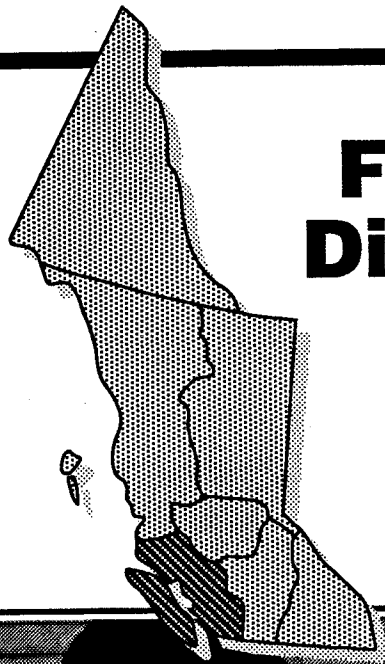
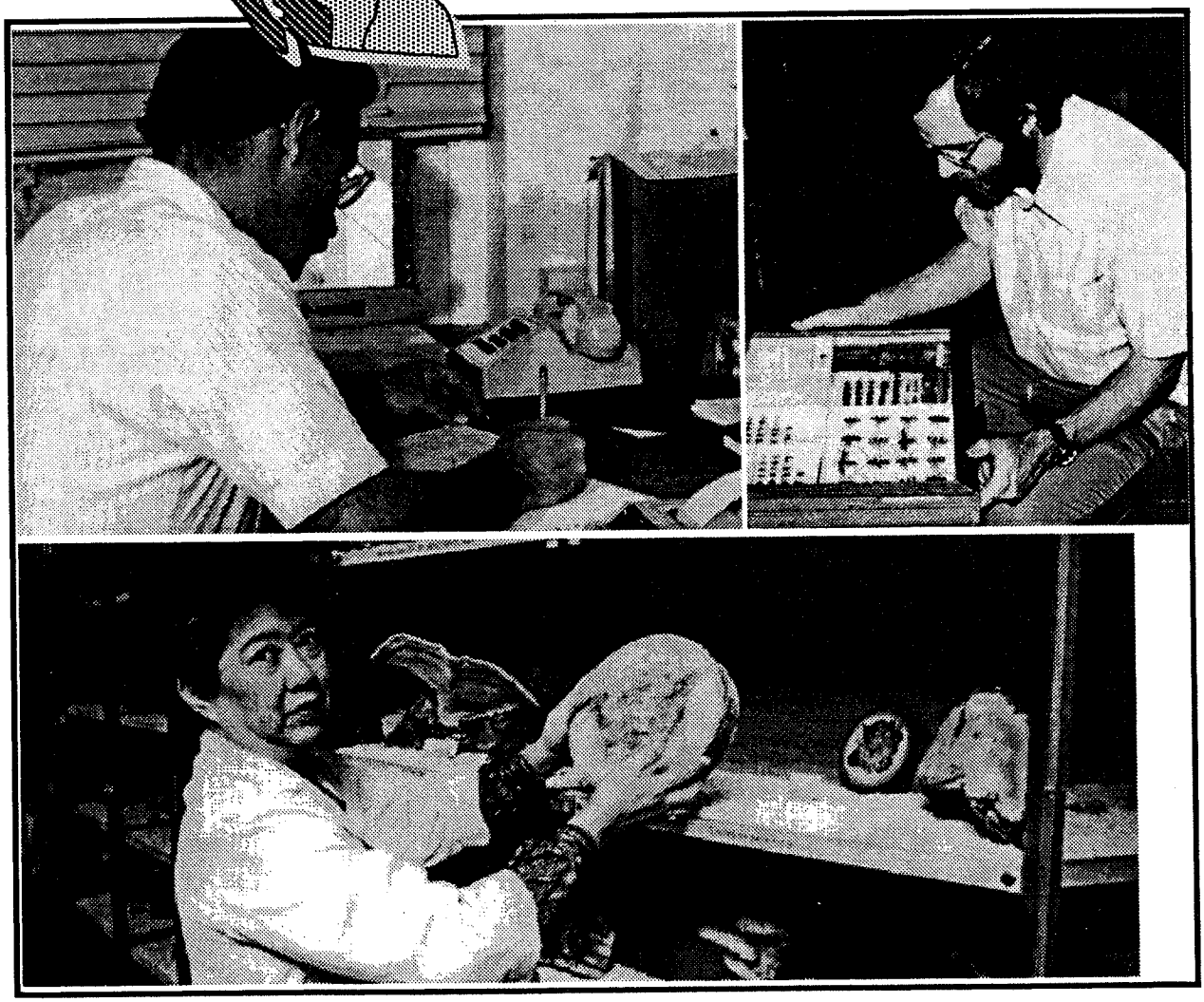


Forest Insect and Disease Conditions

Vancouver Forest Region
1991

R. Turnquist & D.H.L. Clarke



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I. Forestry Canada, Forest Insect and Disease Survey, Seed Orchard Examination Report Summary - 1991.

II. Forest Pest Conditions in Pacific Rim National Park, 1991.

III. Forest Pest Conditions on the Gulf Islands, 1991.

IV. Pest Conditions at Mt. Maxwell Eco Reserve, 1991.

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XI. Pest report on special projects, Queen Charlotte Islands, 1991.

INTRODUCTION

This report outlines the status of forest pest conditions in the Vancouver Forest Region for 1991 and forecasts population trends of some potentially damaging pests. Pests are listed by host in order of importance.

The Forest Insect and Disease Survey (FIDS) is a nation-wide network within Forestry Canada with the responsibility of producing an overview of forest pest conditions and their implications; maintaining records and surveys to support quarantine and facilitate predictions; supporting forestry research with records, insect collections and herbaria; providing advice on forest insect and disease conditions; developing and testing survey techniques; conducting related biological studies and analyzing this year's and previous year's data and producing various pest information maps using the in-house Geographical Information System (GIS).

The Queen Charlotte Islands section is included separately in this report and was submitted by the Prince Rupert west FIDS Ranger, John Vallentgoed. The annual survey of the Queen Charlotte Islands to assess forest disease and defoliator damage was conducted from July 15 to 25. Insect and disease data from the mid-coast Forest District was collected by Cariboo FIDS Ranger, Bob Erickson. FIDS insectary biologist, Robert Duncan contributed to this report by submitting the sections on the oak leaf phylloxeran and the jumping gall wasp as well as providing information on the winter moth situation in the Greater Victoria area. The FIDS pathologist/mycologist Dr. Brenda Callan contributed portions of the bigleaf maple scorch and leafspot section.

The forest pest survey field season extended from mid-May to mid-October. A total of 290 insect and 185 disease collections were submitted to Pacific Forestry Centre by FIDS survey personnel. Map 1 shows the locations where one or more samples were collected and the areas covered by 18 hours of fixed-wing aircraft surveys. A total of 25 special collections included western winter moth, winter moth, woodborers, sawfly pupae, maple leaf scorch, alder casebearer, worms and weed species.

Numerous special surveys were conducted including: inspections of provincial parks; ecological reserves; seed orchards; acid rain plots; spruce budworm, gypsy moth and Douglas-fir tussock moth pheromone trapping; young stand surveys; root disease surveys, European pine shoot moth quarantine surveys; pinewood nematode surveys and public and industry extension calls.

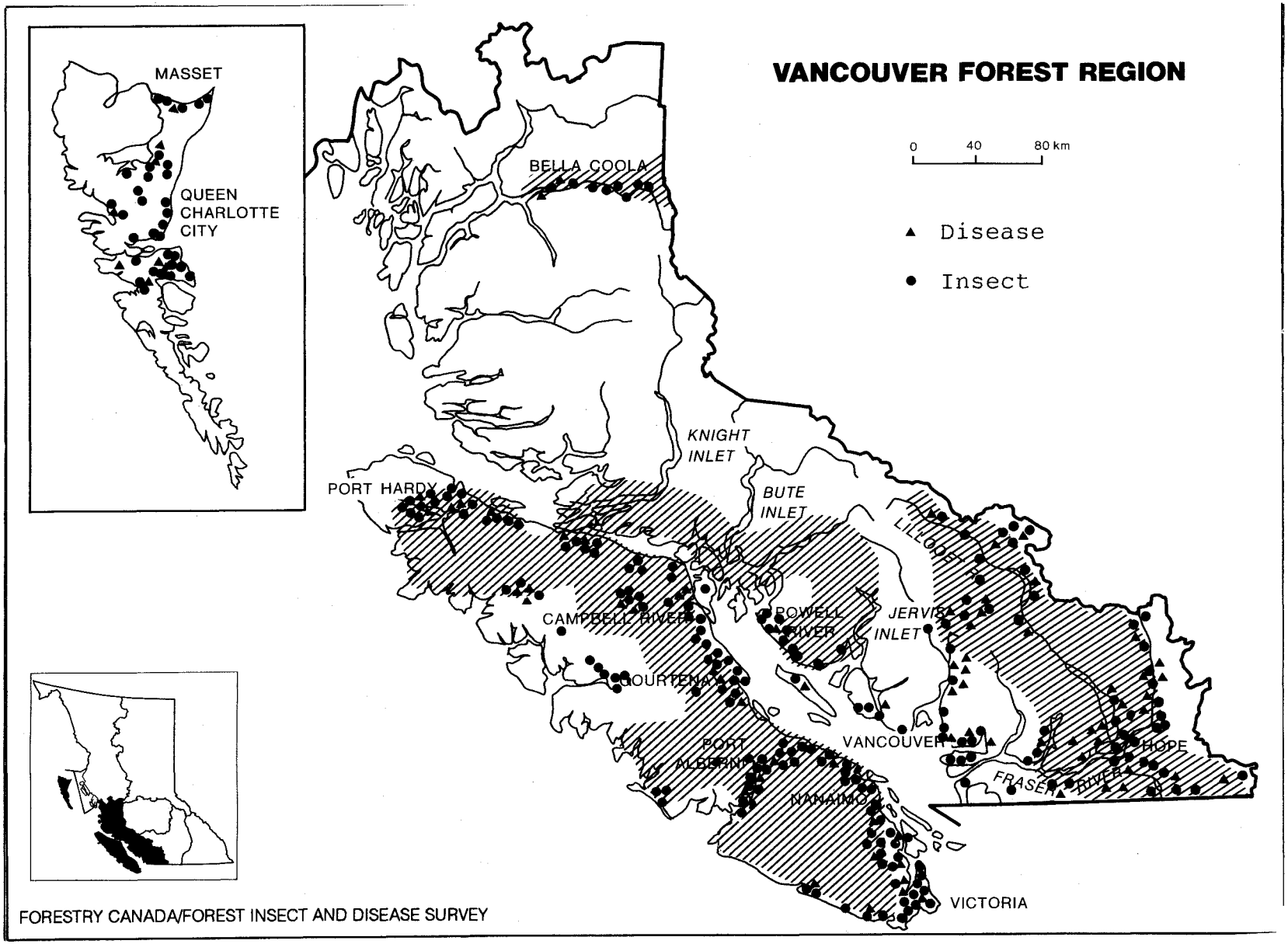
Personnel of the B.C. Forest Service, MacMillan Bloedel Ltd. and Scott Paper Ltd. assisted with ground and air transportation and with defoliator sampling. Defoliation intensities in the report are defined as follows:

