in the Prince George Region. Mostly light defoliation was mapped over 27 000 ha in 203 infestations (Map 5) compared to 172 000 ha in 1994. This is the lowest level of eastern spruce budworm activity recorded in over 10 years. Most of the defoliation occurred along the Liard, Toad and Muskwa rivers and along Kledo Creek.

However, egg mass counts of 600 egg masses per 10 m<sup>2</sup> of foliage, the second highest total on record, indicate that populations will increase dramatically in 1996.

Alpine fir and spruce were defoliated over more than 70 000 ha in 106 infestations by the two-year-cycle budworm, mostly in the Prince George Forest Region. Moderate and severe defoliation was mapped over 60 000 ha in the Fort St. James Forest District around the Nation Lakes and in the Silver and Ominicetla creek drainages (Map 5). Less than 1000 ha of defoliation was recorded in the Nelson Forest Region. Last year over 200 000 ha of budworm damage by



Map 4. Area where recent tree mortality due to spruce beetle was detected during aerial surveys in 1995.



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"on-cycle" budworm was recorded, with more than half of this area in the Cariboo Region.

### **Western balsam bark beetle- fungus complex**

*Dryocoetes confusus-Ceratocystis dryocoetidis*

Mature alpine fir killed by the balsam bark beetle was mapped over 132 000 ha in more than 3100 infestations in all six forest regions. These estimates are incomplete and can be expected to rise with additional aerial surveys. The majority of the attacks

were again in the Prince Rupert Forest Region where more than 72 500 ha of attacks were recorded (Map 6). Most infestations in the Prince Rupert Region occurred in chronically infested mature stands in the Bulkley, Cassiar and Morice TSAs. In the Prince George Region over 50 000 ha of mortality, up from 33 000 ha in 1994, was mapped during limited aerial surveys around Williston Lake in the Mackenzie Forest District and along the Sustut River in the Ft. St. James Forest District. Elsewhere, tree mortality continued over 2600 ha in the Kamloops Region, 2100 ha in the Nelson Region, and 1700 ha in both the Vancouver and Cariboo regions.

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## **Hemlock Pests**

### **Western hemlock looper**

*Lambdina fiscellaria lugubrosa*

Populations collapsed after up to five successive years of defoliation in the Interior Cedar Hemlock zone of British Columbia. Last year only 8000 ha of defoliation of old-growth western hemlock and western redcedar was recorded, down from 180 000 ha at the height of the infestation in 1992. Tree mortality averaging about 40%, resulting from successive years of severe defoliation, was mapped over about 64 000 ha in 1994. An additional 10% of the trees have since died in previously infested stands in the Cariboo and Nelson regions.

The collapse was due largely to egg parasitism by *Trichogramma minutum*, as forecast by the Forest Insect and Disease Survey from egg and pheromone trap surveys. The calibration of a pheromone trapping (10-microgram PheroTech lures in Universal traps) and forecasting system for western hemlock looper continued in 1995. The average number of moths at 23 sites throughout the province decreased to only 24 per trap, down from 168 in 1994 and 1707 in 1993. In the Vancouver Region an average of 180 moths were

