Forest Insect and Disease Conditions Vancouver Forest Region - 1994

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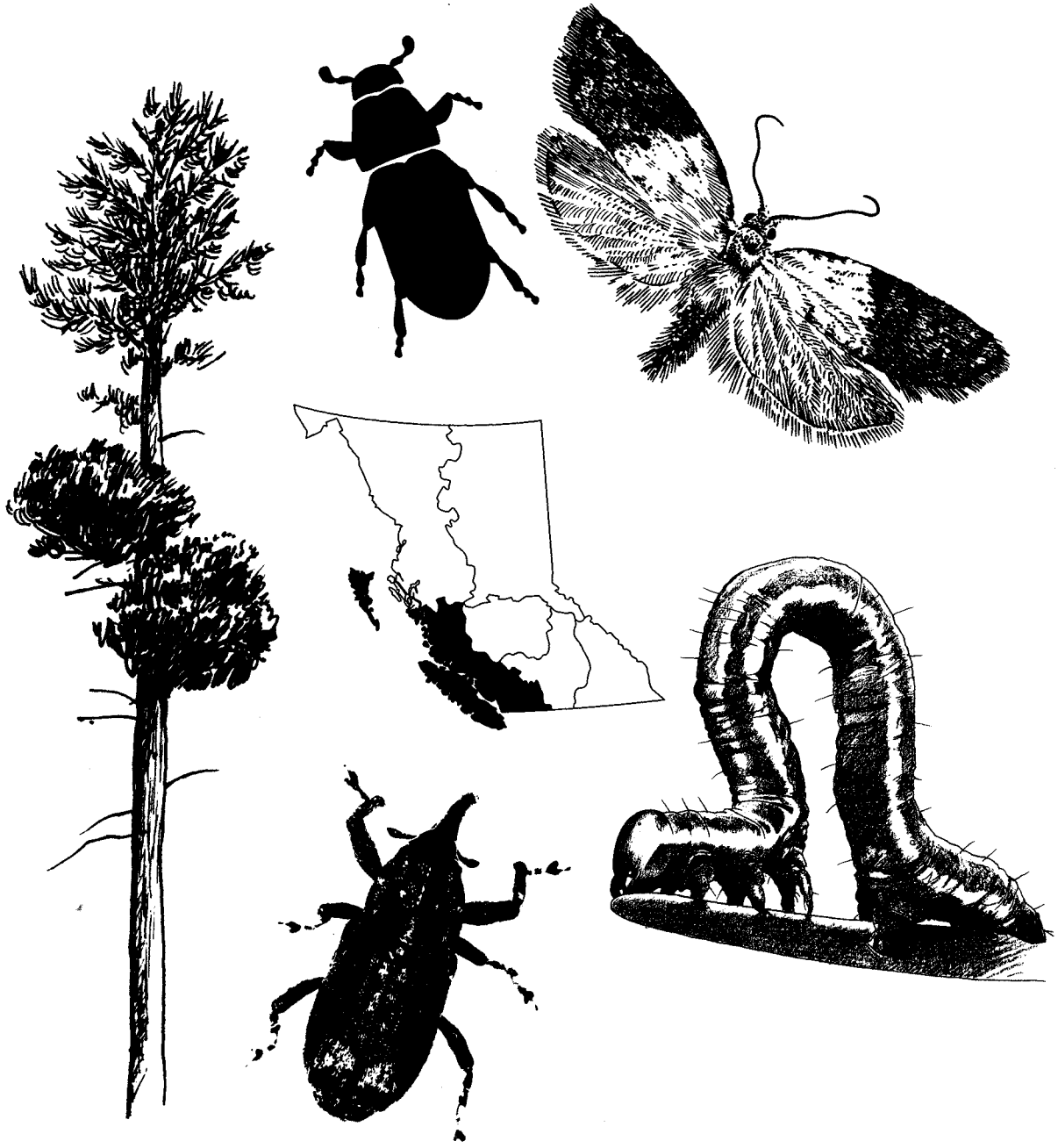

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QUEEN CHARLOTTE ISLANDS

Foreword

Forest Insect and Disease Survey (FIDS) is a nation-wide network within the Canadian Forest Service (CFS) with the responsibility of: (1) producing an overview of forest pest conditions and their implications, including predictions where possible; (2) maintaining records and surveys to support quarantines; (3) supporting forestry research with field studies, records, Herbarium and Insectary collections; (4) providing advice and extension on forest insect and disease conditions; (5) developing and testing survey techniques; (6) and conducting related biological and impact studies.

Throughout the year, correspondence and inquiries regarding forest pest problems, and requests for publications can be directed to FIDS headquarters at:

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During the field season, May to October, inquiries can also be directed to the FIDS field stations.

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Defoliation intensities in this report are defined as follows:

Trace - evidence of feeding barely detectable at close range
Light - some branch and/or upper crown defoliation, barely visible from the air
Moderate - pronounced discoloration and noticeably thin foliage, severe top defoliation
Severe - top and many branches completely defoliated, most trees more than 50% defoliated

Mortality due to bark beetle attack, referred to in this report, are defined as follows:

Light - 10% or less of stand recently killed
Moderate - 11-29% of stand recently killed
Severe - 30%+ of stand recently killed

Introduction

This report outlines the status of forest pest conditions in the Vancouver Forest Region for 1994 and forecasts trends of some potentially damaging pests. Pests are listed by host in order of importance with emphasis given to those capable of damaging outbreaks. Where possible, pest losses are quantified by Timber Supply Areas (TSAs) within Forest Districts. Most of the information was gathered through the monitoring of already known or recently reported insect or disease problems; the detection of pest problems during travels through the region; annual aerial surveys during which major pest problems are mapped for area and severity, and several special surveys and collections.

Several special surveys were carried out during the field season. These included: pests in provincial parks and ecological reserves; changes in tree conditions in Acid Rain National Early Warning System (ARNEWS)/Biomonitoring plots; biodiversity trapping at a select ARNEWS plot; pheromone trapping of defoliators including spruce budworm, western hemlock looper, and gypsy moth; surveys for the recently introduced pine shoot beetle and for European pine shoot moth; follow up surveys for pinewood nematode in western hemlock and lodgepole pine; balsam woolly adelgid surveys; and young stand surveys. Additionally, forest pest-related inquiries from the forest industry, government agencies, and the general public were investigated, causal agents identified, and management options suggested.

During the 1994 field season, special collections were made which contributed to the current and continuing studies at the Pacific Forestry Centre, and other research institutes. The collections included woodborers and woodborer infested material; pinewood nematode samples; defoliator larvae including phantom hemlock looper, winter moth, and pine sawfly; diseased western yew shoots; balsam woolly adelgid; and foliar samples from ARNEWS plots.

The FIDS field season extended from early May to late September, during which samples collected for identification by CFS/FIDS and co-operators totaled 325. This included 215 insect and 110 disease collections, including pheromone-baited traps. The locations where samples were collected and the areas covered during 9.0 hours of fixed-wing and 3 hours of rotary-wing aerial surveys are shown in Figure 1.

Forest pest conditions on the Queen Charlotte Islands in 1994 are detailed in this report. The survey, from July 10-22, and the report were completed by John Vallentgoed, FIDS Ranger based in Terrace in the Prince Rupert Region (West). Forest pest conditions in the Mid-Coast Forest District part of the Vancouver Region were assessed and reported by Bob Erickson, FIDS Ranger based in Williams Lake in the Cariboo Forest Region. The authors wish to acknowledge the support and assistance of the British Columbia Ministry of Forests and Scott Paper Ltd. with aerial surveys.

Vancouver Mainland and Vancouver Island

Summary

This summary of pest conditions in the Vancouver Forest Region in 1994 lists the most damaging pests, generally in order of importance by host affected.

Growing season weather records (from April to September) from the Vancouver, Victoria and Port Hardy Airport Weather stations recorded **warmer than normal temperatures**, and except for Victoria, **drier than normal conditions** prevailed. Mean temperatures at the Vancouver, Victoria, and Port Hardy Airports were warmer than the 30 year (1961-90) average by 8% at all three locations. The rainfall for the same time period at Vancouver and Port Hardy was 11 and 3% less than the 30 year average, respectively. Victoria had 2% more rainfall than the 30 year average.

For the second consecutive year, **western spruce budworm** populations declined, light and moderate defoliation was recorded over only 1910 ha, down almost half from 3715 ha in 1993. Populations north of Pemberton, in the Soo TSA, collapsed completely, while defoliation in the Fraser TSA, near Boston Bar, increased for the second consecutive year. The area of **Douglas-fir beetle** attacks declined to 280 ha in 241 infestations from 360 ha in 312 infestations recorded in 1993. Most of the decline occurred in the Fraser TSA. The **phantom hemlock looper** moderately to severely defoliated boulevard and residential trees in south east Burnaby, the first recorded outbreak in the region since 1982. **Root rots**, a common and ongoing widespread problem in both young and mature stands, were found in various locations region-wide. An unknown agent caused **mortality** of semi-mature to mature Douglas-fir, mostly in the Powell River area in the Sunshine Coast TSA.

Mountain pine beetle killed an estimated 18 450 trees over 465 ha in 156 infestations, compared to 11 000 trees over 525 ha in 144 infestations in 1993. Although the area declined, the number of trees and volume killed increased due to increase severity of infestations. Most mortality continues to occur in the Soo Timber Supply Area (TSA). No new **pinewood nematode** surveys were initiated this year, surveys initiated in 1993 were completed. Expanded surveys for the **pine shoot beetle,** a European pest recently introduced to eastern North America, were negative. There was no recorded spread of **European pine shoot moth** populations in native trees at Richmond, or other locations. Populations remain endemic in ornamental pines in the lower mainland and southeastern Vancouver Island. The incidence of **pine needle cast** increased throughout the region, about 200 ha of discolored foliage was recorded during aerial surveys.

Although **spruce bark beetle** populations remained low for the ninth consecutive year, about 50 ha of recent mortality was recorded east of the Coquihalla summit, just inside the regional boundary. This is part of a large infestation in the adjoining Kamloops forest region. Elsewhere, no mortality was recorded in previously infested stands in the Mid-Coast TSA. **Spruce weevil** populations continued to cause leader mortality throughout most of the host range.

Balsam bark beetle killed mature alpine fir over 1320 ha, more than double the 530 ha recorded in 1993. All of this increase occurred in expanding infestations in the Mid-Coast TSA. Increased surveys again found active **balsam woolly adelgid** populations, both within and outside the new (1992) quarantine zone. All of the infestations outside the quarantine zone were in the Soo TSA, north of Pemberton.

Western hemlock looper populations were recorded as part of an ongoing province-wide calibration of a pheromone trapping system. No current defoliation was recorded. **Hemlock woolly adelgid** populations declined at a seed orchard on the Sunshine Coast, due to applications of pesticides.

A total of 41 **managed, young stands** were surveyed for pest problems, which included **root rots, foliar diseases,** and **abiotic damage**. No evidence of acid rain damage was found at 11 **ARNEWS/Biomonitoring** plots in the region. The cause of **top-kill** in semi-mature to mature trees throughout lower mainland areas was determined to be the result of previous winter damage.

No adult male **gypsy moths** were caught in 89 traps placed by FIDS. However, about 39 were caught in traps placed by Agriculture Canada in various locations in southwestern B.C., including six of the Asian biotype. This is down from a total of about 141 in 1993, but the number of Asian biotype is up from four recorded in 1993. **Winter moth** populations on the lower mainland and Vancouver Island remained low, various deciduous species were mainly trace to lightly defoliated, similar to 1993. **Cottonwood sawfly** populations declined, to 600 ha, down from 730 ha in 1993. Light to severe defoliation was recorded, on mainly black cottonwood on islands in the Fraser River near Chilliwack, some for the fourth consecutive year. For the second consecutive year, infections caused by a recently introduced species of **a poplar rust** were found on hybrid poplars from the Fraser Valley and Vancouver Island. **Northern tent caterpillar** populations increased for the second consecutive year, lightly to severely defoliating a variety of trees and shrubs at various Vancouver Island and some Gulf Island locations. Defoliation was also recorded, for the first time during this outbreak, in the Powell River area. The incidence of scorching of Garry oak by the **jumping gall wasp** in the the Capital Region, although continuing for the ninth consecutive year, declined slightly overall. Severe scorching was recorded, for the first time, at Duncan, Deep Cove and Maple Bay. The gall wasp was found, for the first time, on Saltspring Island. Light damage again occurred north of Duncan to Nanaimo. Discoloration and premature defoliation caused by the **oak leaf phylloxeran**, was again common in the Greater Victoria area, with some branch, and very occasional, tree mortality of some chronically infested trees. Infections by the **dogwood leaf blight** fungus, while continuing throughout the host range, declined in intensity this year. The incidence and intensity of **bigleaf maple scorch** was low in mainland and south-eastern Vancouver Island areas for the second consecutive year. **Birch leafminer** populations again infested most birch in upper Fraser Valley areas, while **amber-marked birch leafminer** populations were recorded in the Pemberton area. **Fall webworm** populations were again common in lower mainland areas, but declined on Vancouver Island for the second consecutive year.

A summary of **new host and distribution records** in the region as well as a table summarizing **other endemic, noteworthy and minor pests** is included in this report.