Trace - evidence of feeding barely detectable close up

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



Map 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 1991.

SUMMARY

This summary of pest conditions in the Vancouver Forest Region in 1991 includes the most damaging pests generally in order of importance by host affected.

Western spruce budworm lightly and moderately defoliated Douglas-fir over 5850 ha, up from 3825 ha recorded in 1990. Defoliation continued at increased levels in the Birkenhead area northeast of Pemberton as well as spreading to the North Creek area, along the upper Lillooet River Valley. Top kill was noted on about 10% of the trees. **Douglas-fir beetle** attacks declined to 240 ha from 330 ha recorded in 1990. Most of the mortality occurred in the Fraser Canyon area near Boston BAr and near Pemberton. For the second consecutive year, **Douglas-fir** and **rusty tussock moth** populations caused moderate and severe defoliation, mainly on scattered hedgerow trees in the Chilliwack and Abbottsford areas. **Root rots** were common and widespread in both young and mature stands throughout the host range. Several mammals, including **black bears, deer, woodrats, squirrels** and **voles** damaged young trees at several locations in the Region.

Mountain pine beetle killed an estimated 7000 trees over 465 ha in 71 infestations, down from 8200 trees over 540 ha in 64 infestations in 1990. Most of the mortality continues to occur in the Soo Timber Supply Area (TSA). **Pinewood nematode** surveys concentrated on active roundheaded woodborer infestations in recently felled material. One such site was located in the upper Squamish River Valley where 24 infested amabilis fir logs were removed and milled prior to a heat pasteurization study. **Pine needle sheathminer** populations declined to endemic levels after 4 years of high populations. There was no further recorded spread of **European pine shoot moth** populations in native trees.

Western blackheaded budworm populations collapsed, no defoliation was recorded on northern Vancouver Island, down from 630 ha recorded in 1990, and 7400 ha in 1989. A **tip die-back** was found on stressed young trees from the Fraser Canyon through to the Squamish area.

Balsam bark beetle killed mature alpine fir over 1105 ha, down from the 1385 ha record in 1990, mostly in the Fraser TSA. Active **balsam woolly adelgid** populations were found for the first time at Lizzie Creek on the east side of Lillooet Lake, beyond the current quarantine and regulation zones. Elsewhere in the Region, active adelgid populations were found in a variety of areas within the quarantine zone. A **balsam shoot boring sawfly** declined to endemic levels in immature high elevation balsam stands in the mainland area.

Spruce bark beetle populations remained at low levels for the sixth consecutive year. Only 2 ha of recent mortality was recorded in the mid-coast Forest District. **Spruce weevil** populations continued to cause leader mortality throughout the host range. **Spruce aphid** populations declined, causing scattered light to moderate defoliation in coastal areas.

The intensity of **Cedar leaf blight** and **cedar flagging** declined overall throughout the Region.

Assessments at 10 **ARNEWS** (acid rain national early warning system) plots in the region found no evidence of acid rain damage. **Tree mortality** was recorded at seven of the plots; however, all mortality was attributed to natural causes. A total of 39 planted and natural young stands were surveyed for pest problems, some of which were **root rots, winter damage, mammal damage** and **storm damage.** Thirteen seed orchards were visited two or more times for detection of pests, some of which included **balsam woolly adelgid, cooley spruce gall adelgid,** and the **hemlock woolly adelgid. Winter damage** causing late or no terminal and lateral bud flush on young trees was widespread on several species from north of Boston Bar through to the lower mainland and the Squamish-Pemberton area, and also caused 'red-belt' damage near Bella Coola.

Gypsy moth traps were placed at 100 locations by FIDS throughout the Region, two adult males were caught in traps placed in the lower mainland. As well, about 72 adult males were caught in traps placed by Agriculture Canada in various locations on Vancouver Island and the lower mainland. Some of these adults have been positively identified as being the Asian gypsy moth, the first time this species has been found in North America. **Winter moth** populations caused scattered light defoliation in the Greater Victoria area and declined on the lower mainland with only trace defoliation noted in scattered locations. **Western winter moth** populations continued to decline on the lower mainland, the only recorded defoliation was at Alexandra Bridge Provincial Park. **Oak leaf phylloxeran** was unchanged from 1990 in the Greater Victoria area but was reported for the first time on the Gulf Islands and at Nanaimo. Severe scorching of Garry oak by the **jumping gall wasp** in the Capital Region continued at increased levels for the sixth consecutive year. An unknown species of **sawfly** moderately to severely defoliated native cottonwood stands over more than 50 ha on several large Islands in the Fraser River near Agassiz. The incidence and intensity of **bigleaf maple scorch** and **leafspot**, while declining somewhat from 1990, was still widespread by late summer throughout southwestern British Columbia. **Dogwood leaf blight** continued at high levels on native and ornamental dogwood throughout the host range. **Fall webworm** populations increased throughout the region with new areas of defoliation along the Sunshine coast and high populations in the upper Fraser Valley and eastern Vancouver Island. **Birch leafminer** populations declined throughout the lower mainland.

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

DOUGLAS-FIR PESTS

Western spruce budworm
Choristoneura occidentalis

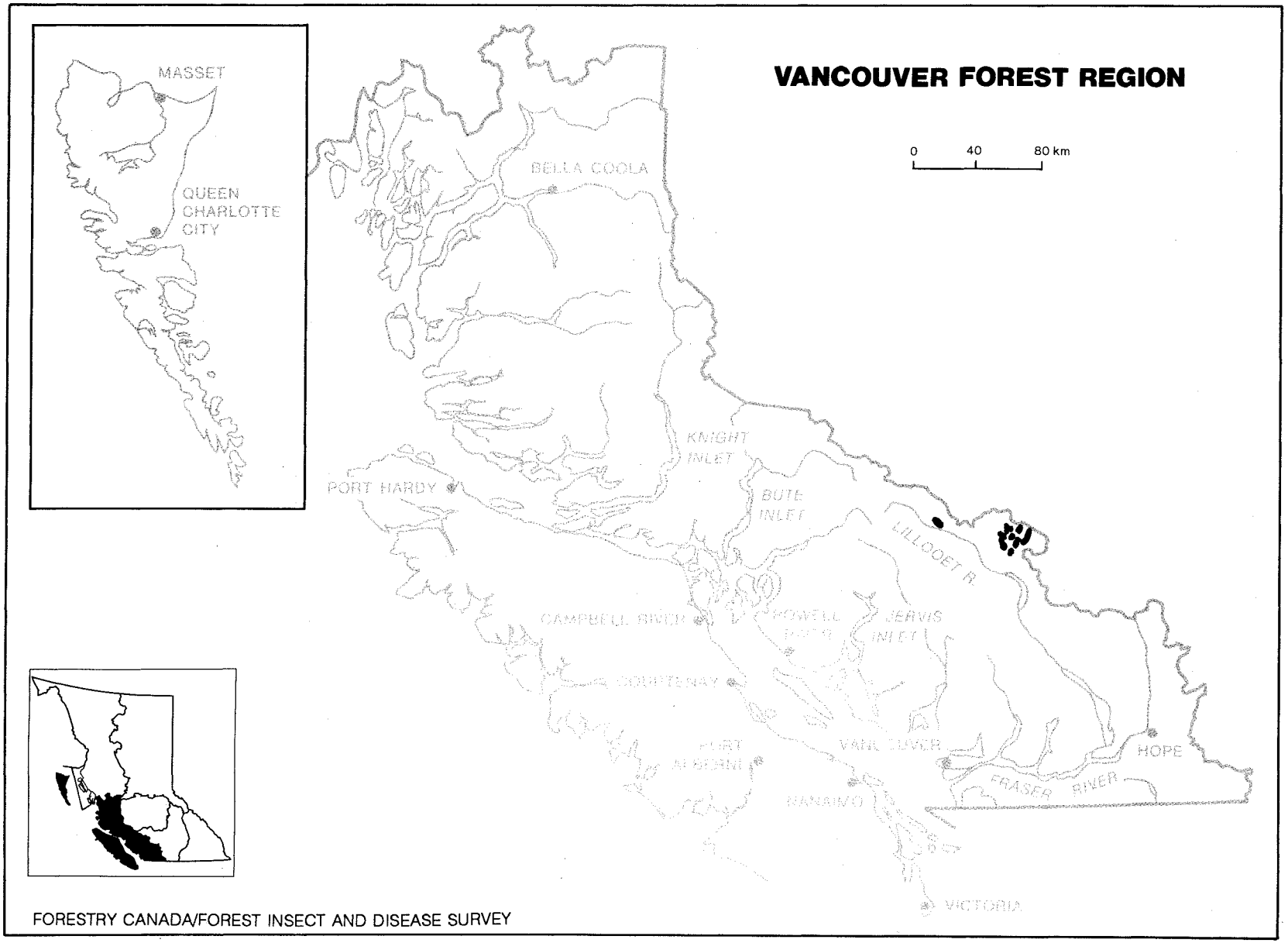
The area of western spruce budworm-damaged Douglas-fir increased to 5850 ha in 28 pockets from 3825 ha in 23 spots in 1990, following one year of declining populations (Map 1). The area of light defoliation increased this year to 4640 ha from 3590 ha, and the area of moderate defoliation increased to 1210 ha from 235 ha. There was no severe defoliation recorded.