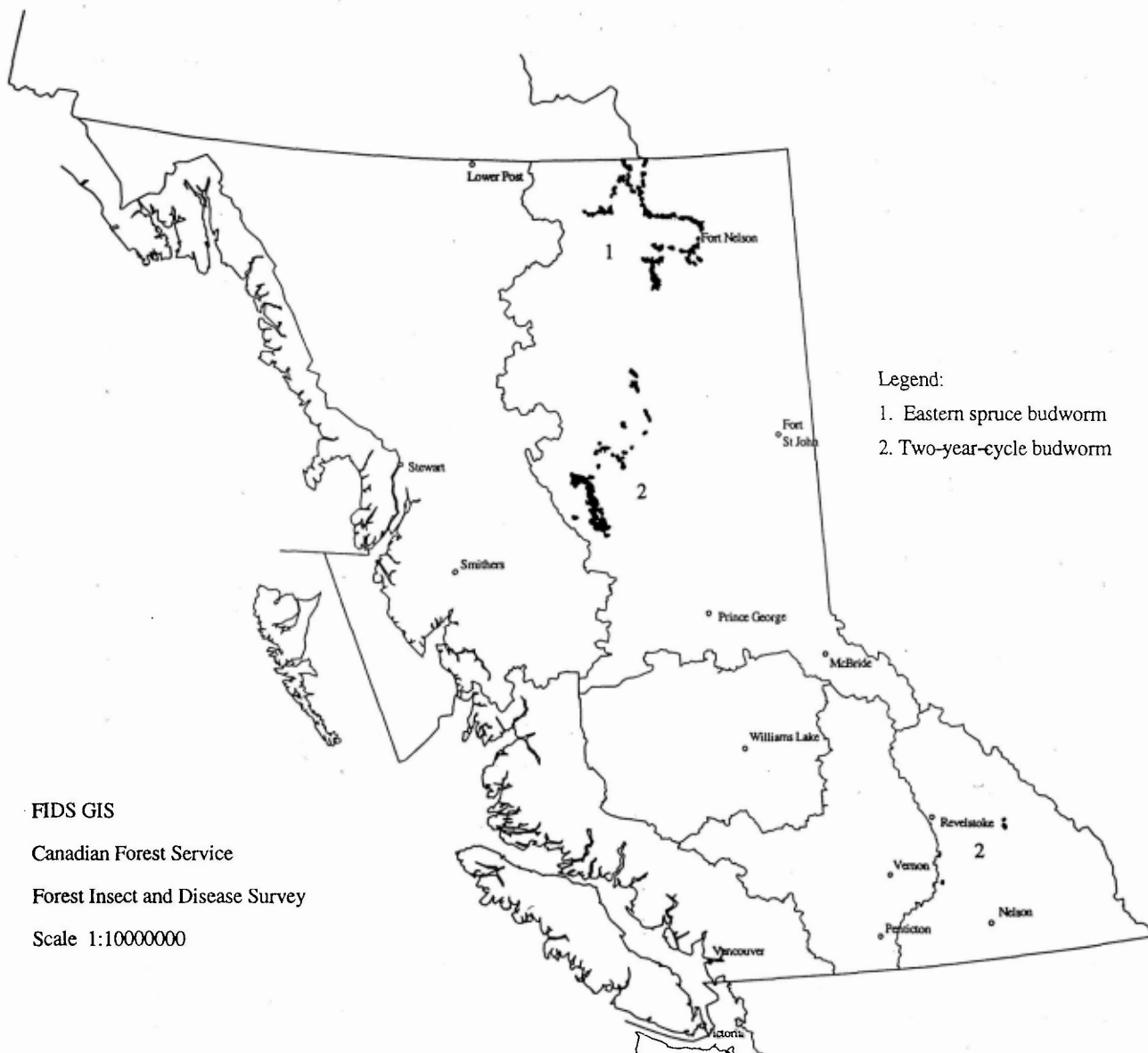
trapped compared to an average of nine in the other four forest regions. Defoliation by the looper is not expected in any areas in 1996.