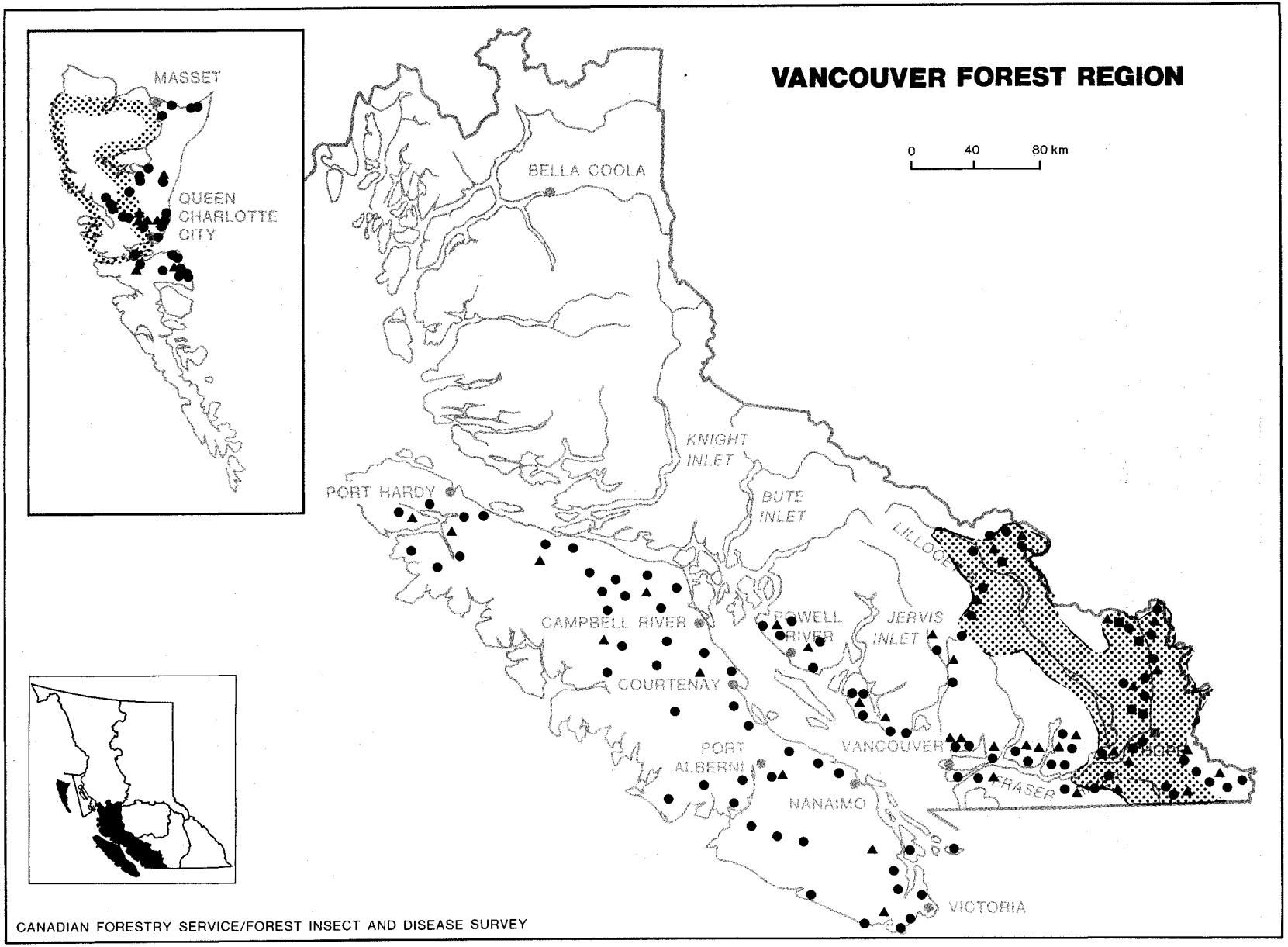

Figure 1. Locations where one or more forest insect and disease samples were collected and areas covered by aerial surveys to map bark beetle and defoliator infestations in 1994.

Douglas-fir Pests

Western spruce budworm
Choristoneura occidentalis

The area of western spruce budworm-damaged Douglas-fir declined by almost half to 1910 ha in 46 infestations, down from 3715 ha in 40 infestations in 1993 (Figure 2). There were 1655 ha of light, 255 ha of moderate, and no severe defoliation recorded in 1994. All defoliation occurred in the Fraser TSA, near Boston Bar. Populations in the Soo TSA, near Pemberton, which declined significantly in 1993, collapsed this year. Although this was the ninth consecutive year of defoliation caused by the budworm during this outbreak (Figure 3), defoliation in the Fraser TSA has only been recorded for six consecutive years.

Defoliation

Budworm populations collapsed in most previously infested areas in the Soo TSA (Table 1). No defoliation was recorded during aerial surveys in any of the areas where defoliation had previously been recorded during this current outbreak, which began in the Blackwater area north of Pemberton in 1986. Trace to very light feeding was seen on understory trees in some areas where light to moderate defoliation was recorded during aerial surveys in past years.

In the Fraser TSA, defoliation increased for the third consecutive year, to 1910 ha from the 745 ha recorded in 1993. Infestations expanded near Hannah and Francis lakes as well as at mid-elevations on both sides of the Nahatlatch River Valley from the Nahatlatch Lakes to the confluence with the Fraser River. Patches of defoliation were also recorded south of the Nahatlatch River along the Fraser River to just north of Boston Bar, at the mouth of Mowhokam Creek, along Ainslie Creek, and opposite Spuzzum Creek, south of Boston Bar.

Two mass collections of budworm larvae were made by the British Columbia Forest Service at Log Creek, near the Nahatlatch River, in the Fraser TSA. Parasitism, by dipteran and hymenopteran parasites, averaged 75% (range 57-92%) while 19% of the larvae from one of the collections died as a result of infection by a fungal disease, *Entomophthora* sp.

Damage

Permanent plots, established in an approximately 30-year-old, naturally regenerated, spaced stand at Eight Mile Creek, north of Pemberton, were assessed again in 1994. Top-kill was noted in this stand, which was moderately defoliated in 1991 and '92. Although no defoliation was recorded in this area during aerial surveys, about 15% of the trees were trace defoliated this year. Top-kill, ranging from 0.1 to 1.0+ metre's was recorded on 11% of the plot trees. Die-back, consisting of dead branches, branchlets and branch tips in the upper third of crowns, was recorded on 48% of the trees. Surveys will continue in these plots to record the long term effects of budworm defoliation on younger trees in spaced stands.

No tree mortality has been recorded during this infestation. Some understory trees in areas with high budworm populations have been moderately to severely defoliated, and may die. Top-kill of up to 1+ metre occurred on semi-mature trees in areas where moderate defoliation has been recorded. These include the North, Blackwater, Salal and Fowl creek areas in the Soo TSA. Top-stripping of up to 1 metre was noted in the 4-barrel main area, above the Nahatlatch River, in the Fraser TSA. Growth reduction, averaging 12%, was recorded in trees moderately defoliated in 1989 (FIDS file report, 90-6, 1989).

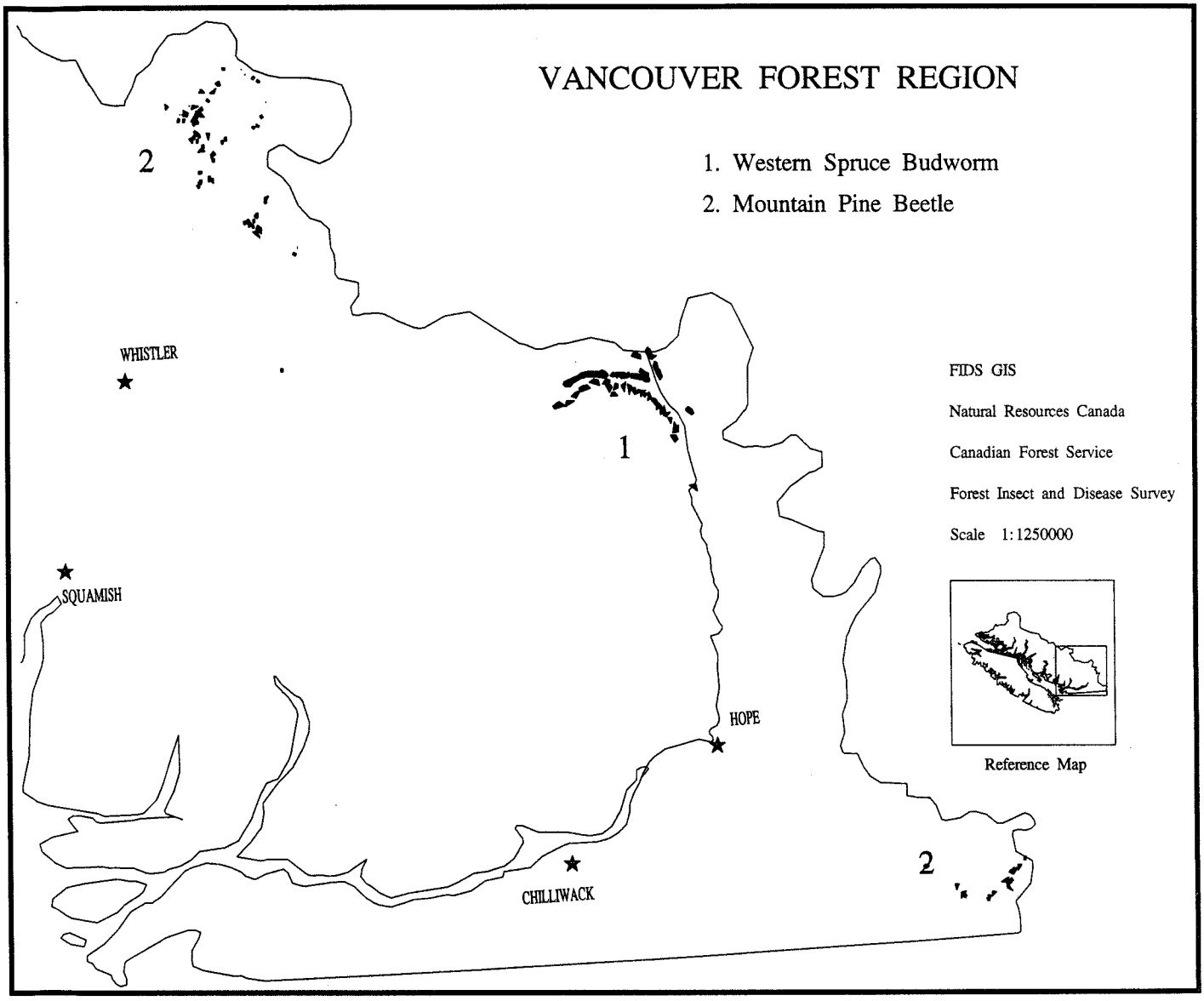

Figure 2. Areas of Douglas-fir where current defoliation by the western spruce budworm, and areas of lodgepole pine recently killed by mountain pine beetle were detected during ground and aerial surveys in 1994.

Table 1. TSA, location and area of defoliation of Douglas-fir by western spruce budworm, from aerial surveys, Vancouver Forest Region, 1994 and 1993.

TSA and location	Area of defoliation (ha) Light		Moderate		Severe		Total	
	1994	1993	**1994**	1993	**1994**	1993	**1994**	1993
Fraser TSA								
Hannah Creek-4 barrel main	**185**	155	**70**	-	**-**	-	**255**	155
Hannah-Francis lakes	**665**	440	**185**	-	**-**	-	**850**	440
Nahatlatch River-Kookipi Creek	**235**	150	**-**	-	**-**	-	**235**	150
Mowhokam Creek-Fraser River	**215**	-	**-**	-	**-**	-	**215**	-
Nahatlatch-Fraser rivers	**255**	-	**-**	-	**-**	-	**255**	-
Scuzzy Creek-Fraser River	**40**	-	**-**	-	**-**	-	**40**	-
Ainslie creek	**60**	-	**-**	-	**-**	-	**60**	-
TSA total	**1655**	745	**255**	-	**-**	-	**1910**	745
Regional total	**1655**	3200	**255**	515	**-**	-	**1910**	3715

Forecast

An average 48 egg masses/10m^2 foliage (range 39-65) were collected at 3 locations in the Fraser TSA, down by more than half from an average of 109 recorded at one site in 1993 (Table 2). No egg sampling was done in the Soo TSA due to the population collapse, which was indicated through egg mass sampling in 1993. The egg mass data indicates the potential for continued light to moderate defoliation in the Nahatlatch and Fraser River areas of the Fraser TSA in 1995. However, the 40% decrease in the number of egg masses in the 4-barrel main area, the oldest part of this infestation, may be the first indication of a declining population. The presence of disease and parasitism may also have a detrimental effect on budworm populations and resulting defoliation.

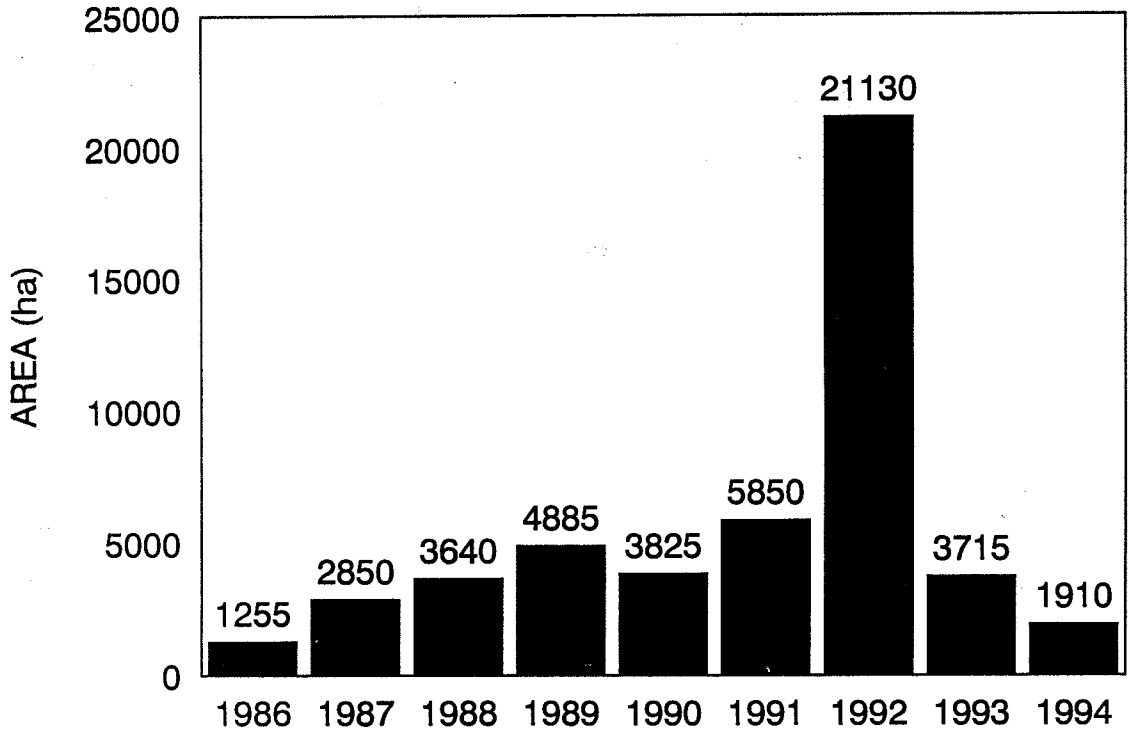

Figure 3. Area of Douglas-fir defoliated by the western spruce budworm, 1986-1994, Vancouver Forest Region.