Defoliation

Defoliation increased in most previously defoliated areas in the soo tsa, and two new areas of defoliation were recorded near North Creek, along the Lillooet river valley northwest of Pemberton (Table 1). This movement westward is following the historical trend of budworm populations in past outbreaks. while populations remained centered between Haylmore-Blackwater creeks and Birkenhead and Gates rivers, their density continues to shift west and to a lesser degree to the south. Moderate defoliation was recorded in the Birkenhead River-Eight Mile-North Creek areas while in the Haylmore, Blackwater and Phelix Creek areas, the oldest areas of infestation, only light defoliation was recorded. The only area of decline occurred in the Fraser TSA near Keefers, north of Boston Bar and at Ainslie creek where 20 ha were defoliated, down from 245 ha in 1990.

Table 1. Defoliation of Douglas-fir by western spruce budworm, from aerial surveys Vancouver Forest Region, 1991 and 1990.

TSA and Location	Area of defoliation (ha)							
	Light		Moderate		Severe		Total	
	1991	1990	**1991**	1990	**1991**	1990	**1991**	1990
SOO TSA								
Birkenhead R.	**470**	700	**720**	235	-	-	**1190**	935
Spruce-Haylmore Creeks	**720**	450	-	-	-	-	**720**	450
Phelix Cr.	**100**	220	-	-	-	-	**100**	220
N. Blackwater Cr.	**720**	150	-	-	-	-	**720**	150
Birkenhead Lk.- Sockeye Creek	**960**	100	-	-	-	-	**960**	100
S. Blackwater Cr.	**500**	650	-	-	-	-	**500**	650
Gates R.	**500**	1075	**110**	-	-	-	**610**	1075
North Cr.	**650**	-	**380**	-	-	-	**1030**	-
FRASER TSA								
Hannah Cr.	**20**	180	-	-	-	-	**20**	180
Ainslie Cr.	-	65	-	-	-	-	-	65
Total	**4640**	3590	**1210**	235	-	-	**5830**	3825



Map 2. Areas where current defoliation by the Western spruce budworm was detected during ground and aerial surveys in 1991.

Damage

Although no tree mortality has been recorded during the present infestation, cumulative top-kill on both mature and younger Douglas-fir trees was observed, particularly in drainages where moderate defoliation has been recorded for several years, mainly in the Soo TSA. Dead tops up to 3 m in length were noted at levels similar to the previous two years were noted on <10% of the trees in all areas. Based on previous years outbreaks, the incidence of top-kill will probably continue over the next few years and will occur even after the infestation subsides. Defoliated trees will continue to suffer growth loss which, from increment cores taken in 1989, was determined to average 12% during years of light and moderate defoliation.

Forecast

An average of 81 egg masses/10 m^2 of foliage (range 21-174) were collected at five locations north of Pemberton, down 28% from an average of 112 (range 38-236) in 1990 (Table 2). Despite this decline, defoliation is predicted to continue at mainly light to moderate levels in 1992.

Table 2. Predicted 1992 spruce budworm defoliation based on egg mass counts, Soo TSA, Vancouver Forest Region, 1991.

Location	Avg. no. of egg masses/10 m^2 of foliage/plot		Percent increase/ decrease	Defoliation*	
	1991	1990		1991	**1992 (predicted)**
Birkenhead R. (N. Fowl)	**174**	93	+46	light-Mod	**mod-severe**
Eight Mile Creek	**119**	-	-	Light-mod	**Moderate**
North Creek	**92**	-	-	Light-mod	**Moderate**
Haylmore Creek	**28**	-	-	Light	**Light**
Blackwater Creek (North)	**21**	38	-45	Light	**Light**
Average	**81**	**65**	**+20**		

*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.

The highest number of egg masses were found where the heaviest, (moderate), defoliation was mapped during aerial surveys. The lowest numbers were in areas that not only suffered the lightest defoliation, but were also two of the oldest sites infested during this current outbreak. Based on these egg mass surveys, defoliation is predicted to continue at moderate to high levels in

the more recently infested areas in the western and southern portions of the infestation, while declining in the older, more northerly sites. No egg masses were collected in the Fraser TSA due to low populations.

A project started in 1987 to detect increasing budworm populations continued in 1991. Pheromone-baited dry "Multipher" traps (5/site) were placed in each of four areas of previous infestations, Devine, Skagit Valley, North Bend and in the Anderson River drainage, to attract male adults (Table 3). The average number of moths per trap increased in three of the four sites while declining slightly at the fourth site. The average number of larvae per tree declined in three of the four sites while remaining static at the fourth.

Table 3. Comparison of 1991 and 1990 larval and pheromone sampling at spruce budworm calibration plots in the Vancouver Forest Region, 1991.

Location	Avg. no. larvae/tree[1]		Avg. no. moths/trap		Total tree defoliation at plots	
	1991	1990	**1991**	1990	**1991**	1990
SOO TSA						
Devine	**4.8**	7.4	**150**	128	**trace**	light
FRASER TSA						
North Bend	**.1**	.5	***94**	28	**none**	none
Anderson R.	**.2**	1.3	**49**	12	**none**	none
Skagit Valley	**0**	0	**4**	6	**none**	none

[1] Based on sampling 3 branches per tree x 25 trees per location.

* Average of 4 traps, one destroyed.

Calibrating the traps to relate the number of moths, larvae and defoliation is still in progress and will probably take several more years before reliable predictions can be made from either larvae or adult male moth numbers.

Douglas-fir beetle
Dendroctonus pseudotsugae

Following two years of increase, the area containing recent Douglas-fir mortality decreased to 240 ha from 330 ha in 1990. Most of the mortality occurred in the Interior Douglas-fir biogeoclimatic zone near Pemberton and Boston Bar.

Most of the decline occurred in the Fraser TSA, where trees were killed over 145 ha in 44 separate infestations compared with 26 infestations over 205 ha in 1990. Most of the mortality, 100 ha in 30 areas, continued to occur in

pockets of trees ranging in size from 0.5 ha to 25 ha in the Anderson and east Anderson River drainages. The remaining 45 ha were located in widely scattered small pockets of attack from: Emory Creek to the Mowhokam River in the Fraser Canyon, along the Klesilkwa River east of Masilpanik Creek, along the Skagit River from Twentyeight Mile creek to Ross Lake, and on the Cascade Peninsula on the east side of Harrison Lake. There were fewer than 20 trees in all infested areas. In most locations the beetle had attacked trees weakened by laminated root rot, Phellinus weirii, with discolored trees evident around the periphery of root rot centers.

In the Soo TSA the area of beetle-attacked Douglas-fir decreased to 95 ha in 13 infestations from 125 ha in 17 infestations in 1990. Infestations, which ranged in size from 0.5 ha to 40 ha, continued in chronic areas along the both sides of Lillooet Lake from south of Lizzie Creek to the Twin One Creek area. Several small spots on the west side of Lillooet Lake opposite Lizzie Creek had coalesced into one large area. Infestations in the Gravell, Ure and Billygoat creeks were not seen this year. One small infestation was mapped along the Birkenhead River, south of Spetch Creek.

Populations are expected to at similar levels in 1992. 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.

Douglas-fir tussock moth
Orgyia pseudotsugata
Rusty tussock moth
Orgyia antiqua badia

The outbreak in the Fraser Valley continued for the second consecutive year, causing moderate to severe defoliation of immature and mature Douglas-fir in scattered pockets mainly along Highway 1 from the Abbottsford area to just west of Chilliwack. Some very light defoliation also occurred at the Chilliwack Golf and Country club along Yale Road, south of Highway 1. Previous outbreaks have occurred in the same general area in 1971-72 and in 1982-83.

Damage

Damage to scattered individual trees ranged from light on a few branches to about 60% of the crown defoliated. Top kill of up to 1m was evident on trees that were moderately defoliated in 1990. Further top kill as a result of this years defoliation is expected to occur, especially on those trees up to 60% defoliated.

Forecast

Fourteen pheromone-baited sticky traps were placed in the Abbottsford-Sumas Mtn.-Chilliwack area to monitor adult male moths and as an aid to predicting next years population (Table 4). An average of 9 (range 0-49) Douglas-fir tussock moth, and an average of 5 (range 0-13) rusty tussock moth were caught in the traps. Research has shown that when the average number of adult males in pheromone traps exceeds 25, then visible defoliation may occur

within two years. Catches in two traps at the Chilliwack Golf and Country Club averaged 41 (range 33-49), signaling potentially high populations and subsequent defoliation at this particular location, while the average number of moths elsewhere in the Fraser Valley was below this threshold.