### **Green-striped forest looper**

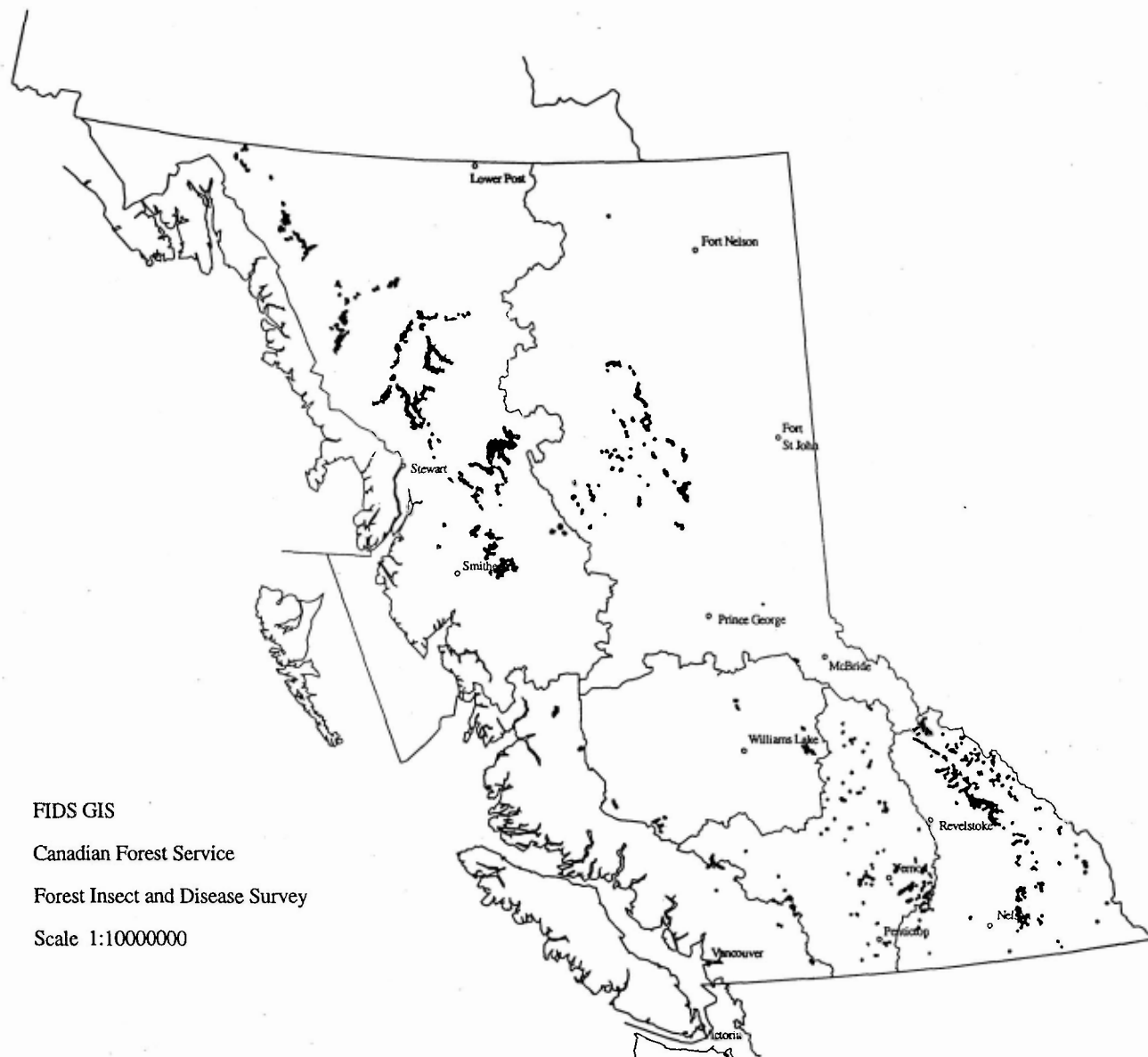
*Melanolophia imitata*

Over 700 ha of mature western hemlock and white spruce were severely defoliated by the looper along the Skeena River northeast of Hazelton. This is the first year that road access has enabled ground assessments of defoliation which has been evident from the air for the past two years. Dead and dying overmature and immature trees have been reported, and continued mortality is expected as trees have already been weakened by the heart rot, *Echinodontium tinctorium*.

Less than half the pupae collected for rearing survived; most died from unknown causes and parasitism. This in conjunction with heavy predation by mammals and birds evident at the infestation site indicates that the population is on the decline. This stand is slated to be harvested in 1996.



Map 5. Areas where defoliation by fir-spruce budworms was detected during aerial surveys in 1995.



Map 6. Area where recent tree mortality due to balsam bark beetle was detected during aerial surveys in 1995.

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## Multiple Host Pests

### Black army cutworm

*Actebia fennica*

Black army cutworm killed about 20% of the spruce seedlings over 20 ha on Blackwater Ridge north of Golden in the Nelson Region. Approximately 80% of the herbaceous growth was completely stripped.

Infestations of the black army cutworm were also reported, but only on herbaceous vegetation in several cut blocks of newly planted spruce and lodgepole pine in the Kamloops, Prince Rupert and Prince George

forest regions. Included were two sites near the north end of Takla Lake, three sites north of Meziadin Lake, and one site in the upper North Thompson River Valley.

Limited pheromone trapping for the black army cutworm was done this year because there were relatively few recently burned sites. An average of only 30 moths were trapped at five sites in the Kamloops Region. This endemic level was forecast last year on the basis of low average trap catches (143 per trap; range 10-370).

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## Nursery and Seed Orchard Pests

The Pacific Forestry Centre's Nursery Clinic received 163 multi-diagnostic requests in 1995. Hot weather in the spring and early summer created an environment conducive to damping-off by *Fusarium* spp. This was especially true for *Abies* species. The demand for seedlings of true firs increased to 15 million, so many nurseries were growing them for the first time. Using irrigation to cool the crops encouraged damping-off diseases. Recommendations were also made regarding nursery sanitation techniques to prevent the reoccurrence of disease in next year's crop.

Shoot diseases caused by *Botrytis cinerea*, *Didymascella thujina*, *Meria laricis* and *Sirococcus strobilinus* were also encouraged by wet weather in August. Early identification and fungicide sprays prevented these diseases from spreading throughout the crops. Studies are underway to determine the impact of these nursery diseases on field performance.

Root rot has not been a problem in 1995. Information obtained at the Pacific Forestry Centre on cultural growing conditions which prevent root rot, especially

in spruce and Douglas-fir, appears to have reduced losses due to *Pythium* spp. and *Fusarium* spp.

Forest tree seed collected in British Columbia and the Yukon and destined for international markets is certified under the Organization for Economic Cooperation and Development (OECD) scheme. Collections for 1995 include Douglas-fir, western redcedar, black spruce, alpine fir, shore pine, and lodgepole pine. This required inspections of 27 collection sites on Vancouver Island, the southern interior, and the Yukon. Collection sites in Powell River, Texada Island, Prince George, Chetwynd, Fort St. James and Hazelton regions were also inspected. These collections have produced approximately 750 hectoliters of cones, most of which (450 hectoliters) was Douglas-fir.

This cone crop, collected under good conditions, should result in a return for the B.C. seed industry in the export market of over a million dollars.

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## Deciduous and Ornamental Tree Pests

### Tent caterpillars

*Malacosoma* spp.

Defoliation of deciduous trees and shrubs by forest tent caterpillar in the interior of British Columbia expanded to about 102 000 ha in 441 areas in the Cariboo and Prince George forest regions (Map 7).