Table 2. Predicted 1995 spruce budworm defoliation based on egg mass surveys, Vancouver Forest Region, 1994.

Location	Avg. no. of egg masses/10m^2 of foliage/plot		%increase decrease	Defoliation[1]	
	1994	1993		1994	**1995 (predicted)**
Fraser TSA					
Hannah Creek (4-barrel main)	**65**	109	-40	Moderate	**Moderate**
Log Creek[2]	**39**	-	-	Moderate	**Light**
Mowhokam Creek	**40**	-	-	Light	**Light**
Average	**48**	-	-		

[1] 1-50 egg masses/10 m^2 = light defoliation
51-150 egg masses/10 m^2 = moderate defoliation
151+ egg masses/10 m^2 = severe defoliation

[2] Log Creek samples taken from +/- 20 year old young stand, defoliation was not visible from the air.

The pheromone trapping portion of a budworm sampling project started in 1987 to detect increasing populations was expanded in 1994. Pheromone-baited dry "Multipher" traps to attract adult males (Table 3) were placed (5/site) in each of five areas of previous budworm activity: Skagit Valley, Anderson River, Rutherford Creek, Devine, and Alexandra Bridge Provincial Park. The average number of moths per trap decreased by an average of 83% (range 75-91) at two of three sites trapped previously, while numbers remained very low at the third site. No defoliation was recorded at any of the sites.

Some relationships develop when analyzing number of moths and total annual area defoliated. The regional area of budworm defoliation from 1991 to 1992 almost quadrupled. This increase is reflected in the numbers of moths trapped, all sites trapped an increasing number of moths from 1991 to 1992. In 1993 the area defoliated was almost 5 times less than 1992, with a corresponding decrease in the number of adults trapped. In 1994, the area defoliated was almost half that of 1993, and there was also a decrease in numbers of moths caught at trap sites.

Initial studies from evaluation of trapping data from 11 sites province-wide over 8 years, using the same pheromone lure and dry traps suggests that, depending on how defoliation is classified, anywhere from 275-450+ moths indicate a 70-90% chance of light to severe defoliation.

Work is continuing at determining threshold levels, based on results from traps at these and other sites province-wide.

Table 3. Comparison of 1991-1994 pheromone sampling results at spruce budworm calibration plots in the Vancouver Forest Region, 1994.

Location	Avg. no. moths/trap				Average defoliation at plots			
	1994	1993	1992	1991	**1994**	1993	1992	1991
Fraser TSA								
Anderson R.	**17**	68	257	49	**none**	none	trace	none
Skagit Valley	**<1**	<1	*16	4	**none**	none	none	none
Alexandra Bridge**	**16**	-	-	-	**none**	-	-	-
North Bend[1]	-	***28	127	*94	-	none	none	none
Soo TSA								
Devine[2]	***29**	-	306	150	**none**	-	trace	trace
Rutherford Creek[3]	***13**	141	-	-	**none**	none	-	-

* Average of 4 traps, 1 destroyed

** New site in 1994

*** Count from 1 trap, 4 destroyed

1 Site logged in 1993, dropped in 1994

2 Dropped in 1993, re-instated 1994

3 New site in 1993

Douglas-fir beetle
Dendroctonus pseudotsugae

The area containing recent beetle-caused Douglas-fir mortality decreased to about 280 ha in 243 infestations, down from 360 ha in 312 infestations in 1993 (Table 4). Most mortality occurred in expanding infestations in the Mid-coast TSA near Bella Coola. Mortality in the Fraser TSA declined, while the area affected by the beetle in the Soo TSA remained similar to last year. Douglas-fir beetle attacks on Vancouver Island are mainly restricted to trees predisposed by root rot and are generally found in small pockets of 1-5 trees in east coastal areas of southern Vancouver Island.

Fraser TSA

The area of beetle-attacked Douglas-fir declined to about 100 ha in some 70 infestations, from 240 ha in 155 infestations in 1993. Declines occurred in most areas previously infested, with a significant reduction in area in the Anderson River, Fraser Canyon and associated drainages; at Sumas Mountain; and in Foley and Tamihi creeks, tributaries of the Chilliwack River. Infestations in the Fraser Canyon and Anderson River areas declined to single tree and small groups of trees, mainly between Yale and Boston Bar. In the Chilliwack River Valley, no recent mortality was mapped at Foley or Tamihi creeks. No new mortality was recorded at Sumas Mountain, where salvage logging and single tree removal has been occurring for two years. An increase in beetle-caused mortality was recorded east of Hope, on ridges above the Coquihalla highway. Some of these infestations, totaling up to 20 ha, were not recorded during aerial surveys, but were observed or reported from ground observations.

Soo TSA

The area of recently killed Douglas-fir remained similar to last year, 40 ha were recorded in 48 infestations, the same as last year when 40 ha were recorded in 32 infestations. Infestations were recorded near Glacier Lake, both within and adjacent to Garibaldi Provincial Park, between Lillooet and Harrison lakes, similar to last year. Infestations in the Park are being looked at for trap tree programs in attempts to reduce populations. Trap tree and salvage logging is also scheduled for forest areas outside the Park. Spot infestations were recorded along the east side of Lillooet River and Lake, from Rogers Creek to Joffre Creek, although previous infestations in the Twin One Creek area declined. A few small areas were also mapped in the Birkenhead River and Gates Lake areas.

Table 4. Area of Douglas-fir beetle caused mortality, Vancouver Region, 1994.

	Area (ha)		No. of Infestations	
TSA	**1994**	1993	**1994**	1993
Fraser	**100**	240	**70**	155
Mid-Coast	**140**	80	**125**	125
Soo	**40**	40	**48**	32
Totals	**280**	360	**243**	312

Mid-Coast TSA

The area of recent mortality almost doubled to 140 ha over 125 infestations from 80 ha in 125 infestations in 1993. Mortality expanded in previously infested areas in the Dean, Talchako, and Atnarko river valleys near Bella Coola.

Populations are expected to remain at similar levels in 1995, based on historical patterns. The beetle prefers material such as felled trees, slash (over 20 cm diameter), stumps, overmature trees, and trees damaged by drought, root rot, logging and road building. Surveys to delineate areas infested by this pest will continue.

Phantom hemlock looper
Nepytia phantasmaria

Moderate to severe defoliation of mainly semi-mature to mature trees occurred in a residential area in the municipality of Burnaby, in the Greater Vancouver area, this year. FIDS was notified of the infestation by the British Columbia Forest Service regional entomologist. This is the first recorded outbreak of this looper since 1982 when defoliation was recorded at Coquitlam lake.

Defoliation was recorded mainly on Douglas-fir over several square blocks in southeastern Burnaby, between Southeast Marine Drive and Rumble Street, and between Gilley and Macpherson Avenues. Most trees were moderately defoliated, with some severely defoliated and a few trees completely top-stripped. Large accumulations of frass were evident on municipal streets, sidewalks alleys and gutters throughout the area. Although Douglas-fir recovers well, repeated defoliation could cause top-kill or even tree mortality. Reports from area residents indicate that this is the second year of noticeable defoliation. Some defoliation, numerous larvae, and a large moth flight apparently occurred in the summer of 1993.

Previous outbreaks of this pest have occurred in urban areas of Greater Vancouver and Hope, including; Central Park in Burnaby, Queen's Park in New Westminster and Hope Municipal Park in 1956-57. Douglas-fir and western hemlock were reported killed at Queen's Park, but not at Hope, Central Park or Coquitlam Lake.

Past outbreaks by this looper have collapsed following one to two years of defoliation. The Queens, Central and Hope Parks infestations were sprayed with D.D.T. The Coquitlam Lake outbreak collapsed due to high levels of disease. Initial data from two mass collections have found low levels of parasitism, average 3% (range 1-10) in three mass collections, and no initial indications of disease. Unless egg parasitism or disease levels area high, the outbreak may continue into next year. Anecdotal reports from Vancouver Parks and Recreation staff indicate another large moth flight occurred in August of this year, a further indication that high populations may may be expected next year.

This area will be monitored by FIDS in 1995.

Armillaria root disease
Armillaria ostoyae
Laminated root rot
Phellinus weirii

These two root rots are chronic problems and were commonly found in all age classes of Douglas-fir stands throughout the Vancouver region in 1994. The information on detection of these root rots came mainly through young (<25-year-old) stand surveys (see POYS section)

conducted annually in the region. Random collections, specific requests for identification of causes of tree mortality, as well as Parks surveys, provide further data on these diseases.

Tree mortality caused by *A. ostoyae* was detected in 10% of young stands surveyed for pest problems on Vancouver Island and Mainland locations. Mortality averaged 3% (range 1-6%) of Douglas-fir in these stands. Armillaria root disease also killed young to semi-mature trees near the ARNEWS plot in the Seymour Demonstration Forest. Although *P. weirii* is mainly associated with semi-mature to mature trees, it was also detected in young stand surveys. Two percent of young stands surveyed had mortality due to laminated root rot, with 2% of the trees killed. Laminated root rot is widespread throughout the Fraser Canyon and Anderson River areas where Douglas-fir beetle attacks are associated with root rot-stressed trees.

Reports of Douglas-fir mortality near Powell River were investigated during surveys in September of this year. The mortality, which occurs in small pockets resembling root rot mortality, was first reported in stands on Goat Island, in Powell Lake. Although root rot is the suspected cause of this mortality, samples collected and received to date have not confirmed root rot as the causul agent.

During boat surveys in September, pockets of mortality ranging from a few trees to several hectares were observed from the Goat Island area in Powell Lake to the mouth of Powell River, at the head of the lake. The mortality, (recently dead and dying, as well as old dead trees), covered an estimated 20+ ha in 50-60 pockets. Although most of the mortality occurred and was reported in the Powell River area, some pockets of similar mortality were sampled near Port Mellon and north of Squamish in the Squamish River Valley.

Ground sampling at two Powell River area sites, as well as at Port Mellon and the Squamish River, found only secondary *Armillaria* spp., but no primary pathogens. Although some of the mortality appeared to be two to three years old or more, most of the dead trees had died in the past two years. Arrangements have been made with both industry and B.C.F.S. personnel to obtain root samples from de-stumped trees at Goat Island and near Gibsons. Results from these samples will be reported at a later date.

Mortality from these root rots occurs annually, and will continue to occur throughout the range of Douglas-fir. Planting root rot resistant tree species, including some hardwoods, and push-over logging in some sites, are some of the management tools used in areas where severe root rot problems occur.

These root rot pathogens also infected other conifer species. Incidences are listed in the Other Endemic, Noteworthy and Minor Pests section of this report.

Pine Pests

Mountain pine beetle
Dendroctonus ponderosae

The area of lodgepole pine killed by mountain pine beetle attacks decreased for the second consecutive year (Figure 4). Current mortality was recorded over some 465 ha in 156 infestations, compared to 525 ha in 134 infestations in 1993. (Table 5). Although the area declined, the number of trees and volume killed increased due to most infestations classed in a higher severity rating. Volume loss increased to approximately 17 160 m^3 from 8085 m^3 last year. The estimated number of trees killed increased to 23 400 from 11 025 last year. Mountain pine beetle attacks were recorded in the Soo, Fraser, and the Mid-Coast TSA's (Figure 2).

Table 5. Recent mountain pine beetle-caused mortality in lodgepole pine as determined from aerial surveys, Vancouver Forest Region, 1994.

	Area (ha)		No. of trees killed		Vol. killed (m^3)		No. of infestations	
TSA	**1994**	1993	**1994**	1993	**1994**	1993	**1994**	1993
Soo	**330**	470	**15 300**	8925	**11 220**	6545	**123**	70
Fraser	**95**	50	**4 500**	1875	**3 300**	1375	**27**	50
Mid-coast	**40**	5	**3 600**	225	**2 640**	165	**6**	14
Sunshine coast	**-**	-	**-**	-	**-**	-	**-**	-
Total	**465**	525	**23 400**	11 025	**17 160**	8085	**156**	134

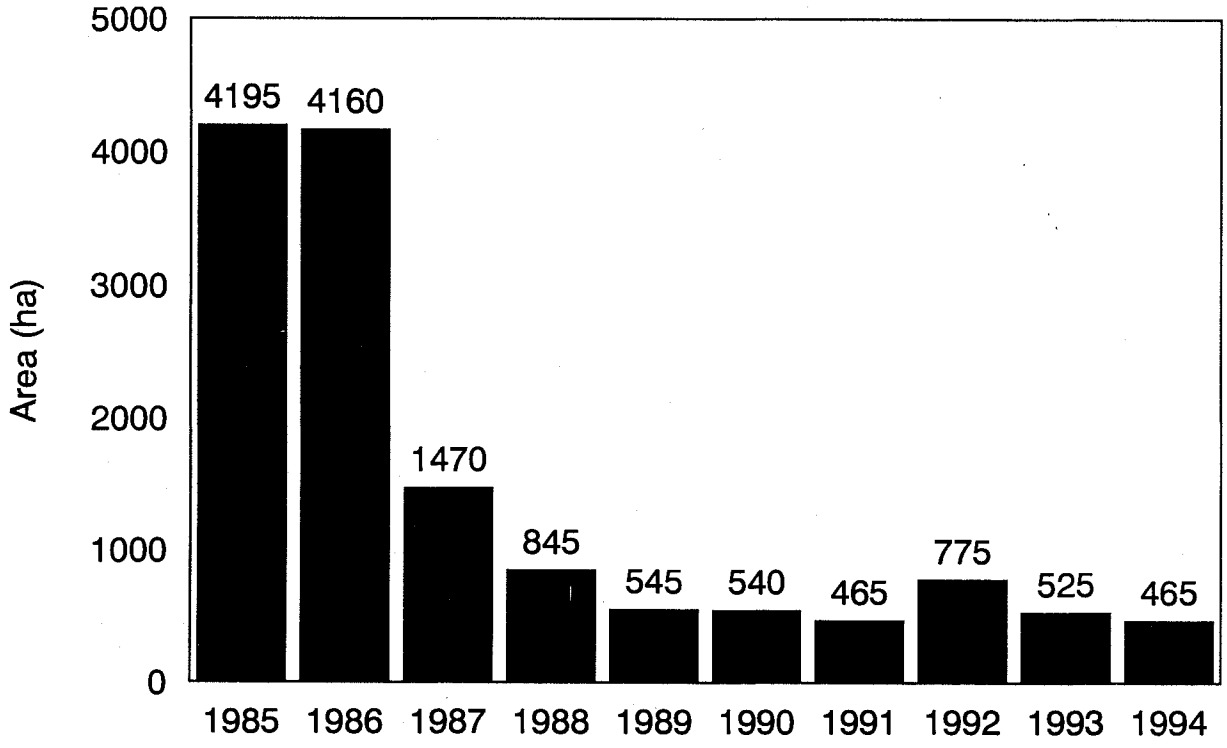

Figure 4. Mountain pine beetle, a ten year history by area, 1985-1994, Vancouver Forest Region.