Table 4. Total and average number of adult male Douglas-fir and rusty tussock moth in pheromone-baited traps, Fraser TSA, Vancouver Region, 1991.

Location	# of traps	# of adult male tussock moth		
		Douglas-fir	Rusty	Total
Abbottsford	4	18	21	39
Sumas Mtn.	4	16	23	39
Chilliwack	6	90	31	121
Total	14	124	75	199
Average		9	5	14

Populations and resulting defoliation will probably continue at similar levels in 1992 as no disease or parasitism was evident in mass collections. Some egg mass surveys will be conducted prior to next summer in order to facilitate predictions at selected sites. Larval assessments will continue in the spring and early summer of 1992.

Laminated root rot
Phellinus weirii
Armillaria root rot
Armillaria ostoyae

These two root rots are chronic problems and were commonly found in both young (see POYS section for details) and mature Douglas-fir throughout the Vancouver Region in 1991.

Laminated root rot infected young trees were found in the Chehalis River area, and at Bear Creek on the east side of Harrison Lake on the mainland, and at McKay Lake and Mt. Prevost on Vancouver Island. Mortality in these areas averaged 2% (range 1-3). Recent mortality also occurred in mature trees in the Mission Municipal Forest and in the Roberts Creek area near Gibsons. The root rot is widespread in mature trees throughout the Fraser Canyon and Anderson River areas where Douglas-fir beetle attacks the stressed trees.

Armillaria root disease mortality averaged 4% (range 2-6) in young trees at Mowhokam Creek in the Fraser Canyon north of Boston Bar, in the Capilano watershed, in the Sechelt and Powell River areas, and on Texada Island. Recent armillaria-caused mortality also occurred in semi-mature trees in the UBC and Seymour demonstration forests,

Mortality from these diseases is perennial and will continue to occur throughout the range of Douglas-fir. Planting of alternate, root rot-resistant species, including some hardwoods, in areas where severe root rot problems occur is becoming a more widely used management tool to lower root disease losses.

Mammal damage

Black bear

Black bears partially and completely girdled trees in a 20 year-old recently spaced young Douglas-fir stand along Sowaqua Creek, near Hope. The mainly old damage which extended up to 1.5m on the stem, was found on 20% of the remaining trees. These trees may die from the girdling or become weakened and thus more susceptible to diseases. The girdling scars may also provide entry courts for stem and butt decay.

Deer

Deer browse was a problem in young stands on Texada island and at Scuzzy Creek near Boston Bar. Near Comet Mountain on Texada Island 35% of the remaining trees in a recently spaced, approximately 10 year-old stand, were moderately to severely browsed. Many of the trees had a stunted bushy form from repeated browsing. On many trees, the deer protectors put on the young seedlings to prohibit excessive browse were restricting height growth, and causing distorted growth, poor form and leader deformation. At Scuzzy Creek, on the west side of the Fraser River, 30% of an approximately 5 year-old stand was lightly browsed.

Wood rat

Leader clipping of approximately 75% of the trees in a 20+year-old stand near Horseshoe Lake southeast of Powell River was attributed to the bushy tailed wood rat. The damage, while similar to grouse feeding, occurred in trees that are considered too large for grouse to feed on, and the damage was not similar to squirrel damage. This causal agent was not confirmed, but company foresters in the area were notified of the possible damaging agent and will be checking to see if confirmation can be made. Wood rat damage has been recorded in past years in the Pacific Northwest. The small mammals use the clipped leaders and branch material to build their nests.

Squirrel

Squirrels caused top-kill and branch mortality in a 10-15 year-old stand at Railroad Creek, northwest of Pemberton. The feeding on the branches and leaders caused large areas of scar or callus tissue, which was infected by a secondary pathogen, Sclerophoma pithyophila. This normally secondary fungus invades predisposed, weakened trees and contributed to the die-back associated with the squirrel feeding.

Voles

Voles clipped or girdled 80% of the trees in a young plantation at Callaghan Creek, southwest of Whistler. The area was planted in 1989, but no regeneration surveys were done until this year when the damaged trees were noted. found. The damage was severe enough to necessitate replanting of the site.

PINE PESTS

Mountain pine beetle
Dendroctonus ponderosae

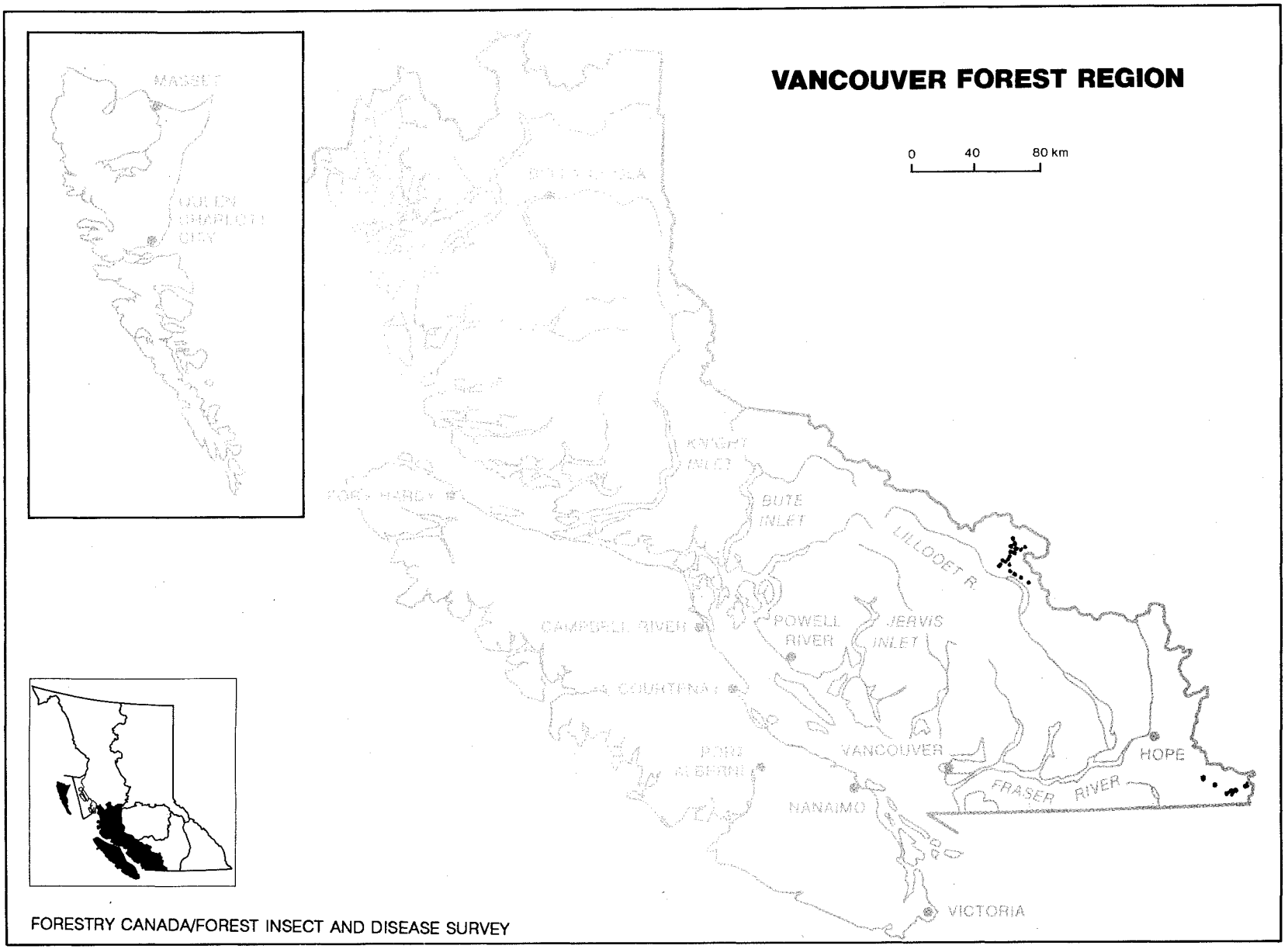
Mountain pine beetle killed an estimated 7000 lodgepole pine over 465 ha in 71 infestations in 1991 (Map 3), a decrease from 8200 trees over 540 ha in 64 infestations in 1990 (Table 5). This is the fifth consecutive year of decline from a high of 4160 ha in 176 infestations in 1986. Volume loss also declined to approximately 5100 m^3 from almost 6000 m^3 last year.

Table 5. Recent mountain pine beetle mortality as determined from aerial surveys, Vancouver Forest Region, 1991.

TSA	Area (ha)		No. of trees killed		Vol. (m^3) killed		No. of infestations	
	1991	1990	**1991**	1990	**1991**	1990	**1991**	1990
Fraser	**80**	-	**1200**	-	**880**	-	**21**	-
Soo	**385**	535	**5800**	8000	**4220**	6000	**50**	51
Mid-coast	-	5	-	200	-	-	-	-
Sunshine coast	-	-	-	-	-	-	-	-
TOTAL	**465**	540	**7000**	8200	**5100**	6150	**71**	51

Fraser TSA

The Manning park area contained some 80 ha of recent and older mountain pine beetle mortality. This area is looked after by a contract which includes ground surveys and MSMA treatment or single tree disposal of the attacked trees. Elsewhere, the lack of beetle activity is largely a result of host depletion and harvesting of previously infested stands.



Map 3. Areas of lodgepole pine recently killed by mountain pine beetle as determined by aerial and ground surveys in 1991.

Soo TSA

In the Soo TSA the area of attack decreased to 385 ha from 535 ha, due in part to host depletion and logging of accessible locations. The infestations remained in approximately the same areas as 1990 with scattered attacks along Lillooet Lake and Birkenhead and Gates rivers.