In the Prince George Forest Region defoliation of trembling aspen increased in area to almost 55 000 ha, up more than 30% from last year. Populations in the Prince George Forest District increased for the third consecutive year, affecting 45 000 ha from Ahbau Creek in the south to McLeod Lake in the north. In the Robson Valley the area of defoliation increased to almost 7000 ha after a decrease last year. Complete defoliation of aspen stands was mapped over 114 separate infestations from west of McBride to McNaughton Lake. Populations in and around Dawson Creek and Taylor increased for the third consecutive year with defoliation reported over 2700 ha. For the first time in more than 15 years the tent caterpillar has caused serious defoliation east of Fort Nelson with patches totalling several hundred hectares along the Liard River. Mortality of trembling aspen has begun to appear in stands that have been severely defoliated for several consecutive years south of Prince George.

In the Cariboo Region tent caterpillar lightly to severely defoliated mainly trembling aspen over 47 000 ha, slightly less than last year. The most widespread and severe defoliation occurred near Quesnel where large populations completely stripped aspen. Severe defoliation was mapped north of Quesnel to 10 Mile Lake and southeast along the Quesnel River to Deaver Creek, and northwest to the Blackwater River.

Egg mass samples from 11 areas in the Cariboo and Prince George regions indicate continuing populations of tent caterpillars for 1996 in all areas. An average of 35 new egg masses per tree were counted at seven sites near Quesnel, eight were counted at two sites south of Prince George, and four at two sites around McBride. The high number of egg counts around Quesnel indicates that the heaviest defoliation will probably occur in this area in 1996. Counts greater

than 10 masses per tree usually result in severe defoliation.

Northern tent caterpillar, increased for a fourth consecutive year and defoliated deciduous trees and shrubs in east coastal areas of Vancouver Island and the adjacent Gulf Islands. Populations again increased near Meziadin Lake in the Prince Rupert Region.

Defoliation of a variety of trees and shrubs was again severe in the Victoria area, on the southern Gulf Islands, and in the Log Creek drainage near Boston Bar in the lower Fraser Canyon. Increased numbers of larval colonies were noted from Sooke to Campbell River and in the Fraser Canyon. Severe defoliation of fruit trees was reported on Saturna, Texada and Salt Spring islands.

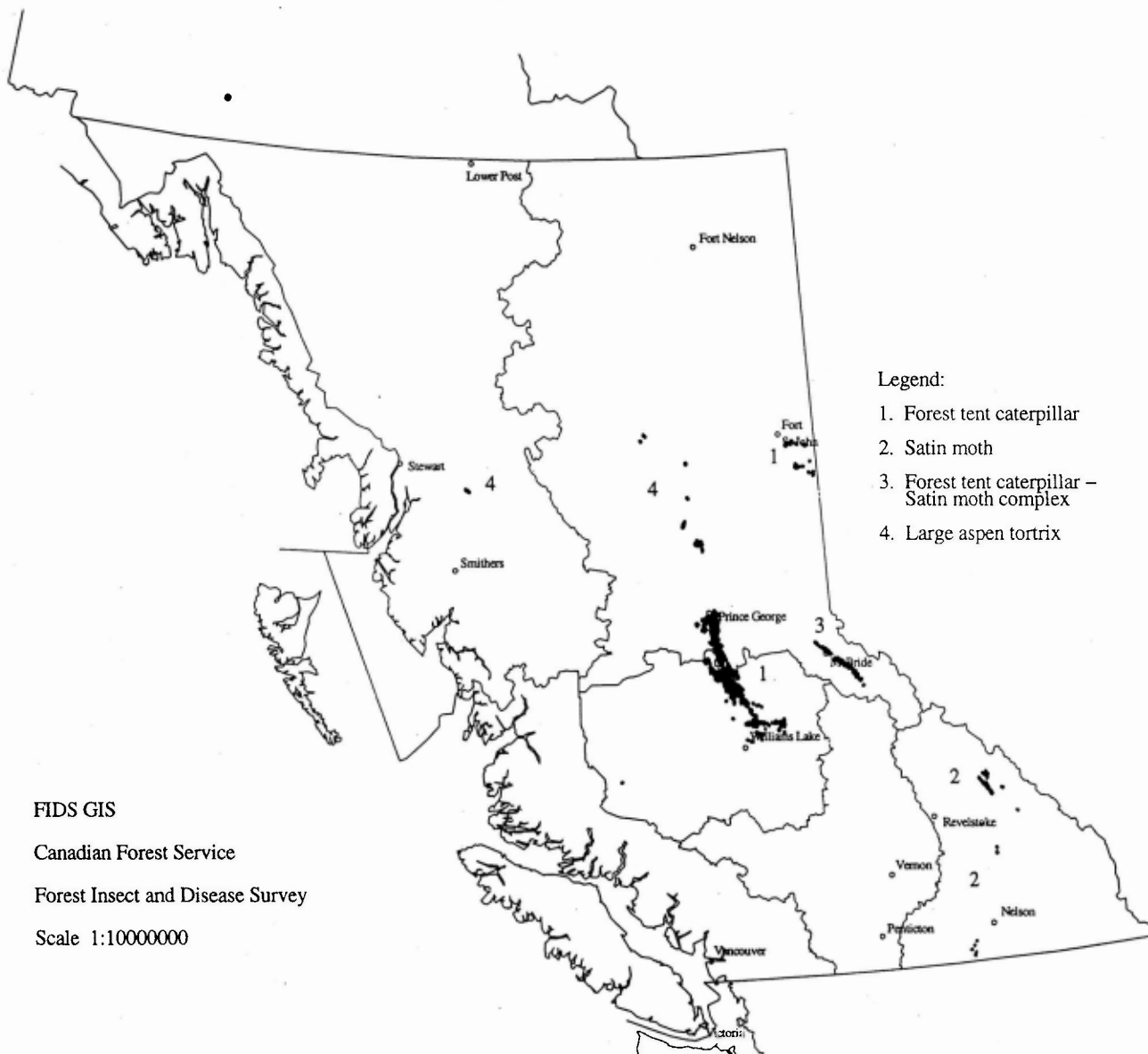
Populations increased for the third consecutive year near Meziadin Lake east of Stewart and egg mass counts indicate that populations will remain high in 1996.