Soo TSA

In the Soo TSA the area of attack decreased to 330 ha from 470 ha. This was mainly due to a decrease in the size of infestations. Salvage logging and to some extent host depletion, due to repeated attacks in the Birkenhead River area, contributed to this decline. While the size of infestations declined, the severity and overall number of infestations increased. The largest and most intense infestations continued in the Birkenhead River and Lake areas. Smaller, spot infestations continued in the Blackwater Creek and Gates River areas, as well as the Birkenhead River Valley including Spetch Creek. Infestations also continued at the mouth of Joffre Creek, as well as a few spot infestations south of Joffre Creek along Lillooet Lake and River. Pheromone trapping to contain infestations, as well as salvage logging, mainly in the Birkenhead area, is continuing.

Fraser TSA

Most mountain pine beetle mortality in this TSA continues to occur in Manning Park. The 90 ha recorded in the Park this year, mainly in the eastern portions of the park, was interpolated from maps supplied by the Park staff. Although this is a doubling of the area recorded last year, part of this increase can be attributed to the transfer of data from one map scale to another. The Park, through contracts, is continuing with cut and burn, as well as Monosodium methane arsenate (MSMA) treatment of attacked trees. The continuing lack of beetle activity in the Fraser Canyon area is largely a result of host depletion and harvesting of previously infested stands.

Mid-coast TSA

Mortality continued in the Dean River area, northwest of Bella Coola, where approximately 40 ha of mortality was recorded in 6 infestations, up from 5 ha in 14 infestations recorded last year. This is the second consecutive year of increasing mountain pine beetle-caused mortality in this TSA. Previous to last year, 5 ha were recorded in 13 infestations in the same general area in 1990.

Sunshine Coast TSA

For the sixth consecutive year, no significant beetle attacks were mapped in this area. Only occasional scattered single tree attacks were reported. As recently as 1986, an estimated 2770 ha of infested lodgepole pine were mapped along the Homathko River.

Pinewood nematode
Bursaphelenchus xylophilus

No new surveys for the Pinewood nematode were conducted in 1994. However, a survey initiated in the region in 1993, was completed. A bait log trial, one of three in the province to support a possible exemption for western hemlock, from the European communities' ban on green lumber, was completed in 1994.

The bait log trial initiated in 1993 north of Pemberton was completed this year. Eighteen 1m long western hemlock, and twelve 1m long lodgepole pine bolts, which were cut from green, standing, healthy trees, had been placed at the study site (a 1990 wildfire) in 1993. Samples to determine the presence of pinewood nematode were taken from both species when they were originally cut in 1993, prior to their placement at the field site north of Pemberton. No pinewood nematode was found in the lodgepole pine, (taken from a natural stand near Rutherford Creek), or the western hemlock, (taken from a natural stand near Ring Creek), prior to their placement in the field. The logs were removed to the British Columbia Forest Service

field station yard in Pemberton in September of 1993, and in 1994, were sampled for the type and severity of insect attack, as well as being re-sampled for pinewood nematode. No pinewood nematode was found in these logs, although nematodes from two common families, Tylenchidae and Rhabditidae, were isolated from samples. Several different types of Cerambycidae, (roundheaded) and Buprestidae, (flatheaded) woodborers were recovered from these logs, however, no sawyer beetle, *Monochamus* sp., the suspected vector of pinewood nematode, were found. Sawyer beetle was recovered from bait logs of both species placed at this same site during a 1992 bait log study.

Between 1980 and 1992, periodic surveys for the nematode were conducted in natural stands throughout British Columbia and the Yukon Territory. Extractions from samples collected during these surveys found only six individual predisposed trees, from widely scattered locations, and one sawyer beetle, *Monochamus clamator* Hald., to contain pinewood nematode. In 1992, log bolt studies were initiated at 11 sites in six regions. From the 550 extractions done during the 1992 study, pinewood nematode was present in 13% of pine, and none of the western hemlock samples.

Unless the political and scientific communities disagree over current findings, pinewood nematode studies will not be carried out in B.C. next year.

Pine shoot beetle
Tomicus piniperda

No pine shoot beetles were found during surveys to detect the presence of this introduced pest. Over 2000 Scots pine Christmas trees, as well as cut and damaged stems and branches, were surveyed at 6 sites in the lower mainland, and one site, near Mill Bay, on Vancouver Island. Between 100 and 500 trees were examined at each location for any evidence of insect activity. The lower mainland sites examined ranged from Richmond, near Vancouver, to past Chilliwack, in the upper Fraser Valley.

This insect is considered a serious pest in Europe and Asia. Adults feeding on shoots, cause branch mortality, and in heavy infestations, serious growth reduction. Attacked trees stressed by environmental factors, (drought, etc.) have died. The beetle was first detected on Christmas tree stock in Ohio in 1992. It has since been found in six states and, in 1993, was found in Southern Ontario. FIDS in this region will continue to survey for the presence of this introduced pest.

European pine shoot moth
Rhyacionia buoliana

There was no reported or observed activity of this pest in native trees in 1994. Infested Douglas-fir and adjacent Scots pine found in Richmond in 1989-90, were destroyed following confirmation of the shoot moth in native Douglas-fir. There was also no evidence of attack in Douglas-fir growing in close proximity to infested Scots and Austrian pine surveyed at a Richmond location for the third consecutive year.

The shoot moth is an established pest in ornamental pines on Vancouver Island from Victoria to Courtenay, in the Fraser Valley from Vancouver to Chilliwack, and in the Okanagan Valley. Up to 50% or more of new tips of Scots pine Christmas trees were infested at on location near Chilliwack, as well as in ornamental Scots pine at some greater Victoria sites. A major concern is the possible spread of this pest into native trees. Surveys of Douglas-fir and other native trees growing in close proximity to infested ornamentals will continue in 1995.

Pine needle cast
Lophodermella concolor

Pine needle cast increased in distribution and severity throughout the host range in the Vancouver region in 1994. Some 200 hectares of discolored, younger, lodgepole pine stands were recorded during aerial surveys. Discolored pine stands were observed in the Lillooet River Valley and in eastern drainages off the Coquihalla Highway. Infected pine were also noted during ground surveys in the Pemberton area, and the Skagit Valley. Widespread discoloration of year-old foliage was observed over a large, but undetermined area, of lodgepole pine, in the eastern half of Manning Provincial Park. Lodgepole pine needle cast in Manning Park is almost endemic, but has been particularly severe the past few years. Many trees have only the current year's foliage left on them after repeated severe infections. Pine needle cast was also common on shore pine along east coastal areas of southern Vancouver Island. A secondary blight fungus, *Hendersonia pinicola,* often found in conjunction with *L. concolor*, was collected near Pemberton.

Spruce Pests

Spruce beetle
Dendroctonus rufipennis

Spruce beetle populations remained at endemic levels for the eighth consecutive year. Increasing attacks in the Merritt Forest District spilled over into the extreme eastern portions of the Chilliwack Forest District. Approximately 50 ha of recent mortality was reported in two areas near the Coquihalla highway summit, east of Mt. Henning, near the Coquihalla lakes.

The infestation in the Vancouver region is not expected to cause extensive mortality as the mature spruce component is only located at the height of land in this area. The spruce component rapidly gives way to Douglas-fir and other species. The BCFS and FIDS will monitor spruce beetle populations in this area next year.

Elsewhere in the region, no spruce beetle attacks were observed or reported in standing or down spruce. The mature Englemann spruce component through most of the southern portion of the Vancouver region is low, and beetle populations should not pose a serious threat.

Spruce weevil
Pissodes strobi

The spruce weevil continues to be a significant pest of immature Sitka spruce leaders throughout the host range in the region. Spruce was a component in 10 young stands surveyed in the Region this year. An average of 42% (range 1-100) of spruce in 6 of the 10 stands surveyed were attacked by spruce weevil. One of the stands with weevil attack was an Engelmann spruce stand in the Anderson River drainage, only 1% of the spruce was attacked in this stand. In another Engelmann spruce stand surveyed, in upper Mowhokam Creek, no weevil attack was recorded. The other 3 stands where no attack was recorded were in low spruce weevil hazard areas on northern Vancouver Island.

Weevil attack has been a chronic problem in the Vancouver region for several decades. Mild winters and warm summers, along with the establishment, through reforestation, of abundant preferred host material, have resulted in continued weevil attacks. Repeated attacks by the weevil can lead to a reduction of merchantable volume at rotation age due to crook, stem

decay, and other deformities. Current research efforts at the Pacific Forestry Centre, in conjunction with the B.C.F.S. are focusing on resistant trees, biological control, stand density and species mix, tree resistance, and deciduous overstory/overtopping effect.

True Fir Pests

Western balsam bark beetle-fungus complex

Dryocoetes confusus, Ceratocystis dryocoetidis

Balsam bark beetle killed some 71 660 alpine fir over 1320 ha in 1994, up from 9340 trees over some 530 ha in 1993. The volume of timber killed increased to 78 035 m^3 from 10 170 m^3 in 1993 (Table 6). The large increase is a result of expanding infestations in the Mid-coast TSA. Elsewhere in the Vancouver Region, the area of mortality due to balsam bark beetle declined slightly.

This is the second year of increased mortality due to balsam bark beetle attacks in the Mid-Coast TSA. Infestations expanded and intensified in Crag Creek, a tributary of the Dean River, north of Bella Coola.

This beetle is a chronic pest in many subalpine fir stands in the Region. The sporadic and frequently remote occurrence and the retention of red foliage for several seasons makes a consistent and accurate annual assessment of the damage caused by this pest difficult. Surveys to delineate damage caused by the bark beetle-fungus complex will continue next year.

Table 6. Estimated true fir mortality by western balsam bark beetle-fungus complex, by TSA, as determined from aerial surveys, Vancouver Forest Region, 1994

	Area (ha)		Number of trees killed		Volume killed (m^3)	
TSA	**1994**	1993	**1994**	1993	**1994**	1993
Fraser	**260**	280	**2925**	3150	**3185**	3430
Soo	**50**	100	**560**	1125	**615**	1225
Mid-Coast	**1010**	150	**68 175**	5065	**74 235**	5515
Total	**1320**	530	**71 660**	7315	**78 035**	7965

Balsam woolly adelgid

Adelges piceae

Surveys to delineate the extent of active balsam woolly adelgid (BWA) populations both within and outside the 1992 BWA quarantine zone were expanded in 1994. Samples were taken from young stands, residual trees adjacent to young stands, and mature stands region-wide.

Although no new populations were found, reports of populations causing gouting on true fir in the Birkenhead River area, south of Birkenhead Lake, were confirmed. This area, north of Pemberton, is outside the (1992) quarantine zone. Current stem attack was found on alpine fir in this area, and at one site north of Birkenhead Lake, the first reported stem attack in a number of years in the Vancouver Region. Gouting was also evident on both amabilis and alpine fir regeneration at this site. As well, active populations causing gouting and crown deformity in 30-40 year old residual trees were collected near Lyon Lake, in the Caren range, a mid-to-high elevation site on the Sechelt Peninsula, an area within the current quarantine zone. The BCFS had made preliminary collections in both of these locations, but positive identification from recent samples was only confirmed through FIDS sampling this year. Extensive surveys by the BCFS in the Whistler area, within the quarantine zone, and at Pemberton, just outside the zone, found a number of positive samples.

Further sampling was also conducted in the Labor Day Lake area, south of Port Alberni, where active populations and recent gouting and top deformity in young, 20-25 year-old, amabilis fir were first found in 1993. Aerial surveys, conducted by industry, found about 10 ha of recent mortality, attributed to BWA attack, south of Labour Day Lake. Mature amabilis fir were also found to be infested in the Caycuse River Drainage, west of Cowichan Lake. All of these sites are within the BWA quarantine zone.

Attempts to obtain samples from mature amabilis fir in the Oyster River Drainage, west of Campbell River, were negative. Positive samples were collected from this site, outside the quarantine zone, by a contractor collecting cones from the crowns of mature trees in 1993. Additionally, efforts to obtain samples of gouted amabilis fir from Tikwalis Creek, near Spuzzum in the Fraser Canyon, were negative. Samples of apparently gouted amabilis fir were collected by a contractor at this site, also outside the quarantine zone, early in 1994. Follow up surveys this year were unable to find further evidence of active populations.

In addition to the above, surveys were undertaken in immature *Abies* in 25 randomly selected young stands, outside the quarantine zone, on Vancouver Island and Mainland areas. All of these surveys were negative. The young stands, ranging in age from 10-25 years and ranging in elevation from near sea level on Vancouver Island to over 1000 metre's in mainland areas, were surveyed using the standard FIDS Pest of Young Stands (POYS) methodology (see POYS section). Besides ocular determination of BWA symptoms, branch samples from dominant trees in each plot were submitted for evidence of BWA. Additional branch samples, taken from residual and semi-mature to mature trees adjacent to these stands, were also negative.