Mid-Coast TSA

No beetle attacks were reported in this area in 1991. This is a decline from 13 infestations covering 5 ha recorded in 1990.

Sunshine Coast TSA

For the third consecutive year no beetle attacks were noted in the Sunshine Coast TSA. As recently as 1986, an estimated 2770 ha of infested lodgepole pine were mapped along the Homathko River. Until the remaining pine reaches maturity, the mountain pine beetle will probably remain at endemic levels. Beetle populations are increasing directly to the north of the headwaters of the Homathko River in the Cariboo Forest Region.

Forecast

Beetle ground cruises and surveys were not undertaken this year due to population decreases, host depletion and inaccessibility of sites, so no population assessments are available. However, based on historical trends, mountain pine beetle caused mortality is expected to continue at similar levels in 1992.

Pinewood Nematode
Bursaphelenchus xylophilus

Pinewood nematode surveys continued in the Vancouver Region in 1991, but with a different focus. In response to the European Economic Communities (EEC) ban on non-kiln dried (green) softwood products, a cooperative study involving the Council of Forest Industries (COFI), Forintek and Forestry Canada-FIDS was initiated. The study is investigating control of the nematode and its potential vector, *Monochamus* spp., by a heat pasteurization treatment. The purpose of the study is to obtain information on a possible alternative treatment to kiln drying. A ban on non-kiln dried material would affect more than $600 million in export lumber annually from British Columbia. Surveys by FIDS, which over the past decade which have shown the pinewood nematode to be extremely rare in British Columbia, are also aimed at continuing to collect information to support a possible exemption from the ban for two species, cedar and hemlock.

Six dry land and water sorts and felled and bucked sites were surveyed for active woodborer populations. At one site in the upper Squamish River Valley, some woodborers including the white-spotted sawyer beetle, *M. scutellatus*, and a cerambycid woodborer, *Leptura* sp. were active in felled and bucked timber. Twenty four infested amabilis fir were removed and milled prior

to being subjected to a heat pasteurization process. Results of this process will be available following completion of the trials later this year.

FIDS surveys have found only 6 of over 2000 samples collected since 1980 to contain the nematode. These collections represent only individual predisposed (stressed) trees at a few widespread locations. Forestry Canada-FIDS will continue to participate when required in nematode related surveys in future years.

Pine needle sheathminer
Zelleria haimbachi

Damage caused by the pine needle sheathminer was not seen or reported in the Vancouver Region in 1991 following five consecutive years of recorded damage. This followed light defoliation of young lodgepole pine over a wide area in 1990. Populations in the Kamloops Region also declined this year, particularly in the western portions adjoining the Vancouver Region

European pine shoot moth
Rhyacionia buoliana

There was no reported or observed spread of this pest in native stands in 1991. It was first found in Douglas-fir that were growing in close proximity to severely infested Scots pine in a Christmas tree plantation in Richmond in 1989. The European pine shoot moth is established in ornamental pine trees on Vancouver Island from Victoria to Courtenay, in the lower Fraser Valley from Vancouver to Chilliwack, and in the Okanagan Valley. Surveys for this pest will continue in 1992.

HEMLOCK PESTS

Western blackheaded budworm
Acleris gloverana

Blackheaded budworm populations on northern Vancouver Island which declined last year, collapsed this year following three years of recorded defoliation. No defoliation was mapped during aerial surveys, down from 630 ha in 1990, 7400 ha in 1989, and 4830 ha in 1988. No larvae were collected in standard beating samples at nine locations within or adjacent to previously infested stands contained no budworm.

Top stripping which was evident at nine widely scattered areas totaling 225 ha in 1990 was not seen this year. Young trees that were severely defoliated are showing signs of recovery, approximately 40% of the trees are now refoliating with 10% of branches now showing tufts of foliage sprouting. There is only 1-2% mortality in several areas surveyed, and foliage and trees in general are now appearing healthy with vigorous growth. There was no mortality

and little top kill recorded following the last, 1970-73, outbreak on Vancouver Island. Populations and tree recovery will continue to be monitored in 1992.

A tip die-back
Sclerophoma pithyophila

This normally secondary opportunistic fungus was isolated from the dead tops and branch tips of western and mountain hemlock from the Anderson River through to the Harrison Lake and Chilliwack River areas and the Mamquam River area near Squamish. An average of 50% (range 11-100) of the trees in four stands were affected. The disease attacks stressed trees, usually following drought or frost damage. The severe winter weather in Dec. 1990-Jan. 1991 probably predisposed the trees thus providing an entry court for the disease. Multiple tops and crooked or forked leaders could result from repeated infections.

TRUE FIR PESTS

Western balsam bark beetle
Dryocoetes confusus

Balsam bark beetle killed some 12 400 mature alpine fir over 1105 ha, down from 13 600 trees over 1385 ha in 1990 (table 6). Volume killed declined to 13 600 m3 from 14 940 m3 in 1990.

Table 6. Estimated balsam mortality by western balsam bark beetle, from aerial surveys, Vancouver Forest Region, 1991

TSA	Area (ha) 1991	Area (ha) 1990	Number of trees killed 1991	Number of trees killed 1990	Volume killed (m^3) 1991	Volume killed (m^3) 1990
FRASER	700	1 010	8 600	10 890	7 900	9 900
SOO	375	365	4 600	3 950	4 200	3 600
MID-COAST	30	10	400	100	300	100
TOTAL	1 105	1 385	13 600	14 940	12 400	13 600

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 assessment of the damage caused by this pest difficult. Surveys to delineate damage caused by the bark beetle-fungus complex will continue next year.

Balsam woolly adelgid
Adelges piceae

Surveys to detect active Balsam Woolly Adelgid (BWA) populations in the Region continued in 1991. A new area of active populations was found outside the quarantine and regulation zones at Lizzie Creek on the east side of Lillooet Lake. Damage was found in an approximately 10-year-old stand as well as in young growth under the mature canopy. Minor gouting and growth loss were evident in <5% of the regeneration. Adelgids were active on Hornby Island for the second consecutive year after being found there for the first time in 1990. This site was also beyond the quarantine and regulation zones when first discovered. Due to these recent finds, the boundaries are now under review. Active populations with recent and cumulative damage were observed in the Koksilah River area behind Shawnigan Lake where young (<25 year-old) grand fir were severely gouted, causing stem deformity and growth loss. An exotic species, noble fir, planted in this same area showed no sign of infestation.

As part of ongoing surveys in the region, thirteen young natural and planted stands where true fir made up more than 20% of the stand component were surveyed for the presence of the adelgid (Table 7). Damage and/or active populations were found at only one site.

Table 7. Results of BWA surveys in young stands, Vancouver Region, 1991.

Location	Species sampled[1]	Inside/outside regulation zone	BWA present/remarks
FRASER TSA			
Mowhokam Cr.	alF	outside	negative
Ainslie Cr.	alF	outside	negative
Chipmunk Cr.	aF	inside	negative
Lembke Cr.	aF	inside	negative
Daniels Cr.	aF	inside	negative
Eastcap Cr.	aF	inside	negative
Hesketh Cr.	aF	inside	negative
SOO TSA			
Crawford Cr.	aF	inside	negative
Eight Mile Cr.	alF	outside	negative
Lizzie Cr.	aF	outside	positive
STRATHCONA TSA			
Memekay W. M/L	aF	inside	negative
Quatchka Cr.	aF	inside	negative
SUNSHINE COAST TSA			
Carlson Cr.	gF	inside	negative

[1] alF=alpine fir; af=amabilis fir; gF=grand fir

Active populations and damage were also detected as part of other ongoing surveys. At the Angus P. MacBean Seed Orchard near Nanaimo, 80% of young amabilis fir trees were infested causing gouting and deformed growth. At Mt. Newton Seed Orchard, no adelgids were found in samples, however moderate to severe gouting was visible on 80% of the young amabilis fir.

Seven pockets of amabilis fir mortality totaling approximately 140 ha east of Port Alberni were again visible during aerial surveys after first being mapped in 1990. This area is bordering the Balsam Woolly Adelgid Quarantine Zone and could be adelgid related as active populations were collected during 1990. However, the low population levels found at that time would not have caused the mortality on their own; other factors such as root rot, poor site, over-maturity or environmental factors may have contributed to or been the sole cause of the mortality.

Surveys to detect the spread of this important quarantine pest will continue next year.

A balsam shoot boring sawfly
Pleroneura sp.

After three consecutive years of infestations, shoot boring sawfly populations in high elevation balsam stands declined throughout the Region. There was no evidence of recent damage in areas infested in 1990. Damage was found in a higher elevation site at Eight Mile Creek, north of Pemberton, where <10% of the lateral shoots on 75% of the trees were currently infested. The cold wet spring and early summer may have caused the population decline.

There is one sawfly generation a year with adults emerging in the spring from overwintering pupae or cocoons. Eggs laid near the tip of the shoot hatch into creamy-white grubs which burrow into the shoot and feed until mid-summer, then drop to the ground to spin cocoons.

SPRUCE PESTS

Spruce beetle
Dendroctonus rufipennis

Spruce beetle populations declined for the fifth consecutive year. Only two ha of recent mortality were recorded in Sitka spruce along the Nusatum River near Bella Coola in the Mid-coast TSA. In 1990, 5 ha of recent mortality was recorded in the same drainage. Populations remained low throughout the rest of the Region, mainly due to a lack of suitable host material.

Spruce weevil
Pissodes strobi

The spruce weevil continued to cause leader mortality of immature Sitka spruce throughout the host's range in the Region. Surveys in 1991 recorded an average of 10% of the leaders attacked at four locations on Vancouver Island from Jordan River to Holberg. At one location in the mid-coast district, in a low elevation site along the Nusatum River, 50% current attack was recorded in a 5 ha block. The weevil has virtually eliminated spruce as a choice of species for regeneration in this area.