### Satin moth

*Leucoma salicis*

Satin moth defoliated trembling aspen and cottonwood over more than 13 000 ha in the Prince George, Cariboo, Kamloops and Nelson forest regions. The largest infestations occurred in the Robson Valley in conjunction with forest tent caterpillar infestations and in the Nelson Region (Map 7). Almost 7000 ha of defoliation in scattered patches was reported in the Nelson Region near Golden, Duncan Lake, Trail and Castlegar. Satin moth larvae were also found throughout the almost 7000 ha of mostly aspen defoliation reported from McBride to Valemount. Random surveys of the infested stands indicated that approximately 25% of the larvae were satin moth. The satin moth was first reported in this area last year when large moth flights occurred.

Elsewhere, much smaller infestations were detected. Severe defoliation of trembling aspen was observed for the second year in the Bluff Lake area of the Cariboo Region. In the Kamloops Region a 30-ha infestation was noted along the Coquihalla Highway south of Merritt.



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Map 7. Areas where defoliation of aspen was detected during aerial surveys in 1995.

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**Large aspen tortrix**  
*Choristoneura conflictana*

Defoliation of trembling aspen by the large aspen tortrix continued in the Yukon Territory, Prince George and Prince Rupert regions in 1995 (Map 7).

Defoliation was mostly moderate and severe over 7000 ha in the Vanderhoof, Mackenzie, Dawson Creek and Fort Nelson forest districts. For the third consecutive year, defoliation was noted over approximately 2000 ha in the Nechako River Valley from the Sinkut River to west of Fort Fraser. In the Dawson Creek and Mackenzie forest districts over 2500 ha of defoliation was mapped in each district. The tortrix, often in conjunction with the forest tent caterpillar, defoliated aspen north and east of Fort Nelson.

In the Prince Rupert Region severe defoliation was reported over approximately 850 ha north of Kitwanga between Douse Lake and Cranberry River. Additional smaller infestations occurred adjacent to Tyhee and Burns lakes. Yukon infestations declined to a single 200-ha patch near Jakes Corner.

**Birch leaf miners**  
*Fenusa pusilla*  
*Lyonetia speculella*

Birch leafminer, *Fenusa pusilla*, lightly to severely defoliated white birch for 22 km along Creighton Valley road east of Lumby. For the fourth consecutive year this leafminer discoloured white birch in the lower Fraser Canyon near Yale.

Another birch leafminer, *Lyonetia speculella*, severely discoloured birch stands in several areas in the West Kootenay of the Nelson Region. Damage was reported in the Tangier River-Jumping Creek area and along the Illecillewaet and lower Kaslo rivers. Infestations in the Kamloops Region increased almost three fold to 2200 ha along Adams Lake and east of Vernon. In the

Echo Lake area of the Prince Rupert Region, over 200 ha of severe discoloration was recorded in this year, which was at least the fifth year of attack.

**Jumping gall wasp**  
*Neuroterus saltatorius*  
**and an Oak leaf phylloxera**  
*Phylloxera* sp. nr. *glabra*

The discoloration of Garry oaks in the Capital Regional District by jumping gall wasp decreased dramatically in 1995. However, defoliation by the oak leaf phylloxera, which is often associated with the gall wasp, continued at 1994 levels. Near Maple Bay and North Saanich, where gall wasp infestations have only been active for a couple of years, populations remain high. In the areas where these defoliators have been present for up to nine years, populations declined, largely due to increased levels of predators and parasites.