An extensive, joint survey and sampling system will be conducted by the BCFS and FIDS in areas outside the quarantine zone, next year.

Hemlock Pests

Western hemlock looper
Lambdina fiscellaria lugubrosa

Western hemlock looper populations remain at endemic levels in southwestern B.C. Pheromone traps, placed at 3 locations region-wide, were part of a province-wide effort to calibrate a pheromone trapping system for the early detection of looper outbreaks. Two different types of traps and lures were used. The test between trap types and lure strengths was also duplicated province-wide in order to finalize the type of trap and strength of lure to be used in this ongoing program.

Pheromone traps were placed on the mainland, for the second consecutive year, at Rolley Lake Provincial Park and the University of British Columbia (U.B.C.) Research Forest. Additionally, traps were placed, for the first time, near Port Renfrew, on Vancouver Island. All of these sites have a previous history of either high looper populations, or outbreaks of the looper. Low numbers of larvae were detected through standard FIDS beating samples at the lower mainland sites, but not at the Vancouver Island site. No defoliation was detected at any of these sites.

Tentative thresholds for predicting outbreaks have been set, for universal traps baited with a 10 microgram lure: > 5000 adults indicates potential for severe defoliation; > 2500 - 5000 adults, potential for moderate defoliation; 400 - 2500 adults, potential for light defoliation; < 400 adults indicates nil defoliation. All of the Vancouver Region sites fall into this last category. This program will continue in the Vancouver Region in 1995.

Hemlock woolly adelgid
Adelges tsugae

High populations of this adelgid, which have caused branch and inner crown die-back at CanFor's Sechelt Seed Orchard, were reduced this year through applications of test products used as pesticides. Elsewhere, populations at other coastal seed orchards and throughout the host range remained similar to 1993.

A pulp mill by-product, Tall Oil, applied at 1 and 2% rates, was the most successful of 4 different products tested in order to reduce the high populations which had been building up at this site. The highest rates of crawler mortality were seen when trees treated with Tall Oil were compared to control trees, as opposed to trees treated with a dormant oil, Safer Insecticidal soap, and Metacystox. Seed orchard staff will be using the Tall Oil in a dormant oil-type of application early in 1995 to reduce populations. Previously, high adelgid populations had caused foliar discoloration, and branch and inner crown die-back on trees severely infested for one and two years.

In an international cooperative effort, a native predator beetle, *Laricobius nigrinus,* was collected from Vancouver Island and shipped to the United States. The beetle is found in association with high adelgid populations, a phenomenon which sometimes occurs in some coastal seed orchards. The adelgid is normally found at low levels throughout the range of western hemlock in B.C. The overwintering adults were collected and sent to the U.S. to try and help reduce hemlock woolly adelgid populations in the northeastern states, where the adelgid, introduced from Asia, is causing severe damage to eastern hemlock. The possibility of using the beetle as a biological control agent will be tested on hemlock adelgid populations at the Northeastern Centre for Forest Health Research in Pennsylvania.

Multiple Host Pests

Pests of young stands

A total of 41 young stands were surveyed for pest incidence and intensity in the Vancouver region in 1994. These stands ranged in age from 4-to 30-years old, and were located in 4 Biogeoclimatic zones: Coastal Western Hemlock, Coastal Douglas-Fir, Interior Douglas-Fir and Engelmann Spruce-Subalpine Fir. A total of 4592 trees representing 12 species were examined, of which 3320 (72%) were pest-free.

This is the fifth year of the current young stand survey format, and the level of pest free trees after the past 5 years of surveys averages 69% (range 54-86) in young stands in this region. Root diseases, while causing the most damage, continue to occur at low levels in stands surveyed. Needle diseases and gall adelgids continue to be very common, but, because they have been recorded at generally low levels, have caused little long term damage.

Less than half of the surveys (34%) were in stands that had been treated under the Forest Resources Development Agreement (FRDA). This years POYS surveys in the Vancouver Region were concentrated in true fir stands, and not many of these stands received treatment under the FRDA agreement. The different silvicultural treatments examined were: spacing, spacing and fertilizing, and mechanical brushing and weeding, representing 58, 14 and 14% of stands, respectively. Two other treatments including: chemical brushing and weeding aerial application; and spacing and pruning, were each 7% of stands examined. The results of the survey are summarized in Table 7. Minor pests, or pests that affected only a few trees, are not included in the table.

Eight of the 41 young stands surveyed were classified as impact category 4 (see Appendix 1). This shows a level or type of pest damage that indicates a resurvey (within 2-5 years) of the stand might be necessary to assess stocking levels and acceptability of stem form. Root diseases and top deformities were the main reason for this recommendation.

Needle disease fungi were the most common pest encountered, affecting 275 trees overall, (6% of all trees surveyed). Poor form, (including crook, sweep, fork, multiple tops and dead tops), winter damage (causing red foliage) and the Cooley spruce-gall adelgid were the next most common pests, affecting 244, 243, and 240 trees (5% of all trees surveyed, each) respectively. The most damaging pests were root diseases, including Armillaria root disease and laminated root rot, which affected 18 trees (<0.5% of the total trees surveyed). These root diseases were present in 27% of the stands surveyed.

Although 12 tree species were recorded during the young stand survey, only 8 are included in the table (amabilis and alpine fir are lumped together under the true fir heading). Two of the other 4 species, western larch and lodgepole pine, totaled less than 10 trees surveyed each, with no pests recorded. The other two species were: Ponderosa pine, which totaled 37 trees, of which one tree was browsed, and one tree had a dead top; and western white pine, which totaled 24 trees, with no pests recorded

Table 7. Summary of pests of young stands surveys, by host and pest in descending order of importance, Vancouver Forest Region, 1994.

Host/pest	Severity index[1]	Affected no. of trees	Affected no. of stands	% of trees affected[2] average	% of trees affected[2] range
True firs - 1828 trees in 33 stands, 1032 trees (57%) pest free (amabilis and alpine fir)					
Armillaria root disease	6	4	3	1	1
Balsam woolly adelgid	4	7	1	6	6
Browse	4	25	3	7	4-13
Poor form (crook, fork, sweep, multi top, dead top)	3-4	159	28	5	1-17
A shoot boring sawfly	3	6	1	5	5
A tip moth	3	137	3	40	11-71
Winter damage (red foliage)	2-3	244	8	29	1-73
Fir-fireweed rust	2-3	224	8	22	1-85
Western hemlock - 1250 trees in 39 stands, 1232 trees (99%) pest free					
Poor form (crook, fork, sweep, multi-top, dead top)	4	3	2	1	1-2
Sirococcus tip blight	3	14	3	3	1-8
Douglas-fir - 758 trees in 22 stands, 481 trees (64%) pest free					
Armillaria root disease	6	11	4	3	1-6
Laminated root rot	6	2	1	1	1
Spruce budworm	4	60	3	20	1-48
Poor form (crook, fork, sweep, multi-top, dead top)	3-4	63	13	4	1-14
Cooley spruce-gall adelgid	2-3	142	5	28	1-84
Western red cedar - 210 trees in 21 stands, 198 trees (93%) pest free					
Browse	4	2	2	1	1
Poor form (crook, fork, sweep)	3-4	6	3	2	1-3
Sitka spruce - 312 trees in 7 stands, 242 trees (78%) pest free					
Spruce weevil	4	70	7	8	1-22
Engelmann spruce - 103 trees in 2 stands, 18 trees (18%) pest free					
Armillaria root disease	6	1	1	1	1
Spruce weevil	4	1	1	1	1
A tip moth	3	91	2	28	11-46
Cooley spruce-gall adelgid	2-3	98	2	30	14-47
Yellow cedar - 57 trees in 7 stands, 47 trees (83%) pest free					
Poor form (crook, sweep)	4	8	2	3	3

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

[2] Percent of trees affected includes all trees from stands in which the pest occurred.

Acid Rain National Early Warning System (ARNEWS)/Biomonitoring plots

Annual assessments of tree condition, mortality, acid rain symptoms, and insect and disease conditions were made at the 11 ARNEWS/Biomonitoring plots in the Vancouver Region. These plots were established to detect early signs of damage to Canadian forests due to aerial pollutants, and to monitor changes in forest vegetation and soils. No acid rain symptoms were recorded on any vegetation at any of the sites.

Although chlorotic foliage was again common on amabilis fir, it was recorded on fewer trees, and at lower intensities than the past few years. The foliar discoloration was present in plots 910, 912, 913, and 914, all located in the north shore watersheds of Greater Vancouver. On average, 5% of the foliage, in the lower to mid crown, was discolored on about half (56%) of the trees, compared to an average of 10% discoloration on 98% of the trees last year. Samples taken this year found a secondary foliar blight, *Lophodermium uncinatum*, on chlorotic foliage. A needle blight, *Phaeocryptopus nudus*, which was present on chlorotic foliage the past two years, was not not found this year. Discoloration was most pronounced at the Capilano River plot (910), and the Coquitlam Lake plot (914). Natural foliar die-back in dense, closed canopy stands is likely the major cause of this discoloration.

About 5% of the western hemlock in half the mainland plots had <5% foliar discoloration, mainly chlorotic older foliage in the lower crowns. This was down slightly from last year, and was attributed to natural shading and competition in closed canopy coastal stands.

Less than 5% of the foliage was chlorotic on <1% of Douglas-fir in the Vancouver mainland and Vancouver Island plots. The chlorosis was restricted to older foliage in the lower crown, and was also attributed to natural die-back. Additionally, foliar thinning and discoloration caused by Swiss needle cast, *Phaeocryptopus gaeumannii*, which was present in 1993, was again recorded on Douglas-fir adjacent to plot 904 near Campbell River.

A die-back in salal, caused by *Phyllosticta gaultheriae*, present in 1993, was again present in sub-plots in, and adjacent to, plots 901, 903, and 916.

Tree mortality was recorded in seven plots where a total of 12 trees died (Table 8). The largest single cause of mortality was shading and suppression which killed 10 trees. Three of these ten trees were also attacked by the Pacific silver fir beetle, *Pseudohylesinus sericeus*. This bark beetle is often associated with stressed, dying trees. Additionally, two trees died as a result of storm damage. These two trees, which had most of the live crown broken off in previous years, finally died this year. The 1994 mortality represents <2% of the total number of trees in all the ARNEWS/Biomonitoring plots in the Vancouver region. To date 123 trees, or 17% of the total, have died, all from natural causes.

Armillaria root disease, caused by *Armillaria ostoyae*, was found in a recently dead amabilis fir off-plot tree in the Coquitlam Lake plot (914). A secondary root decay fungus, *A. sinapina*, was present in samples of recently dead, understory western hemlock, Douglas-fir and amabilis fir in plots 902, 910, 911, and 913.

Fungi associated with dead trees were collected adjacent to ARNEWS plots: the 'purple conk', *Trichaptum abietinum* (=*Polyporus abietinus*), causing a pitted sap rot, was collected from a standing dead western hemlock adjacent to plot 902; a decay fungus, *Perenniporia* (=*Poria*) *subacida*, which causes a white, spongy heart rot, was collected from a recently dead Douglas-fir in plot 911; and a saprophytic mushroom, *Naematoloma capnoides*, was collected from a standing dead western hemlock adjacent to plot 909.

Table 8. Current and cumulative tree mortality in ARNEWS/Biomonitoring plots, Vancouver Region, 1994.

Plot number and location	Tree sps[1]	Total trees at plot est.	Mortality 1994	1984-1993	Total	Cause in 1994
901-Shawnigan Lk.	dF	120	-	25	25	
	W	8	-	4	4	
	wwP	2	-	-	-	- -
902-UBC forest	wH	32	-	14	14	- -
	wrC	15	-	6	6	
	B	3	-	1	1	- -
903-Saltspring	dF	100	**2**	25	27	**shaded/suppressed**
	wrC	2	-	-	-	- -
904-John Hart Lk.	dF	30	-	1	1	
	lP	1	-	-	-	- -
909-Jones Lake	wH	57	**1**	8	9	**shaded/suppressed**
	dF	2	-	-	-	- -
	wrC	1	-	-	-	- -
910-Capilano R.	aF	57	**3**	10	13	**shaded/suppressed and Pseudohylesinus sericeus (B.B.)**
	wH	17	-	-	-	- -
	wrC	1	-	-	-	- -
911-Seymour R.	dF	36	**1**	6	7	**shaded/suppressed**
	wH	2	-	-	-	- -
912-Seymour R.	dF	24	-	4	4	- -
	wH	23	**3**	1	4	**2 old storm damage 1 shaded/suppressed**
	aF	5	-	-	-	- -
913-Or Creek	wH	46	-	1	1	- -
	wrC	20	-	2	2	- -
	aF	3	**1**	-	1	**shaded/suppressed**
	dF	2	-	-	-	- -
914-Coquitlam Lk.	aF	36	-	-	-	- -
	wH	29	-	-	-	- -
916-Saturna	dF	56	**1**	2	3	**shaded/suppressed**
	lP	1	-	-	-	- -
	wrC	1	-	1	1	- -
Total		732	**12**	111	123	
Percent mortality			**<2**	15	17	

[1] dF-Douglas-fir; W-willow; wwP-western white pine; wH-western hemlock; wrC-western red cedar; B-birch; lP-lodgepole pine; aF-amabilis fir

A biodiversity study was initiated at the Shawnigan Lake plot this year. Both pitfall and barrier traps were placed at the plot, and sampled every two weeks. Identification of the insects trapped, as well as an evaluation of the trapping techniques is still in progress.

The total number of trees at the time of plot establishment of plots 901-903 included trees less than 10 cm dbh. These tree were included before guidelines for minimum tree diameter were introduced. Most of the accumulated mortality in these plots has been a result of small diameter trees dying due to shading, suppression, and competition in dense, closed canopy stands. All but one of the dead trees in plot 916 were standing dead at the time of plot establishment.

These plots will continue to be monitored in 1995.