Weevil attacks have been a chronic problem in the Vancouver Region for several decades, with populations fluctuating from year to year and site to site but always evident. Clipping and predator release programs have been ongoing for several years with varying degrees of success. There is potential for a reduction of merchantable timber at rotation age due to crook, stem decay and other deformities resulting from weevil attack, particularly in areas where high incidences of attack occur over several years. Surveys will continue in 1992.

Spruce aphid
Elatobium abietinum

Defoliation of sitka spruce by the spruce aphid declined from levels noted in 1990. Pockets of light to moderate defoliation were scattered throughout coastal and some urban areas in the region. Defoliation continued, but at reduced levels, in the Campbell River area on Vancouver Island where severe defoliation occurred in 1990. No mortality was observed as a result of last years damage but some of the most severely defoliated trees may not fully recover. FIDS will monitor tree recovery in this area as well as population fluctuations of this pest in 1992.

CEDAR PESTS

Cedar leaf blight
Didymascella thujina

Infections by this leaf blight fungus, while continuing to be widespread, declined overall from high levels recorded in 1990. The disease was common in forest stands on the the north shore of Vancouver and the Upper Fraser Valley. Up to 100% of the old foliage was infected on groups or scattered individuals in dense stands, but infections are more common on the lower branches.

The infected leaves may be mistaken for natural flagging which commonly occurs on western red cedar, as both old and infected foliage die over the summer. In the case of the leaf blight, infected foliage becomes gray and small black fruiting bodies or holes can be found on the upper side of the scales.

High levels of infection can cause sapling mortality while older trees will exhibit minor growth reduction and branch mortality, mainly in the lower crown.

Cedar flagging

The incidence of cedar flagging declined considerably, particularly in the mainland portion of the region. Some flagging is natural and is expected, heavy flagging is often stress related. The cool wet spring and early summer probably helped cedar trees which have been suffering from drought conditions over past years. Discoloration was still evident in some areas, the most visible damage was on the Gulf Islands, on eastern Vancouver Island and the in the Pemberton area.

MULTIPLE HOST PESTS

Acid rain plots

Annual assessments of tree condition, mortality, acid rain symptoms, and insect and disease conditions were made at the 10 ARNEWS (Acid Rain National Early Warning System) study plots in the Vancouver Region. No **acid rain** symptoms, including damage to herbaceous vegetation, was recorded. Some **foliar discoloration**, mainly in the form of chlorotic older foliage in the lower crown of western hemlock, was recorded at six of the ten plots; however, all of the symptoms were attributed to natural causes.

Tree mortality was recorded in seven of the plots, a total of 19 trees died (Table 8). The largest single cause of mortality was **shading out/suppression** which killed 14 trees. Mainly secondary **bark beetles** found in four of these trees were probably attracted as the trees became stressed. Three trees were killed by **Armillaria root disease** and 2 trees were killed as a result of **storm damage**. The 1991 mortality represents only 3% of the total number of trees in all the ARNEWS plots in the Vancouver Region. To date 88 trees, or 13% of the total, have died with all mortality attributable to natural causes.

Table 8. Current and cumulative tree mortality in ARNEWS plots, Vancouver Region, 1991.

Plot number and location	Sps[1]	Total # trees at plot est.	Mortality			
			1991	1984-1990	Total	Cause in 1991
901-Shawnigan Lk.	dF	120	4	20	24	shaded/suppressed
	W	8	1	2	3	shaded/suppressed
	wwP	2	-	-	-	- -
902-UBC forest	wH	32	1	13	14	shaded/suppressed
	wrC	15	1	5	6	shaded/suppressed
	B	3	-	1	1	- -

(Cont'd)

Table 8. (Cont'd)

Plot number and location	Sps[1]	Total # trees at plot est.	Mortality 1991	Mortality 1984-1990	Mortality Total	Cause in 1991
903-Saltspring	dF	100	2	15	17	shaded/suppressed
	wrC	2	-	-	-	-
904-John Hart Lkl.	dF	30	-	1	1	-
	lP	1	-	-	-	-
909-Jones Lake	wH	57	3	5	8	-
	dF	2	-	-	-	-
	wrC	1	-	-	-	-
910-Capilano R.	aF	57	4	2	6	shaded/suppressed and bark beetles. Pseudohylesinus sp. in 3 trees, Scolytus ventralis in one tree
	wH	17				-
	wrC	1	-	-	-	-
911-Seymour R.	dF	36	3	2	5	Armillaria ostoyae
	wH	2	-	-	-	-
912-Seymour R.	dF	24	-	2	2	-
	wH	23	-	-	-	-
913-Orr Creek	wH	46	-	-	-	-
	wrC	20	-	1	1	-
	aF	3	-	-	-	-
	dF	2	-			-
914-Coquitlam Lk.	aF	36	-			-
	wH	29	-			-
Total		674	19	69	88	
Percent mortality			3%	10%	13%	

[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

These plots, part of a national system to gather baseline data on acid rain in Canada's forests, will continue to be monitored in 1992.

Pests of young stands

A total of 39 young stands ranging in age from two to thirty years old were surveyed for pest incidence in the Vancouver Region in 1991. A total of 4105 trees representing 13 species were examined, of which 2230 or 54% were pest free. The results of the survey are summarized in table 9.

The most common pest was the Cooley spruce gall adelgid, Adelges cooleyi, found infesting 991 trees overall, or 24% of trees surveyed. The most damaging pest was root rot, both laminated root rot, Phellinus weirii, and armillaria root disease, Armillaria ostoyae. A total of 18 trees (<1% of the total surveyed) representing 4 species were recently dead or dying.

Table 9. Results of pests of young stands surveys, by host and pest in descending order of importance, Vancouver Region, 1991.

Pest/problem	Severity index[1]	Affected # of Stands	Affected # of Trees	Remarks
DOUGLAS-FIR - 2097 TREES IN 32 STANDS, 940 PEST FREE, MAJOR SPECIES[2] IN 31 STANDS				
armillaria root rot	6	4	9	dead and dying trees
laminated root rot	6	4	8	dead and dying trees
storm damage	6	3	3	blown over, dead
herbicide damage	6	1	1	mortality from spray
bear damage	5	1	12	partially girdled stems
storm damage	4	1	2	broken tops
unflushed buds	4	7	104	winter damage
poor form	4	4	6	extreme crook, snow press?
browse	4	7	83	causing bushy tops
spruce budworm	3	1	6	trace-light defoliation
Cooley spruce gall adelgid	2	19	964	mainly light infestations
Swiss needle cast	2	1	5	light infections
herbicide damage	2	1	18	trace-light damage
WESTERN HEMLOCK - 786 TREES IN 26 STANDS, 751 PEST FREE, MAJOR SPECIES IN 11 STANDS				
armillaria root rot	6	1	2	dead trees
blowdown	6	1	1	blown over, dead
leader and branch mortality	4	6	35	old winter damage?
hemlock-blueberry rust	2	1	11	light infections
winter flecking	2	1	10	light foliar discoloration
WESTERN RED CEDAR - 405 TREES IN 20 STANDS, 149 PEST FREE, MAJOR SPECIES IN 6 STANDS				
armillaria root rot	6	1	1	mortality
blowdown	6	1	1	blown over, dead
poor form	4	1	1	extreme crook, snow press?
multiple top	4	1	1	cause unknown
browse	3	5	16	mainly light damage
cedar blight	2	4	235	light infections
tip die-back	2	1	3	old winter damage?

(Cont'd)

Table 9. (Cont'd)

Pest/problem	Severity index[1]	Affected # of Stands	Affected # of Trees	Remarks
AMABILIS FIR - 334 TREES IN 8 STANDS, 272 PEST FREE, MAJOR SPECIES IN 4 STANDS				
top kill	4	3	13	old winter damage?
browse	4	3	13	bushy tops, clipped leaders
poor form	4	1	16	extreme crook, snow press?
fir-fireweed rust	3	1	36	light-moderate infections
a needle cast	3	1	1	moderate infection
balsam twig aphid	2	1	1	trace-light damage
ALPINE FIR - 118 TREES IN 3 STANDS, 12 PEST FREE, MAJOR SPECIES IN 3 STANDS				
armillaria root rot	6	1	1	recent mortality
dead/multiple tops	4	1	16	old winter damage?
unflushed buds	4	1	5	winter damage
poor form	4	1	2	extreme crook, snow press?
fir-fireweed rust	3	2	95	light-moderate infections
balsam shoot boring sawfly	3	1	12	mainly old damage, trace new
spruce budworm	2	1	2	trace defoliation
ENGLEMANN SPRUCE - 73 TREES IN 3 STANDS, 28 PEST FREE, MAJOR SPECIES IN 2 STANDS				
unflushed buds	4	1	2	winter damage
balsam twig aphid	3	1	15	light-moderate infestations
frost damage	3	1	1	lateral flush killed
cooley spruce gall adelgid	2	1	26	mainly old galls
an adelgid	2	1	1	trace damage
spruce budworm	2	1	15	trace-light defoliation
GRAND FIR - 52 TREES IN 3 STANDS, 21 PEST FREE, MAJOR SPECIES IN 2 STANDS				
fir-fireweed rust	2	1	31	light infections
PONDEROSA PINE - 44 TREES IN 1 STAND, 9 PEST FREE, MAJOR SPECIES IN 1 STAND				
multiple top	4	1	2	cause unknown
a secondary needle disease	2	1	33	light infections
MOUNTAIN HEMLOCK - 34 TREES IN 1 STAND, 32 PEST FREE, MAJOR SPECIES IN 1 STAND				
dead top	4	1	1	old winter damage?
multiple top	4	1	1	old browse damage?
LODGEPOLE PINE - 20 TREES IN 4 STANDS, 17 PEST FREE, MINOR SPECIES[3]				
western gall rust	5	1	1	stem gall
poor form	4	1	1	extreme crook