**Western oak looper**  
*Lambdina fiscellaria somniaria*

The western oak looper killed Garry oak and Douglas-fir trees over approximately 25 ha on the southern end of Saltspring Island. In 1994 the looper completely stripped mature Garry Oak and Douglas-fir trees in the Mount Maxwell Provincial Park, in the adjacent Ecological Reserve, and on nearby private lands. Populations have subsided somewhat this year with light to moderate defoliation noted on scattered Garry oak trees.

Research on oak looper pheromones is being done on Saltspring Island this year by Simon Fraser University. The constituents of the pheromone have been extracted, identified and synthesized; however, one more season of testing will be required before the most effective combination of the constituents can be determined.

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## Special Projects

### **Pine shoot beetle**

*Tomicus piniperda*

Pine shoot beetles were not found during the fourth year of surveys for this introduced pest. Over 1800 Scots pine at five locations in the Fraser Valley east of Vancouver were assessed for shoot flagging, typical damage of this pest. This insect is considered a serious pest in Europe and Asia and was first detected in North America in Ohio in 1992.

### **European pine shoot moth**

*Rhyacionia buoliana*

European pine shoot moth continued to infest exotic pine trees at low levels in mostly ornamental and Christmas tree plantations in the Fraser and Okanagan valleys.

### **Balsam woolly adelgid**

*Adelges piceae*

A cooperative survey to update the known distribution of balsam woolly adelgid in southwestern British Columbia continued in 1995. The Canadian Forest Service, Forest Insect and Disease Survey in cooperation with the British Columbia Ministry of Forests and the forest industry, sampled 94 mature and immature stands adjacent to selected portions of the 1992 quarantine zone boundary. Surveys along Nelson Regional border north of outbreaks in Idaho were also negative.

To determine if the adelgid occurred north of the quarantine zone boundary on Vancouver Island, two upper crown branches were sampled per tree from five trees in each of 77 stands, and three nodes per branch were examined in the laboratory for balsam woolly adelgid. Balsam woolly adelgid was present in four widely separated mature stands: at Wowo Lake (four of five amabilis fir were heavily infested and gouting was evident); at Browns River two trees were infested; and at the remaining two locations (Pearl Lake and Menzies Bay) single trees were infested. The discovery of an infested grand fir at Menzies Bay, north of Campbell River, confirms the presence of balsam woolly adelgid near all locations on

Vancouver Island where *Abies* seedlings are grown for reforestation. Additional sampling of symptomatic fir on Vancouver Island resulted in the discovery of one mature and two young infested amabilis fir stands beyond the quarantine zone and two other infested sites within the quarantine zone.

On the mainland, surveys of symptomatic immature fir stands along the eastern boundary of the quarantine zone confirmed balsam woolly adelgid at 11 of the 12 locations sampled. Five sites were outside of the existing quarantine zone, and the presence of balsam woolly adelgid was confirmed east of the Fraser River for the first time.

A cooperative trial by the Canadian Forest Service and the British Columbia Ministry of Forests to examine the ability of the adelgid to infest one- and two-year-old container grown *Abies* seedlings continued in 1995. Live balsam woolly adelgid and gouting on artificially infested one-year-old seedlings demonstrated successful reproduction of the adelgid after one growing season on containerized nursery stock under operational growing conditions. Survey and research trial results will be reviewed by the Plant Protection Advisory Council Balsam Woolly Adelgid Committee to determine possible actions.

### **Pests of young managed stands**

In 1995, 166 young 2- to 40-year-old natural and planted conifer stands containing over 20 000 trees were surveyed in British Columbia. This was part of a continuing study to identify major pest and environmentally related problems and their impacts on young stands. Most sites were randomly selected from History Record System lists provided by the Silviculture Branch of the British Columbia Ministry of Forests, which identified sites by forest district, biogeoclimatic zone, and stand opening number. At each location a minimum of 10 randomly selected stocked circular plots with a minimum total of 100 trees per site were surveyed.

Pine accounted for 48% of the trees examined, Douglas-fir 17%, spruce 16%, hemlock 10%, and true fir, cedar, larch and poplar comprised the remainder. Sites were located in eight biogeoclimatic zones. Most



(32%) were in the Sub-Boreal Spruce zone, 22% in the Interior Douglas-fir zone, 18% in the Coastal Western Hemlock zone, 12% in the Interior Cedar Hemlock zone and the balance were in four other zones. In over 70% of the stands spacing was the primary silvicultural treatment.

Approximately 56% of the 166 stands surveyed were either free of pests or contained only insects or disease of little consequence. Pests causing losses to current growth potential occurred in 21% of the stands and 23% contained pests which caused levels of tree mortality which should be of concern to the forest manager. Overall, 65% of the trees were pest free. Almost half the stands in the Nelson Forest Region and more than 60% of the stands in the Engelmann Spruce Subalpine fir biogeoclimatic zone had more than 5% tree mortality. In both instances a root rot, *Armillaria ostoyae*, was the main risk to the health of some of the young stands.