Top kill

Top kill in semi-mature and mature trees, mainly Douglas-fir but also western hemlock, has been observed and reported throughout the lower mainland over the past few years. The most noticeable areas where the phenomenon has occurred are along the north shore of the Fraser River, particularly Maple Ridge and Mission, although reports of top-kill have been received from Surrey, Chilliwack, and other areas. The top-kill occurs in urban and suburban areas as well as along the fringes of, and within, standing timber. Usually the most dominant trees in any area are top-killed.

Although there has been some speculation, no definite answers as to the cause of the die-back were determined until this year. In cooperation with the BCFS, Chilliwack District, samples of top-kill were obtained from recently felled Douglas-fir and western hemlock near Mission. Additionally, samples were obtained from a Douglas-fir near Gibsons that only started exhibiting top-kill symptoms this year.

All three trees were diagnosed as being winter damaged, followed by secondary pathogens which became established in the dead tops. The following canker-causing secondary organisms were isolated from these samples; *Dermea pseudotsugae* and *Valsa abietis* from Douglas-fir, and *Botryosphaeria tsugae* from western hemlock. The original damage was likely caused by a sudden temperature drop, probably the very low temperatures and high winds that have occurred in these areas in the late 1980's and early 1990's. These extreme weather conditions affected the upper-most, exposed crowns of dominant trees, causing frost cracks and scars that were colonized and exacerbated by the opportunistic fungi listed above.

Deciduous Tree Pests

Gypsy moth
Lymantria dispar

There were no adult male gypsy moths caught in 89 pheromone-baited sticky traps at 76 sites throughout the Vancouver Region, including two traps in the Bella Coola valley, in 1994. Most of the traps, placed and retrieved by CFS/FIDS were in Provincial Parks (52%) and private campgrounds (25%) and the remainder in national parks and defence lands, airports, ports, and rest areas.

In additional surveys, only 39 adult males (33 of the European strain and 6 of the Asian strain) were caught in 34 traps in nine locations, all in the Vancouver Forest Region, in traps

placed mostly by Agriculture Canada. This was down from 141 males in 100 traps at 15 locations in 1993. The six Asian biotype, confirmed by mitochondrial DNA analysis, were two more than in 1993, and the second year since the type was first found in B.C. in 1991.

Most of the adult males trapped in 1994 were at previously active areas including Chilliwack (15), Hope (8), Nanaimo (5, including 2 Asian), Oak Bay (2), and on Gabriola Island near Nanaimo (2). Additional males were trapped at Surrey (3 Asian), Burnaby (2), Langley (1 Asian), and New Westminster (1). This was the fourth consecutive year for catches at Chilliwack, Hope, Nanaimo, New Westminster, and Oak Bay; the second consecutive year at Gabriola Island; catches at Burnaby were new this year.

Increased catches of males of the European strain in 1993 at Hope, Whiskey Creek west of Parksville, Nanaimo, and continuing captures at Victoria, prompted aerial applications of *Bacillus thuringiensis* var. *kurstaki* (Btk., Foray 48B) in late April and May 1994. A total of 680 ha at five locations were treated in an effort to eradicate populations. Additionally, a 14 ha site in south Vancouver was treated from the ground with the same product. No males were caught in post treatment assessments at Whiskey Creek, south Vancouver and Victoria, but additional males were trapped at Hope (8) and Nanaimo (2).

The monitoring program in cooperation with Agriculture Canada (Plant Health), the British Columbia Ministry of Forests and the Canadian Forest Service/Forest Insect and Disease Survey, will continue in 1995, for the eighteenth consecutive year.

Winter moth
Operophtera brumata

Defoliation of boulevard, ornamental, fruit and other deciduous trees by the winter moth, continued at reduced levels in urban areas of Vancouver, and at a few locations in Victoria in 1994, down slightly from 1993.

Defoliation of deciduous hosts, including Norway maple, birch, ornamental plum and cherry, and fruit trees, was common in areas of the lower mainland, some for the sixth consecutive year. Boulevard trees had trace to light defoliation in south Vancouver and Point Grey, and in some areas of New Westminster. Trace to light defoliation was also recorded on fruit and other deciduous trees in Cloverdale, Surrey, Delta and Richmond.

Very light defoliation of Garry oak continued in the Victoria area in 1994, mostly in the Cattle Point, Lansdowne, Uplands, Christmas Hill and High Quadra Reservoir areas, some for the fifth consecutive year. Most trees were lightly defoliated, with occasional severe defoliation in the lower crowns. Some larvae were also found on Garry oak on Salt Spring Island.

In a cooperative program with City of Vancouver, Parks and Recreation and Natural Resources Canada, winter moth larvae, parasitized by introduced parasites, *Cyzenis albicans*, and *Agrypon flaveolatum*, were collected in the Victoria area in the spring of 1994. These parasitized larvae, which will be allowed to pupate in specially constructed rearing boxes, are being placed at 4-5 strategic sites in the south Vancouver area in the spring of 1995. It is hoped that the parasites, which should emerge from the infested winter moth pupae, will (over time) have the same positive effects as a similar program in the Victoria area. Parasite introduction into Victoria, in 1979-81, was considered successful in reducing winter moth populations. Tree banding is also continuing in the City of Vancouver.

There were no assessments of natural control factors in 1994. However, in 1993 parasitism by *Cyzenis* spp. probably C. *albicans*, averaged 9% at three sites in south Vancouver. These low levels of parasitism in the Vancouver winter moth population prompted

the attempt to introduce more parasites into the Vancouver population from known areas of high parasitism in Victoria.

Winter moth populations will continue to monitored in 1995.

A cottonwood sawfly
Nematus currani

Native black cottonwood on islands in the Fraser River and some foreshore areas, near Chilliwack, were defoliated by cottonwood sawfly over 600 ha, some for the fourth consecutive year. This is down from 730 ha in recorded in 1993, and is the first decline in the area defoliated since the infestation began in 1991.

Severe defoliation occurred over 100 ha, moderate over 200 ha, and light over 300 ha, down from 260 ha of severe, 365 ha of moderate, and 105 ha of light defoliation recorded in 1993. Most defoliation occurred from the Herrling Island group east of Agassiz to Matsqui Island near Mission, on islands within TFL # 43 managed by Scott Paper. The decline in area defoliated occurred mainly in the Herrling Island group, east of Agassiz, where the infestation began.

Native black cottonwood was the major host, although some hybrid poplars in managed plantations at Harrison Mills and Carey Island, as well as one or two other small islands, were again lightly defoliated. Defoliated trees usually produced new leaves. Growth loss occurs only after several years of severe defoliation.

The decline was attributed, in part, to infection by entomopathogenic fungi, *Beauveria* spp. and *Entomophthora* spp. These fungi were isolated from dead larvae collected in 1993, from infestations at Carey and Herrling Islands.

This is the first recorded outbreak of this native sawfly in British Columbia. Previously, defoliation had been limited to single or small groups of trees at widely scattered locations.

A poplar rust
Melampsora medusae f. sp. *deltoidae*

The poplar rust *M. medusae f.* sp. *deltoidae*, which is pathogenic and very damaging to many hybrid poplar clones used in commercial plantations, has not yet been collected from native cottonwood, *Populus trichocarpa* in British Columbia. It was found on hybrid poplars in the Fraser Valley and on Vancouver Island again this year, where it had first been found in B.C. in 1993.

Damage in British Columbia plantations was severe on susceptible *P. trichocarpa* x *deltoides* clones which were repeatedly defoliated. Commercial nurseries removed susceptible clones and replaced them with more resistant hybrids. Mortality of susceptible clones has not yet been reported in B.C., but occurred in plantations in the United States last year, where the rust has been established since 1991.

The Eurasian poplar rust, *Melampsora larici-populina*, discovered in Oregon and California in 1991 and in Washington State in 1993, where damage to hybrid poplar plantations has been limited, is still not known to occur in Canada.

Northern tent caterpillar
Malacosoma c. pluviale

Increased populations of the northern (western) tent caterpillar, were again common on Vancouver Island and some of the southern Gulf islands this year. Also, for the first time in this outbreak, defoliation occurred in the Powell River area and in some Fraser River tributaries near Boston Bar.

Alder, willow, apple and other fruit trees, were moderately to severely defoliated from Lund south to Powell River. In Powell River, tent caterpillar populations, in conjunction with apple ermine moth, *Yponomeuta malinella,* (see Other Endemic, Noteworthy and Minor Pests section) moderately to severely defoliated fruit trees. Defoliation south of Powell River to Saltery Bay was less severe, and none occurred from Earls Cove to Gibsons on the Sunshine Coast. Severe defoliation of alder and other deciduous species was also widespread for the first time on Texada, Harwood and Savory Islands near Powell River. Light defoliation of Sitka alder and willow was new at upper Log Creek in the Nahatlatch River drainage, at elevations above 1000 metre's. A few tents were observed in upper Mowhokam Creek, on the opposite side of the Fraser River.

Defoliation of deciduous trees and shrubs particularly alder, was again severe and widespread in patches in the Victoria area and on Saturna Island. Increased numbers of larval colonies occurred at widely scattered locations from Sooke to Campbell River, particularly in the Cowichan River estuary, and from Buttle Lake to Gold River. Small patches of alder were again totally defoliated over about one hectare at Myra Creek west of Buttle Lake in Strathcona Provincial Park, for the third consecutive year.

Egg mass surveys, at several locations on the Saanich Peninsula, east Vancouver Island, and Saturna Island generally found more than five overwintering egg masses per tree. These numbers of egg masses indicate the potential for continuing high populations and defoliation in 1995.

Jumping gall wasp
Neuroterus saltatorius

Discoloration and premature foliage loss of Garry oaks caused by the gall wasp on southern Vancouver Island, declined slightly overall in most areas for a second consecutive year. This followed annual increases in damage since 1986 when the gall wasp was first observed in the area. Severe leaf scorch, however, occurred for the first time at Deep Cove, Duncan and Maple Bay. Elsewhere, trees were moderately discolored from Sooke to Oak Bay and from Beacon Hill Park to North Saanich. Very light damage by low numbers of the wasp was again common north of Duncan and at Nanaimo. The gall wasp was found, for the first time, on Salt Spring Island near Fulford Harbour.

The continued decline in gall wasp populations, particularly south of Brentwood Bay was likely due to increased parasitism, predation, and host resistance. Parasitism of gall wasp populations averaged about 10% at six sites, similar to 1993. Populations are expected to continue to decline in 1995, mostly in areas where high populations have persisted for 4 or more years, particularly in the Beaver Lake, Royal Oak, and high Quadra areas.

Trees infested by the gall wasp are readily identified by the small (1.0 to 1.5mm) round mustard seed galls attached to the underside of infested leaves.

An Oak leaf phylloxeran

Phylloxera sp. near *glabra*

From 25-100% of the foliage on 10% of the Garry oaks throughout southern Vancouver Island was discolored and subsequently defoliated by the introduced phylloxeran (an aphid-like sucking insect). This was similar to previous years, and occurs on the same trees each year. This damage has progressively reduced tree vigor and has resulted in branch and occasional tree mortality.

Garry oaks have also been damaged by the phylloxeran on Galiano, Saltspring, Saturna, Hornby, and Thetis islands. Damage also occurred in east coastal areas on Vancouver Island north to Comox, and in an isolated Garry oak stand at Sumas Mountain near Chilliwack.

The phylloxeran is identified by examining the lower surface of affected foliage, which is covered with numerous minute orange insects resembling aphids. Predators of the phylloxeran were common, but still too few to effectively reduce populations.

Populations are expected to continue on chronically infested trees throughout much of the host range in 1995, and will continue to be monitored and reported by CFS/FIDS.

Dogwood leaf blight

Discula destructiva

Discoloration and premature defoliation of new foliage on western flowering dogwood was again common throughout much of the host range, but less severe than in 1993. Infection by the fungus, chronic in the region for over a decade, resulted in branch dieback and occasional mortality of heavily blighted understory trees.

Light to moderately blighted trees were visible from south of Boston Bar to Vancouver, from Squamish to the Sunshine Coast, and throughout most of the east coastal areas on Vancouver Island. Lower crown dieback and mortality of understory trees was most severe at Alexandra Bridge Provincial Park north of Spuzzum, and at Buttle Lake on Vancouver Island, where heavy blighting has persisted for several years. Trees at Alexandra Bridge had been moderately to severely defoliated by western winter moth from 1988 to 1991, thus weakening them and making them more susceptible to mortality from severe blighting.

Inoculum is retained on twigs, branches, and foliage. Infection occurs when rain splashing causes spores to disperse to adjacent new foliage in the Spring. Protection of ornamental trees can be aided by removing and destroying infected foliage on the ground, and pruning dead branches before leaf flush in the spring.

Bigleaf maple scorch

Leaf scorch of bigleaf maple in the region declined for the second consecutive year, following widespread moderate to severe discoloration in 1992. Scorched foliage was evident, at lower intensities, in stands on the lower mainland near Yale in the Fraser Canyon, and between Powell River and Lund and north of Sechelt. Trees on southern Vancouver Island and the Gulf Islands were also less noticeably affected except at chronically affected areas near Goldstream Provincial Park and the Malahat.

A bacterium, *X. fastidiosa,* was identified for the first time in 1992 in some, but not all, of the scorched maple leaves from Goldstream and Victoria on Vancouver Island, and from Stanley Park, Gates Lake, and Powell River on the mainland. This was determined by tests at

the Pacific Forestry Centre in Victoria using an Enzyme-Linked Immunosorbent Assay (ELISA) kit.

Little change is expected in the intensity or extent of damage in the region next year

Birch leafminers
Fenusa pusilla
Profenusa thomsoni

Birch trees throughout the mainland were moderately discolored by the birch leafminer, *F. pusilla*, for a third consecutive year. Discolored trees were again common throughout the upper Fraser Valley to near Yale, similar to last year. The amber-marked birch leafminer, *P. thomsoni*, increased in the Pemberton area but there was little visible damage.

Larvae mine the foliage resulting in wrinkled and blotched leaves, which prematurely turn brown, and gives the trees a scorched appearance. Repeated periods of severe defoliation, which in ornamental or shade trees may cause some die-back, can be controlled with proper use of a systemic insecticide. Damage in natural stands is mainly aesthetic and control is usually not warranted.