(Cont'd)

Table 9. (Cont'd)

Pest/problem	Severity index[1]	Affected # of Stands	Affected # of Trees	Remarks
WESTERN WHITE PINE - 15 TREES IN 7 STANDS, 9 PEST FREE, MINOR SPECIES				
white pine blister rust	6	3	4	all dead
poor form	4	1	2	extreme crook
YELLOW CEDAR - 12 TREES IN 2 STANDS, 9 PEST FREE, MINOR SPECIES				
dead tops	4	1	3	old winter damage
SITKA SPRUCE - 5 TREES IN 3 STANDS, 4 PEST FREE, MINOR SPECIES				
cooley spruce gall adelgid	2	1	1	light infestation

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] major species comprises more than 20% of stand and more than 20 trees surveyed per site

[3] minor species comprises less than 20% of stand and 20 trees or less surveyed per site

Seed orchards

Thirteen seed orchards in the Vancouver region were surveyed two or more times during 1991 for the early detection of insects, diseases and abiotic damage as well as damage assessments, discussions of management options and transfer of technical information. During these surveys, numerous insects, diseases, and other problems were recorded, most of which are not serious. Where any serious problems were encountered, seed orchard staff were contacted and further studies were carried out. The low incidence of significantly serious insect or disease problems is indicative of the efforts and attention to potential problems displayed by seed orchard staff. Some of the most common pests are noted below, a complete detailed list of all pests found during these surveys has been compiled as an appendix to this report and is available upon request.

Douglas-fir

The **Cooley spruce gall adelgid**, Adelges cooleyi, was the most common pest on Douglas-fir, lightly to moderately infesting up to 100% of the trees at eight of ten orchards. Low levels of **western spruce budworm**, Choristoneura occidentalis, were recorded at three orchards.

Western hemlock

The **hemlock woolly adelgid**, Adelges tsugae, was the most common pest of western hemlock, lightly infesting up to 80% of the trees at two locations surveyed.

True fir

Damage by the **balsam woolly adelgid**, Adelges piceae, was noted at two of the three orchards growing Abies spp. which were surveyed. The **balsam twig aphid**, Mindarus abietinus, caused light damage to 20% of the foliage on 50% of the trees at one location.

Sitka spruce

Galls formed by the **Cooley spruce gall adelgid**, Adelges cooleyi, were noted on an average of 10% of new tips on 75% of the trees at one orchard.

Seed orchard surveys will continue in 1992 and significant problems will be reported as they are noted.

Winter damage

Severe winter winds and cold weather in December 1990-January 1991 combined to cause extensive bud kill, mainly on Douglas-fir, with Engelmann spruce and true firs affected to a lesser degree. Damage was recorded in both the Fraser and Soo TSAs, from the North Mowhokam Creek area throughout the Fraser Canyon and the Chilliwack River valley area, and in the Pemberton-Whistler-Squamish area. The affected trees failed to flush or exhibited only partial flush of deformed needles. Those portions of the trees below the snow line during the winter were unaffected, with normal healthy bud flush and lateral shoot development. Severe winter weather also caused 'red belt' type injury to mainly lodgepole pine over some 340 ha in the Noomst and Burnt Bridge creeks area east of Bella Coola in the Mid-coast TSA.

An area west of Bella Coola where extensive winter damage, including defoliation and blowdown, was recorded over some 9300 ha in 1990 (the result of severe winter weather in 1989) was re-assessed for damage and recovery this year. A cruise strip near Clayton Falls Creek, where over 1000 ha of severe defoliation was recorded in 1990, found 60% of the affected trees alive and healthy, 32% of the trees dead, and 8% of the trees windthrown (total mortality 40%). Original estimates after assessing the damage in 1990 indicated that mortality could be as high as 50-75%; however, recovery has been somewhat better than expected. Tree species affected in the area are western hemlock, sitka spruce, western red cedar, amabilis fir and black cottonwood.

DECIDUOUS PESTS

Gypsy moth
Lymantria dispar

Two adult male Gypsy moths were caught in pheromone-baited sticky traps placed at 100 locations, mainly in provincial and municipal parks, throughout the Vancouver Region by FIDS. One moth was caught at Alice Lake Provincial Park north of Squamish and one at Golden Ears Provincial park north of Maple Ridge. No moths were trapped by FIDS in 1990. About 70 moths were caught by Agriculture Canada this year, compared to 121 in 1990.

Twelve of the 72 males have been confirmed by DNA analysis to be the Asian strain of the Gypsy moth, and 13 more are suspected. These are the first known captures of this strain in North America. The Asian adults in the Vancouver area were trapped in the vicinity of the Pacific National Exhibition, near Stanley Park and in North and West Vancouver.

The Asian strain was introduced to the Vancouver area via cargo vessels originating from ports in eastern Russia where large infestations have been reported. Adults were attracted to lights on the ships and laid egg masses on the vessels. These egg masses hatched and young larvae were reported ballooning to shore in the Port of Vancouver this past summer. The difference between the Asian and European strains is the female, which is capable of flight, thus potentially able to spread populations further and faster than the European strain already established in eastern North America. A spray program, using Bacillus thuringiensis var. kurstaki (Btk., Foray 48B) is proposed for infested areas of the City of Vancouver and the north shore (aerial and ground application)in an attempt to eradicate the Asian strain.

Only one male was caught on the Saanich peninsula south of the Victoria International Airport where high trap catches (96 males) and the discovery of numerous egg masses (37) in 1990 prompted aerial (113 ha) and ground (40 ha) applications of B.t.k. in late April to late May 1991. This eradication effort was apparently successful based on the very low number (1) of adults caught in the area this year. Seven males and at least one egg mass were found at Parksville near where aerial (85 ha) and ground (7.5 ha) applications of B.t.k. were completed in 1990. This is the fifth consecutive year that moths were caught in the Parksville area, and a control program consisting of aerial and ground application of B.t.k. is proposed for this area in 1992. An aerial and ground spray control program is also being considered for the Colwood (Belmont Park) area following adult catches and egg mass finds for the second consecutive year.

Other areas where Agriculture Canada caught adults were; for the third consecutive year, West Vancouver and Vancouver; and for the second consecutive year Victoria, Coquitlam and Comox. New catches were made at Saltspring Island, Courtenay, Lynn Valley, Langley, Surrey, Aldergrove and Richmond.

This is the fifteenth year of a cooperative program with Agriculture Canada (plant health), the B.C. Ministry of Forests and FIDS, Forestry Canada.

Over 8000 sticky traps were placed throughout the province in 1991 as part of this program, and traps will continue to be placed and monitored by all participating agencies in 1992.

Winter moth
Operophtera brumata

Winter moth populations declined to very low levels throughout the lower mainland area following two consecutive years of increasing populations after first being noted in 1989. On Vancouver Island, populations also declined below levels reported in 1990.

Mainly trace with occasional light defoliation occurred in patches from Vancouver south to the Richmond and Ladner area. The highest populations were seen in the Marine Drive area south of U.B.C. with scattered light defoliation of ornamental and shade trees. No defoliation was seen in birch stands adjacent to Highway 99, the area that suffered the worst defoliation in 1990.

On southern Vancouver Island, light defoliation again occurred in scattered locations in the Greater Victoria area after increasing populations and defoliation was recorded in 1990. Garry oak, bigleaf maple, birch, elm and other ornamental and fruit trees were affected.

A biological control program on Vancouver Island involving the release of parasitic flies and wasps initiated in 1979 has been reasonably successful in controlling winter moth populations. To date no biological control program has been initiated in the lower mainland area. Homeowners can help prevent defoliation of ornamentals and fruit trees by applying a sticky barrier, (i.e. tanglefoot) to tarpaper bands around tree trunks in late October. The barrier prevents the flightless females from crawling up the trunk to lay eggs, the barrier should be left in place until mid-January.

Western winter moth
Erannis tiliaria vancouverensis

Western winter moth populations remained at low levels throughout the lower mainland and Fraser Canyon areas with the exception of one location. At Alexandra Bridge Provincial Park and surrounding area various understory deciduous trees and shrubs including alder, Douglas and bigleaf maple, willow and dogwood were moderately to severely defoliated over some 20 ha.

Low populations with some scattered trace defoliation occurred between Emory Creek Provincial Park and Cultus Lake near Chilliwack. At Cultus Lake Provincial Park some trace defoliation was observed; however, dead and dying larvae were also noted in this area. A mass collection in early June confirmed the presence of the nuclear polyhedrosis virus (NPV). This virus which is responsible for the collapse of many different defoliator outbreaks, was isolated from populations in this area last year and was probably responsible for the population collapse in this area which was severely defoliated two years ago.

Elsewhere in the Region, no defoliation was observed or reported in the Harrison Lake-Sasquatch Provincial Park area or in the Squamish-Horshoe Bay and UBC areas, locations where populations and some defoliation was recorded last year.

No tree mortality is anticipated as a direct result of defoliation; however, trees severely defoliated for two or three consecutive years will probably experience some growth reduction. Only trees already under severe stress are likely to die. Trees usually refoliate by mid-July. FIDS will continue to monitor this pest in 1992.