As in previous years the most common types of damage were caused by adelgids, mammals, western gall rust (*Endocronartium harknessii*), climatic damage, terminal weevils (*Pissodes strobi* and *Pissodes terminalis*), and pine needle disease (*Lophodermella concolor*). These were found in 16 to 42% of the stands examined.

A more detailed five-year summary of pests of managed stands in British Columbia for the period 1991 to 1995 is being compiled.

### **Quarantine surveys of ports and adjacent areas**

Special surveys undertaken by the Forest Insect and Disease Survey in collaboration with Agriculture and Agrifood Canada to evaluate the potential for the introduction of exotic pests associated with dunnage in and around the ports of Greater Vancouver and Prince Rupert has resulted in additional new records.

During overview surveys of dunnage in port environs at 11 locations, examples of the following were found: Ambrosia beetle galleries in exotic hardwoods from Australia; large Cerambycid borings in crating from China; Scolytid galleries under bark in crating from Israel; and Asian powder post beetles active in crating from India.

In subsequent trapping surveys with Lindgren funnel traps and three different lures, more than 115 adults of an Asian ambrosia beetle, *Xylosandrus germanus*, were trapped in 2 of 24 locations in the Richmond and Surrey areas. Two adults of a second species of Asian ambrosia beetle, *Xyleborus perforans*, were discovered on Reifel Island at the mouth of the Fraser River. This is the first record for *X. perforans* in North America. These ambrosia beetles have a wide, mostly hardwood host range. Additional surveys are required to determine in which hosts they occur and if *X. perforans* is established or whether this record only represents a recovery of adults flying from infested dunnage on nearby vessels or discarded crating.

Other records resulting from this limited survey include multiple recoveries of an Asian powder post beetle, *Sinoxylon anale*, from a forested area immediately adjacent to an import location at which crating infested by this species was also found. As well, the second Canadian collection and locality record for the native bark beetle *Hylocurus hirtellus*, which attacks willow, was obtained. The monitoring techniques employed in this study may also be useful in future forest biomonitoring and biodiversity studies.

### **Control of Ermine moths in apple and cherry**

At the request of Agriculture and Agrifood Canada, staff of the Forest Insect and Disease Survey released apple and cherry ermine moth parasitoids on Vancouver Island. The ermine moths have caused persistent and widespread defoliation of fruit and ornamental trees (apple, plum, cherry, hawthorn, mountain ash) and native trees (Pacific crab apple, Saskatoon-berry) for several years in south coastal British Columbia. The damage is highly visible and has been the subject of numerous enquiries. Larval rearings have shown that little if any parasitism is evident in Vancouver Island populations.

In an effort to reduce damage levels, a European egg-larval parasitoid, *Ageniaspis fuscicollis*, obtained by Agriculture and Agrifood Canada, from Swiss and German sources was received and released at 13 sites in Victoria and on the Saanich Peninsula. The parasitoids were released July 13-24, 1995; an average of about 900 parasitic wasps were released at each site, and about 12 000 were released in total.

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## European elm bark beetle

*Scolytus multistriatus*

European elm bark beetles were again captured in pheromone baited traps near Kelowna in the Okanagan Valley and for the first time at Grand Forks and Midway. The beetle is a potential vector of the fungus causing Dutch Elm disease, but surveys for the fungus have been negative to date. As one of the few areas to be free of the disease, British Columbia exports more than 10 000 elm saplings annually.

## Gypsy moth

*Lymantria dispar*

A single site with positive trap catches and egg masses at Chilliwack was treated with *Bacillus thuringiensis* var. *kurstaki* in 1995. Foray 48B® was applied three times by air over a 352-ha block at a rate of 50 BIU/ha in May, and two ground sprays were applied over a central core of 17 ha in late May and June. No gypsy moths have been recovered following treatment.

Surveys to detect gypsy moth populations with 16 000 traps throughout British Columbia continued for the seventeenth year in a cooperative interagency program involving Agriculture and Agrifood Canada (Plant Health), Canadian Forest Service and British Columbia Ministry of Forests. This year, 39 adult male moths were trapped. Thirty-three males were captured between Vancouver and Hope in 25 traps, while a single moth was captured in each of six traps on Vancouver Island. Two Asian race male moths were trapped at widely separated locations in the lower mainland. Only 39 moths were collected from 9000 traps in 1994.

## Foliar diseases of poplar

Field surveys of hybrid poplars and native cottonwood were conducted as part of a research project on poplar diseases sponsored by the Canada-British Columbia Forest Resources Development Agreement (FRDA II). In October, 1995, a total of 984 trees in a four-year-old hybrid poplar clonal trial near Sayward on Vancouver Island were rated for four pests.

Damage by leaf rusts, *Melampsora* spp., was extremely low this year: only 7% of the trees were rusted at trace levels.

Leaf blotching caused by *Linospora tetraspora* occurred at some level on 79% of the trees and 40% of the infected trees were seriously damaged.

Leaf spotting caused by *Septoria populicola* occurred on 39% of the trees and 25% of the infected trees were seriously damaged.