Fall webworm
Hyphantria cunea

Defoliation of hardwood trees and shrubs was again common and widespread in the lower mainland, as in 1993, but declined for the second consecutive year on the east coast of Vancouver Island, where defoliation had been severe between 1989 and 1992.

Numerous tents were again common on alder, birch, willow and various fruit, ornamental and shade trees, particularly in the upper Fraser Valley near Agassiz and Chilliwack, and in the Fraser Canyon from Hope and Yale. Lighter populations were seen between Yale and Spuzzum, Langley and the lower Fraser Valley, the Sunshine Coast and Powell River, and at Squamish and Pemberton. Populations declined in east coastal areas of Vancouver Island for a second consecutive year to a few widely scattered tents and very light defoliation, mainly in areas where defoliation of branches and occasional small trees was common in 1992.

Defoliation is usually limited to individual branches, however, when epidemic, trees can be totally defoliated. Infested branches can be clipped and burned to protect fruit and shade trees. Pesticides registered for use against leaf-chewing insects can be applied when young caterpillars are spinning webs, usually in early summer.

New Records of Occurrence and Distribution

A total of 15 fungus collections in the Vancouver Region were new records for British Columbia in 1994. Five were new records, and ten were new host records. These collections included needle and foliar blight fungi and rusts, mushrooms and saprophytes. Additionally, nine insect collections region-wide were new records in B.C. Four were new records, three were new host records, and two were new distribution records. These included tortricid moths, lady beetles, mites, jumping gall wasp, a leaf roller, and a weevil.

Other Endemic, Noteworthy and Minor Pests

Table 9. Other noteworthy and minor pests, Vancouver Forest Region, 1994.

Host and pest	Location	Remarks
CONIFERS		
Amabilis fir		
A needle blight fungus, *Lophodermium uncinatum*	Spuzzum Creek, Capilano River	Associated with foliar die-back.
A shoot boring sawfly, *Pleroneura* sp.	Higher elevation mainland stands	Lightly infested shoots in scattered locations.
Armillaria root disease, *Armillaria ostoyae*	Coquitlam Lake,	Off-plot trees infected at ARNEWS plot 914.
Fir engraver beetle, *Scolytus ventralis*	Railroad Pass	In recently dead fire-scorched trees.
Fir-fireweed rust *Pucciniastrum epilobii*	Region-wide	Common, mainly higher elevation sites, wherever abundant alternate host occurs.
Fir root bark beetle, *Pseudohylesinus granulatus*	North-central Vancouver Island	Common in predisposed, mature/ overmature trees in pockets in most drainages.
Pacific silver fir beetle, *Pseudohylesinus sericeus*	Capilano River	In recently dead trees in ARNEWS plot 910.
Douglas-fir		
A decay fungi, *Perenniporia subacida*	Seymour River	Colonizing trees previously killed by Armillaria root rot in ARNEWS plot 911.
A die-back, *Valsa abietis*	Port Mellon	In winter killed, dead top of mature, dominant trees.
A secondary fungus, *Dermea pseudotsugae*	Mission	In winter killed, dead top of mature, dominant trees.
A wood decay fungus, *Chondrostereum purpereum*	Agassiz	On Pinewood nematode bait logs.
Silver spotted tigermoth, *Lophocampa argentata*	Southern Vancouver Island	Light defoliation of branches; no long term impact.

Table 9. (Cont'd)

Host and pest	Location	Remarks
Swiss needle cast, *Phaeocryptopus gaeumannii*	Campbell River, Squamish River, Stave Lake areas	Moderate infections common in young stands in these areas.
Grand fir		
A bud midge, *Dasineura* sp.	Chemainus, Sooke	A few trees infested; rare.
Larch		
Larch sawfly, *Pristiphora erichsonii*	UBC Research Forest, Haney	Light to moderate defoliation of ornamentals.
Ornamental cedar, cypress, juniper		
Cypress tip moth, *Argyresthia* sp.	Greater Victoria	Moderate discoloration of ornamentals for 11th year.
Pines		
A needle blight fungus, *Lophodermium pinastri*	Duncan	Shore pine lightly blighted.
A pine sawfly, *Neodiprion* sp.	Coquitlam	Light to severe defoliation of ornamental pines common over several square blocks near Lougheed Hwy and North Road.
A secondary bark beetle, *Pityophthorus* sp.	Richmond	In dead and dying Austrian pine branches.
White pine blister rust, *Cronartium ribicola*	Host range	Branch and stem cankers common on western white and whitebark pines.
Sitka spruce		
Spruce aphid *Elatobium abietinum*	Host range	Common and widespread, mostly in coastal areas; damage varies annually.
Western hemlock		
A canker-causing fungus, *Botryosphaeria tsugae*	Mission	In winter killed, dead top of mature trees.

Table 9. (Cont'd)

Host and pest	Location	Remarks
A saprophytic mushroom, *Naematoloma capnoides*	Jones Lake	On recently dead tree adjacent to ARNEWS plot 909.
A shoot blight fungus, *Sirococcus strobilinus*	North Vancouver Island	Very light on 10% of trees; less severe than in 1993.
Armillaria root disease, *Armillaria ostoyae*	Maple Ridge, UBC Research forest	In standing, live trees. No crown symptoms, some basal resinosis. Mycelial fans under bark to 1.5m up bole from root collar. Also killing occasional young trees in plantations.
	Vancouver Island	Common in regeneration at 1% or less.
Dwarf mistletoe, *Arceuthobium tsugense*	Host range	Endemic, widespread.
Laminated root rot, *Phellinus weirii*	East Vancouver Island, Rolley Lake Provincial Park	Common throughout host range, particularly second growth. In pockets of dead/dying second growth.
Purple conk, *Trichaptum abietinum*	Maple Ridge, UBC Research Forest.	On standing dead trees adjacent to ARNEWS plot 902.
Western red cedar		
Ambrosia beetle, *Trypodendron* sp.	Bella Coola	Attacking large, decked logs. An uncommon occurrence.
Cedar flagging	Region-wide	Common throughout host range.
Cedar leaf blight, *Didymascella thujina*	Region-wide	Common throughout host range.
Western yew		
A tortricid moth, *Clepsis* sp.	Saanich	A new record, in English yew.
A die-back fungus, *Nectria* sp.	Spuzzum Creek	Common causing die-back on branches, a new host record.
Yew big bud mite, *Cecidophyopsis psilaspis*	Host range	Common in coastal areas, kills 25% of buds annually, not found past Whistler (interior sites).

Table 9. (Cont'd)

Host and pest	Location	Remarks
Yellow cedar		
A tip gall midge, *Chamaediplosis nootkatensis*	Host range	Buds of high elevation trees very lightly infested.
Cypress twig mite, *Triseticus chamaecypari*	Vancouver Island	On ornamentals and in seed orchards.
Multiple conifer hosts		
A saprophytic armillaria, *Armillaria sinapina*	Widespread mainland areas	Common on trees dead due to suppression and other factors. On Douglas-fir, amabilis fir and western hemlock.
Spruce tip moth, *Epinotia radicana*	Mainland, mid-high elevation sites	Common and widespread on Englemann spruce and amabilis fir.
DECIDUOUS		
Alder		
A leaf rust, *Melampsoridium hiratsukanum*	Powell River, Port Alberni	Light infections on occasional trees. A new record.
Alder woolly sawfly, *Eriocampa ovata*	Southwestern B.C.	Common, causing scattered light to moderate defoliation.
Obliquebanded leafroller, *Choristoneura rosaceana*	Boston Bar area	Common, light to moderate defoliation on 50% of trees.
Striped alder sawfly *Hemichroa crocea*	Victoria,Comox, De Courcy Island	Groups of 2-5 trees defoliated for second consecutive year.
Apple		
Apple ermine moth, *Yponomeuta malinella*	Victoria to Campbell River. Vancouver-Hope, Pemberton, Powell River.	Endemic, scattered, light defoliation. Widespread, common. Some trees severely defoliated.

Table 9. (Cont'd)

Host and pest	Location	Remarks
Arbutus		
Winter injury	Host range	Less common than last year; some foliar discoloration on a few trees.
Bigleaf maple		
A leaf spot fungus, *Cristulariella depradens*	Lund	Common in this area.
A powdery mildew, *Uncinula bicornis*	Upper Fraser Valley	Widespread, moderate to severe foliar discoloration common.
Speckled tar spot, *Rhytisma punctatum*	Lower Mainland, Powell River	Leaf spotting common.
Birch		
A hardwood trunk rot, *Fomes fomentarius*	Tweedsmuir Park, Hunlin Falls trail.	Approximately 1/2 ha of birch affected.
Holly		
A leaf spot fungus, *Gloeosporium* sp.	Saanich Peninsula	Causing necrosis on branches and foliage. New host record.
Poplars		
A bud midge, *Dasineura* sp.	Southwestern B.C.	Common for eighth consecutive year; light bud kill on black cottonwood.
A leaf blight, *Linospora tetraspora*	Harrison Mills	Causing light leaf spotting on on some hybrid poplars.
A leaf roller, *Herpetogramma pertextalis*	Harrison Mills	Common on hybrid poplars. New host record.
Marssonina leaf spot, *Drepanopeziza populorum*	Harrison Mills	Common on most hybrid poplars.
A leaf blister, *Taphrina populina*	Southern Vancouver Island	Common, widespread throughout host range.
A saprophytic leaf spot, *Mycosphaerella tassiana*	Powell River	Common on hybrid poplar.

Table 9. (Cont'd)

Host and pest	Location	Remarks
Septoria leaf spot, *Mycosphaerella populicola*	Harrison Mills	Causing light-moderate leaf spot, common on hybrid poplar.
Venturia leaf blight, *Venturia populina*	Harrison Mills, Herrling Island, Fraser River.	Causing Light to moderate, with occasional severe, infections on some hybrid poplars.
Salal		
A dieback disease, *Phyllosticta gaultheriae*	Shawnigan Lake, Saltspring and Saturna islands	Recently dead, dying branches common in patches. Adjacent to ARNEWS/biomonitoring plots.
A leaf miner, *Cameraria gaultheriella*	Shawnigan Lake	Common on year-old leaves in patches throughout the area.
Willow		
Willow tar spot, *Rhytisma salicinum*	Northern Vancouver Island	Common, widespread on widely scattered trees.
Multiple Deciduous Hosts		
Cherry ermine moth, *Yponomeuta padella*	Greater Victoria	Declining colonies of this introduced defoliator on hawthorn, cherry, plum, cherry, Saskatoon and mountain ash.
	Delta, Ladner	Increased colonies on hedgerow and ornamental trees.
Oak looper, *Lambdina somnaria*	Mt. Maxwell, on Saltspring Island	Severe defoliation over about 10 ha in Ecoreserve. Primarily on Garry oak, but also on Douglas-fir.
Western winter moth, *Erranis tiliaria vancouverensis*	Fraser Valley, Fraser Canyon	Endemic populations since infestation collapsed in 1992.

Queen Charlotte Islands

Summary

Western blackheaded budworm larval populations although remaining low, were more common than in previous years. The negative effects of defoliation (growth reduction), resulting from the most recent outbreak, were clearly evident in a young stand. Endemic populations of **hemlock sawfly** continued throughout the district and no defoliation was recorded. Minor branch dieback caused by **abiotic agents** was common in many areas; no Sirococcus shoot blight was identified from any samples assessed.

Spruce aphid infestations were recorded over 1105 ha in 33 areas during aerial surveys and localized light to moderate attack was noted in many additional areas during ground surveys. **Large-spored spruce-labrador-tea rust** infections continued causing moderate to severe discoloration of current spruce foliage from Tlell to Port Clement with scattered infections continuing to Masset and between Juskatla and Yakoun River. **Cooley spruce gall adelgids** were only found on Douglas-fir at one site east of Queen Charlotte City. No galls were found on spruce in the district.

In **three young stands** surveyed, 65% of trees were pest free while only 2% were severely affected, primarily by deer browse.

A number of pests currently causing minor damage or noted at endemic levels are included in table 10 at the end of the report. Notable among these pests were two species of **spruce sawfly**, which caused severe branch dieback and tree mortality in urbanized areas and **Rhizina root disease**, which has not been recorded on Queen Charlotte Islands since 1943 and is known to cause seedling mortality in plantations.

Hemlock Pests

Western blackheaded budworm
Acleris gloverana

Western blackheaded budworm populations remained at endemic levels in 1994. Larvae were collected at 4 of 14 standard FIDS larval sample sites scattered throughout road accessible areas of Graham and Moresby islands. No defoliation was recorded during ground or aerial surveys and while a total of only five larvae were found, this was four more larvae then were found in all samples between 1989 and 1993. In the province, outbreaks have historically occurred approximately every 10 years. The last major outbreak on the Queen Charlotte Islands started in 1985. These positive samples indicate the need for continued ground surveys and expansion of aerial surveys for 1995.

On Moresby Island, in the Kagan Peninsula, about 1% top-kill (1-2 metres) or mortality was noted in a young hemlock stand scheduled for spacing. This damage was similar to that documented in previous blackheaded budworm outbreaks. A survey of the site indicated that most of the damage was not current. Field examinations revealed no active insect or disease agents and lab examination confirmed that no pathogen was present. This area suffered

repeated attack by blackheaded budworm and hemlock sawfly between 1985 and 1988; as a result the damage noted may have been lingering damage from that outbreak.

In continued assessments of long term effects of the western blackheaded budworm/hemlock sawfly infestation of 1985-1988 in young stands, one plot (#5) was sampled in the Honna River area on Graham Island. This plot was part of a system of plots established by BCFS in 1987 throughout the infested areas. Each plot consisted of a large number of trees tagged and tallied with 1987 defoliation estimates documented for about 25% of the trees. This area was spaced in March of 1990 and only 14 of the tagged trees were found available for increment core sampling. Unfortunately most sampled trees were not among those on which defoliation estimates were done. Overall defoliation in this plot was severe in 1987. Based on aerial survey maps, moderate defoliation occurred in this area in 1986, while in 1988, based on descriptions from ground assessments and aerial surveys, defoliation was probably nil to very light.

No mortality or top-kill was evident in remaining crop trees. An assessment of growth from core samples shows a dramatic reduction of radial increment during the outbreak period (see Figure 5). Increment averaged only .68 mm in 1987, 290% less then average growth in 1985, the year before defoliation occurred in this area. Recovery was already evident in 1989 with 1.36 mm average increment.