Foliar discoloration caused by an undescribed genus of eriophyid mite was also recorded on 66% of the trees in the clonal trial. Further study of this pest is planned.

Strong correlations between disease intensity and clonal families were observed. Preliminary results will be confirmed by a rating next year, and these results will be compared to those from parallel studies being conducted on the same clones in Oregon.

An unusual leaf blight of native black cottonwood was collected from a nursery near Terrace. This appears to be the first record of *Guignardia niesslii* in western North America but the characteristic conidial state is not present. This fungus should probably be redescribed in a different, if not new, genus.

## Other Noteworthy Insects

Insect	Host	Remarks
Asian lady bird beetle, <i>Harmonia axyridis</i>		This predator of aphids introduced to the USA is now common enough in British Columbia to draw enquiries from the public.
Conifer sawfly, <i>Neodiprion</i> sp.	Western hemlock	Moderately defoliated 200 ha of mature trees northeast of Campbell River on the mainland.
Cottonwood sawfly, <i>Nematus currani</i>	Poplar	Collapsed after 3 years of infestations on the Islands in the Fraser River near Agassiz.
Fall webworm, <i>Hyphantria cunea</i>	Deciduous	Widespread throughout the Fraser Valley.
Hemlock woolly adelgid, <i>Adelges tsugae</i>	Western hemlock	Endemic levels throughout the host range.
Larch budmoth, <i>Zeiraphera improbana</i>	Larch	Populations collapsed in the East Kootenay of the Nelson Region.
Larch casebearer, <i>Coleophora laricella</i>	Larch	Populations declined, with light defoliation over 70 ha near Armstrong.
Larch sawfly, <i>Pristiphora erichsonii</i>	Exotic larch	Moderate defoliation of larch trees was recorded near Whistler, north of Vancouver.
Spruce cutworm, <i>Egira</i> sp.	Sitka spruce	Light defoliation near Long Beach in the Pacific Rim National Park.
Winter moth, <i>Operophtera brumata</i>	Deciduous spp.	Low levels throughout Greater Vancouver and Victoria.
Western blackheaded budworm, <i>Acleris gloverana</i>	Western hemlock	Populations collapsed after defoliating 6000 ha in 1994.

## New Records of Occurrence and Distribution

Pest	Host	Location	Remarks* **
<b>Fungi</b>			
<i>Bertia moriformis</i> (Tode:Fr.) De Not.	Trembling aspen	Kamloops	New host record
<i>Biscogniauxia bartholomaei</i> (Peck) L.N. Vasil'eva	Red alder	Metchosin	New record
<i>Biscogniauxia mediterranea</i> (De Not.) Kuntze	Red alder	Metchosin	New record
<i>Bisporella citrina</i> (Batsch:Fr.) Korf & S. Carpenter	Trembling aspen	Kamloops	New host record
<i>Calosphaeria pulchella</i> (Pers.:Fr.) J. Schröt. in Cohn	Cherry	Appledale	New host record
<i>Ganoderma applanatum</i> (Pers.) Peck	American mountain- ash	Nelson	New host record
<i>Gnomonia intermedia</i> Rehm var. <i>alni</i> Barr	Sitka alder	Williams Lake	New host record
<i>Hypoxylon rubiginosum</i> (Pers.:Fr.) Fr.	Trembling aspen	Kamloops	New host record
<i>Hysterangium</i> sp.	Soil	Port Renfrew	New record
<i>Lophodermium sediciosum</i> Minter, Staley & Millar	Scots pine	Matsqui	New host record
<i>Peziza ostracoderma</i> Korf	Coulter pine	Surrey	New record
<i>Peziza repanda</i> Pers.	Spruce	Parksville	New host record
<i>Phellinus punctatus</i> (Fr.) Pilát	Walnut	Vernon	New record

## New Records of Occurrence and Distribution (continued)

<b>Pest</b>	<b>Host</b>	<b>Location</b>	<b>Remarks</b>
<i>Phyllosticta abietis</i> Bissett & Palm	Grand fir	Waneta	New record
<i>Xenomeris abietis</i> Barr	Western white pine	Lake Cowichan	New host record
<b>Insects</b>			
<i>Apterona crenulella</i> form helix (Siebold)	Douglas-fir	Kootenays	New record
<i>Cecidophyopsis</i> <i>psilaspis</i> (Nalepa)	Western yew	Prince Rupert	New record
<i>Coleophora</i> sp.	Ash	Richmond	New host record
<i>Dioroctria cambiicola</i> (Dyar)	Scots pine	Langley	New host record
<i>Hylocurus hirtellus</i> (LeConte)	Trap	Richmond	New record
<i>Nalepella</i> sp.	Spruce	Vernon	New host record
<i>Orthotomicus</i> <i>caekatus</i> (Eichhoff)	Scots pine	Matsqui, Hatzic	New host record

\* first record of pest found on particular host

\*\*first record of pest in British Columbia, Canada or North America