This stand was defoliated for two or three years, loss of increment clearly reflected the pattern and intensity of the outbreak. Results of this sample again confirm findings in other young stands surveyed in the last three years; while losses were significant, young vigorous stands seem to recover quickly and sustain less overall damage then older semi-mature to overmature stands. Post outbreak- post-spacing growth rates were also consistently higher than any pre-outbreak growth rates. Average increment by 1991 was 5.23 mm which increased to 9.35 mm by 1993, far surpassing any pre-outbreak growth rates.

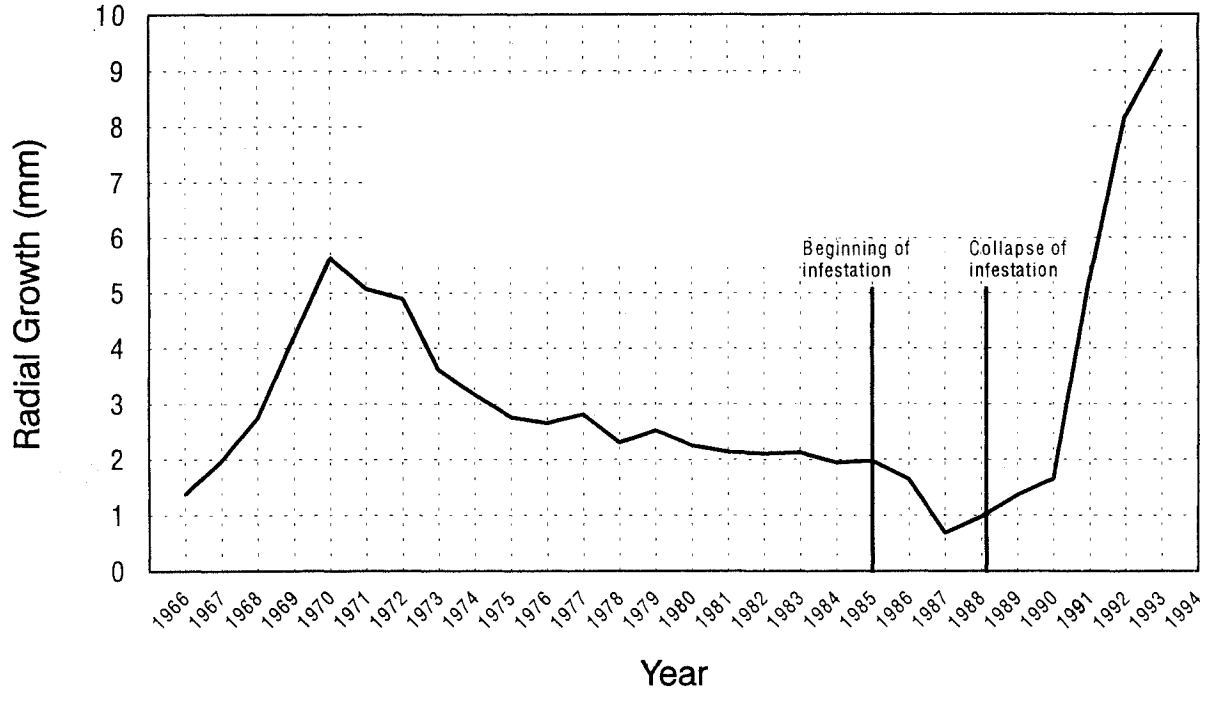

Figure 5. Radial increment of western hemlock in the Honna River plot (#5), defoliated by western blackheaded budworm. Queen Charlotte Islands, 1994.

Hemlock sawfly
Neodiprion tsugae

Hemlock sawfly populations remained at endemic levels and no defoliation was recorded in the district. Of 22 standard samples, only four were positive, averaging 10 larvae/collection (range 2-16). The maximum number of larvae were again at Marie Lake, where trace, spot defoliation was noted in 1991. No larvae were found at the Hangover and Gregory creeks study areas. Monitoring for this pest will continue in 1995.

Abiotic damage

Tip dieback in young hemlock was noted in a number of sites in the Queen Charlotte Islands. Sirococcus shoot blight, *Sirococcus strobilinus*, has often been associated with this type of damage, however, in samples examined from several different sites, this pathogen was not found. In a hemlock plantation at Deena Creek, up to 2% of current foliage was missing on approximately 50% of crop trees and understory natural regeneration. A saprophyte, *Therrya tsugae*, usually associated with dieback caused by such things as suppression, was identified from samples. Minor incidence of tip dieback, possibly caused by shading or suppression was also recorded in a young hemlock stand along Gregory Creek. Tip dieback was also minor, but common in a young hemlock stand in the Honna River area.

At these sites, no pathogen was found as causal agent of the damage; such abiotic agents as suppression, shading or frost are the most likely causes.

Spruce Pests

Spruce aphid
Elatobium abietinum

During aerial surveys of the western half of Graham Island, 1105 ha of mostly severe discoloration of Sitka spruce, caused by the spruce aphid, *Elatobium abietinum,* was mapped.

Following a year of low, endemic level aphid populations in 1993, the relatively mild winter of 1993-94 resulted in very active spruce aphid populations, mostly in coastal areas of the district. Severe discoloration was recorded during aerial surveys mainly along the west and southwest of Graham Island including Haines Creek, Tartu Inlet, Rennell Sound, Gudal Bay and Tana Bay. Severe discoloration was also noted near Queen Charlotte City, Tlell and Masset with light and moderate attack recorded near Sandspit, on Maude Island and at Athlow and Ingraham bays.

Scattered small populations causing trace to light discoloration or defoliation were also common along Highway 16 from Queen Charlotte City to east of Masset and from Deena Creek through Sandspit to Gray Bay. Populations in these roadside areas were generally much smaller then in 1992 when many areas suffered severe defoliation.

Coastal areas of Moresby Island were probably also infested, though no aerial surveys were completed. In previous outbreaks, populations tended to occur inclusively throughout the district.

In a permanent study plot at Heather Lake, in a mixed, young plantation with spruce representing about 25% of crop trees, overall attack severity in 1994 was light at time of

assessment. Populations at this site were only slightly increased from the previous year. In 95% of trees, 25-80% of older foliage was missing due to succeeding years of attack. Overall, 58% of foliage was affected compared to 56% in 1993. Branch tip length averaged 8 cm compared to 8.6 last year and 8.9 in 1992, indicating a continued cumulative affect of spruce aphid feeding on growth reduction from repeated years of defoliation.

Twenty semi-mature trees assessed for levels of defoliation at each of two sites in 1992 were assessed for the third time in 1994. At Chinukundl Creek, new aphid populations were present and a minor overall increase in discoloration and total defoliation was noted. In 1993, 6 trees were moderately and 5 trees severely affected, while in 1994, 5 trees were moderately and 8 trees severely impacted. No branch dieback or tree mortality was noted.

At Gray Bay, where one tree was killed in 1993, only 7 of the 19 remaining trees were severely defoliated compared to 11 in 1993. Few aphids were noted in the stand and new feeding damage was readily evident, in these high crowns, in only three trees. One tree, severely defoliated for three consecutive years, had only a small complement of mainly chlorotic foliage left and appeared unlikely to survive. This implies that 10% of trees at this site have thus far not survived the recent aphid outbreaks.

Large-spored spruce-labrador-tea rust
Chrysomyxa ledicola

Infection of current foliage of young Sitka spruce by *C. ledicola* was notably less than in 1993. Current foliage continued to be moderately to severely discolored on young roadside spruce (2-4 m) from Tlell to Port Clements, but attacks north to Masset were only scattered. Scattered severe discoloration of young plantation spruce was also again noted in areas between Juskatla and the Yakoun River.

Although losses of up to 90% of current needles have been reported causing serious effects on the following year's growth, no top kill, severe dieback, or mortality has been recorded in areas affected for the last four consecutive years. Suitable fungicides or removal of the alternate host are effective controls but are economically impractical.

Cooley spruce gall adelgid
Adelges cooleyi

In Sandspit, for the first time in four years, no new galls were found on young Sitka spruce located adjacent to the site where several infested semi-mature Douglas-fir were removed over a year ago. Near Queen Charlotte City, three young Douglas-fir, on private property, continued to harbor large populations of *A. cooleyi* for at least the fifth consecutive year. As in previous years, no galls have been found on spruce in this area. In Port Clements, Douglas-fir and adjacent spruce were checked at two sites and no evidence of adelgids were found.

Surveys over the past four years indicate no establishment of this adelgid in any young Sitka spruce in managed or natural settings. Complete removal of Douglas-fir continues to be the recommended procedure to combat this potential threat. The disappearance of adelgids from the Sandspit location following removal of the alternate host confirms the potential success for this type of corrective treatment.

Pests of Young Stands

Three young recently spaced stands were surveyed as part of the ongoing province-wide program to assess pests in young stands. Locations were selected primarily on the basis of having received silviculture treatment under the SMFRA or other special funding programs. In addition to insect and disease concerns, environmental damage, mammal damage and other conditions affecting the health and growth of young stands were examined.

At Deena Creek, 49% of trees were pest free and 1% of trees were significantly impacted by forking or pronounced crooks. Low levels of defoliation by a spruce budmoth, *Zeiraphera* sp. occurred, as well as some minor mechanical and abiotic tip damage. At Bonanza Creek, 78% of trees were pest free while on Sitka spruce and western red cedar, deer browse seriously impacted 4% of trees. Other notable conditions were: a minor abiotic tip dieback similar to damage caused by Sirococcus shoot blight; minor spruce aphid, *Elatobium abietinum* feeding; some competition, forking and broken or dead top damage. At a site along the Honna River, 62% of trees were pest free. Deer browse was the only severe damage and that only on one western red cedar plot tree. Minor incidence of such things as abiotic agents causing tip dieback, a spruce budmoth causing minor defoliation, sapsucker damage, browning by the cedar leaf blight, *Didymascella thujina*, and mechanical damage were recorded. A low level of a needle cast, *Lophodermium piceae* and a needle blight, *Rhizosphaera pini* along with some abiotic agent or spruce aphid caused minor needle damage.

Overall 65% of trees were pest free while only 2% were severely affected and no trees were dead at the sites assessed. As in the previous year, browsing was the only serious problem noted.

Other Noteworthy and Minor Pests

Table 10. Other noteworthy and minor pests, Queen Charlotte Islands, 1994.

Host and Pest	Location	Remarks
Pines		
A pine adelgid, *Pineus coloradensis*	Sheldens Bay	Light to moderate populations on 44% of western white pine in trial plantation.
Fir coneworm, *Dioryctria abietivorella*	Sheldens Bay	2% of wwP damaged at upper crown nodes.
Pine leaf chermid, *Pineus pinifoliae*	Chinukundl Cr.	Incidental on western white pine, causing little damage.
Pine needle cast, *Lophodermella concolor*	Riley Creek	Again common on young roadside and bog pine.
Western gall rust, *Endocronartium harknessii*	Riley Creek	Branch galls common on young roadside shore pine over a 0.2 ha area.
Sitka spruce		
An adelgid, *Pineus* sp.	Kagan Penninsula	Occasional woolly adelgids and galls.
Spruce needle blight, *Lirula macrospora*	Yakoun River	Scattered, minor discoloration of 1993 foliage.
Yellow/green headed spruce sawfly, *Pikonema alaskensis/dimmockii*	Lawn Hill Pt. Tow Hill, Gray Bay, Chinukundl Creek	Up to four larvae per sample in spruce, no damage.
An aphid, *Mindarus obliquus*	Sheldens Bay	High populations on current foliage of 64% of spruce.
Unknown agent	Rivtow	Broken or dead leaders in +/-20% of crop trees, old damage.
Yellow cypress		
A gall mite, *Triseticus chamaecypari*	Phantom Creek, Marie Lake, Yakoun Lake	Common wherever host occurs. Causing minor, atypical growth.

Table 10. (Cont'd)

Host and Pest	Location	Remarks
Western Yew		
Yew big bud mite, *Cecidophyopsis psilaspis*	Yakoun River, Marie Lake.	Very common, causing branch deformity and bud mortality.
Western red cedar		
Cedar leaf blight, *Didymascella thujina*	Gregory Creek, Honna River, Hangover Creek	Occasional on young growth. Light to severe on 5% of seedlings at 2 sites.
Multiple Host		
Deer browse	District-wide	Common throughout, 28% of seedlings at two sites browsed, mainly cedar but also spruce
Rhizina root rot, *Rhizina undulata*	Honna River	Occasional scattered fruiting bodies in 1993 wildfire area (first collection since 1943).

Appendix I

PEST IMPACT CODES

- based on the sum of %trees/severity index/stand.
- SI=Severity Index i. e. SI 1 = Severity Index 1

Impact I - No Action Required

- No impact, pest-free
- These are stands where 100% of the trees were pest-free i.e. SI 1

Impact II - Consider Reassessment in 4 years

- Minor damage, occasional significant volume losses.
- 70%>SI3
- 25%>SI4>0
- 3%>(SI5 or SI6 or SI5+SI6)>0

Impact III - Consider Reassessment in 4 years

- Significant current volume loss and potential long-term; reassess within 2 years.
- SI3 >= 70%
- 5%> (SI5 or SI6 or SI5 + SI6) >=3%
- 50%> (SI4 or SI4+SI5 or SI4+SI6 or SI4+SI5+SI6) >=25%

Impact IV - Consider conducting a more intensive survey

- Significant long-term volume losses, possibly resulting in NSR stands. Immediate action.
- 5%>SI5 or SI6 or SI5+SI6
- 50%> (SI4 or SI4+SI5 or SI4+SI6 or SI4+SI5+SI6)

Appendix II

The following related reports are available on request from FIDS.

I. Forest pest conditions in the Vancouver Watersheds and Seymour Demonstration Forest, 1994.
II. Forest pest conditions in Provincial Parks, Vancouver Forest Region, 1994.

Detailed copies of aerial survey maps, pest reports, pest leaflets, monographs and other maps and reports in addition to those listed above are available from the Pacific Forestry Centre upon request.