An Oak leaf phylloxeran
Phylloxera sp. near glabra

Premature browning and defoliation of Garry oak, caused by an introduced oak leaf phylloxeran, affected about 10% of the oaks in the greater Victoria area, unchanged from 1990. This year, damage was reported for the first time on Salt Spring and Galiano Islands and in Nanaimo. The phylloxeran tends to re-attack previously infested trees, many of these repeatedly attacked trees in the Capital area are currently in very poor health.

Damage is expected to continue on chronically infested trees and may spread throughout the entire geographic range of Garry oak in B.C.
The damage caused by this insect can be identified by examining the lower surface of affected foliage, the oak leaf phylloxeran-injured leaves are covered with numerous minute orange insects resembling aphids.

Jumping gall wasp
Neuroterus saltatorius

Severe scorching and some defoliation of Garry oak foliage caused by the jumping gall wasp increased for the sixth consecutive year in the greater Victoria area. The infestation spread noticeably southwest towards Albert Head, east towards Gordon Head and south to the Saanich/Victoria border. One area in Oak Bay, Cattle Point, showed noticeable damage. A slight northward movement also occurred to the southwest slopes of Mt. Newton in Central Saanich. Oak woodlands in the worst hit areas were completely scorched by late July, attracting much attention.

Rearings at PFC indicate a continuing relatively low level of parasitism by four species of chalcid parasitoids, however, in a few sites the level of parasitism was somewhat higher (20-30%). Damage is expected to continue in previously infested areas with further expansion of the infestation south into Victoria and Oak Bay. Jumping gall wasp infested foliage can be identified by examining the underside of the leaves, which have large numbers of small, 1.0- to 1.5-mm round galls attached to the them.

A sawfly
Nematus sp. or Amauronematus sp.

Moderate to severe defoliation of mature native black cottonwood stands was observed over approximately 50 ha on Herrling Island in the Fraser River in late May-early June. Additional surveys noted light defoliation on several more Fraser River islands from below Agassiz to Herrling Island. These islands support both native cottonwood stands and hybrid poplar plantations under license to Scott Paper. All surveys of these islands were carried out in cooperation with Scott paper.

Initial surveys found no evidence of the causal agent as the larvae had already dropped to the ground, however, a subsequent survey in the same area found numerous sawfly cocoons in the duff below the defoliated trees. These cocoons are presently in rearing at PFC. Neither of these two species of sawfly have caused significant recorded damage to native cottonwoods in the past. The extent and severity of the defoliation, coupled with the presence of high-value hybrid plantations in the same area as the defoliated stands makes the identification of the insect and observation of the extent of any further defoliation of some importance. Further early season surveys in 1992 are planned in order to supplement the 1991 collections of the pest and to help confirm the identification. FIDS will continue to monitor and report any spread of this insect, particularly if it moves into adjacent high-value hybrid poplar plantations.

Bigleaf maple scorch and leafspots
Rhytisma punctatum
Cristulariella depradens
Xylella fastidiosa?

The intensity and area of bigleaf maple scorch declined overall in 1991. Most of the decline occurred on the mainland, while on Vancouver Island and Gulf Islands areas intensities remained similar to 1990.

By early summer, scorch and leaf spot was most visible at Stanley Park and near Boston Bar. Discoloration was not visible on bigleaf maple throughout the rest of the lower mainland area until late summer-early fall. Leaf spotting was caused by two fungi; tar spot, R. punctatum and a leaf spot, C. depradens. On Vancouver Island, leaf margin discoloration was visible at the same time and throughout most of the same areas as in 1990.

Preliminary tests using an Enzyme-linked Immunosorbent Assay (ELISA) test indicate that some of the scorched maple leaves from Stanley Park were infected by X. fastidiosa, a xylem inhabiting bacterium. Not all of the scorched leaves tested positive for this pathogen. The positive samples are currently being tested for confirmation, along with several additional samples taken from widespread locations on Vancouver Island, the Gulf Islands and the lower mainland-sunshine coast area. If confirmed, this will be the first record of this wilt pathogen on bigleaf maple.

FIDS will continue to make collections and observe and report on bigleaf maple discoloration next year.

Dogwood leaf blight
Discula (=Gloeosporium) destructiva

Discoloration and premature defoliation of western flowering dogwood by this leaf blight fungus was again severe throughout most of the host range in 1991. A chronic and common problem in the region for over a decade, the blight causes branch dieback and some mortality, especially on heavily infected understory trees.

Infections of up to 100% of the foliage was common, even on some of the more open growing trees, and was widespread from south of Boston Bar to Vancouver, the Squamish and sunshine coast areas and throughout most of the southern half of Vancouver Island. The extremely wet spring weather is largely responsible for the continued high levels of infection. The infected foliage hangs on the trees rather than dropping off in the fall, thus the inoculum is present on the trees in the spring where rain splash causes spore dispersal to adjacent healthy foliage. Homeowners can try to protect ornamental trees by removing and burning infected foliage as well as raking up and removing all foliage from under the trees before leaf flush in the spring.

Fall Webworm
Hyphantria cunea

For the third consecutive year, this common defoliator of willow, alder, poplar, and various fruit and ornamental trees caused light to moderate defoliation of branches in the Chilliwack and Agassiz areas in the upper Fraser Valley and on southeastern Vancouver Island from Victoria to Comox. For the first time in many years, populations were noted in the sunshine coast area. Light branch defoliation occurred on scattered individual trees from Powell River to Saltery Bay. Moderate and occasionally severe defoliation (entire smaller trees covered by tents) was seen from south of Earls cove to Sechelt. Very occasional tents were also noted in the Fraser valley through Surrey and Langley.

In severe infestations, such as south of Earls Cove, larvae can defoliate entire trees. Homeowners wishing to protect fruit and shade trees can clip and burn branches bearing webs. Insecticides registered for use against leaf-chewing insects should be effective if sprayed on the feeding areas when the young caterpillars are spinning webs, usually in early summer.

Birch leafminer
Fenusa pusilla

Leafminer damage, mainly consisting of blotched and wrinkled foliage, declined throughout the lower mainland in 1991. Light damage was visible in the Agassiz-Harrison-Hope area in the upper Fraser Valley and in some areas in Vancouver, including natural regeneration in the Coquitlam watershed. The ambermarked birch leaf miner, Profenusa thompsoni, which was common in the lower mainland in conjunction with F. pusilla last year was not collected in 1991. The damage caused by these pests is primarily aesthetic. Severe infestations in

ornamental or shade trees may cause unsightly, premature browning of foliage. Control may be obtained through the use of systemic insecticides.

OTHER NOTEWORTHY AND MINOR PESTS

Table 10. Other noteworthy and minor pests, Vancouver Region, 1991.

Host and Pest	Location	Remarks
Douglas-fir		
A sawfly, *Neodiprion* sp.	region-wide	larvae common in collections
Green-striped forest looper, *Melanolophia imitata*	region-wide	larvae common in collections
Silver spotted tigermoth, *Lophocampa argentata*	region-wide	scattered light defoliation
Swiss needle cast, *Phaeocryptopus gaeumannii*	region-wide	scattered light infections
Lodgepole pine		
A pine needle cast *Lophodermella concolor*	Hornby Island, Port Alberni	moderate infections in localized stands
Western gall rust *Endocronartium harknessii*	Ucluelet, Pemberton	light-moderate infections common in localized areas
Ornamental cedar, cypress, juniper		
Cypress tip moth, *Argyresthia* sp.	Vancouver Island	scattered Light foliar damage
Sitka spruce		
A spruce needle cast *Lirula macrospora*	Port Alice area	common on up to 50% of foliage
Large-spored spruce-Labrador tea rust, *Chrysomyxa ledicola*	Port Alice area	severe infections, 100% new foliage infected on 100% of trees.
Spruce budmoth *Zeiraphera* sp.	Vancouver Island	light defoliation in scattered patches along west coast

(Cont'd)

Table 10. (Cont'd)

Host and Pest	Location	Remarks
Western hemlock		
A sawfly, Neodiprion sp.	northern Vancouver Island	moderate numbers of larvae common in collections
Dwarf mistletoe Arceuthobium tsugense	region-wide	endemic, widespread
Western hemlock looper Lambdina f. lugubrosa	north-central Vancouver Island, some mainland areas	larvae appearing in collections some adults in pheromone traps
Western larch		
Larch sawfly Pristiphora erichsonii	lower mainland	scattered light defoliation of ornamentals
Yellow cedar		
Cypress twig mite, Triseticus chamaecypari	Vancouver Island	common on ornamentals and in seed orchards
Alder		
A leaf spot fungus, Taphrina japonica	south Vancouver Island, upper Fraser Valley	moderate infections common on alder foliage
Alder casebearer Coleophora sp.	Harrison Lake area	common, causing light skeletonizing
Alder flea beetle Altica ambiens	U.B.C. Demo. forest	causing scattered light to moderate defoliation
Alder woolly sawfly Eriocampa ovata	upper Fraser Valley	common, causing scattered moderate defoliation
Apple		
Apple ermine moth, Yponomeuta malinella	southern Vancouver Island	light defoliation at scattered locations

(Cont'd)

Table 10. (Cont'd)

Host and Pest	Location	Remarks
Cottonwood		
A bud midge, *Dasineura* sp.	southwestern B.C.	common for fifth consecutive year, mainly light bud kill
A leafblotch miner *Phyllonorycter* sp.	Herrling Island, Fraser River	moderate infestation on hybrid poplar
Septoria leaf spot *Mycosphaerella populorum*	Harrison Mills	causing light-moderate leaf spot, common on hybrid poplar

NEW RECORDS OF OCCURRENCE AND DISTRIBUTION

A total of five disease and one insect collections in 1991 were new host records in the Vancouver Forest Region. The new disease records were minor decay fungi, a saprophytes, a leaf spot and a leaf rot. Three collections were on conifer host and two on deciduous hosts. One insect collection was a new host record, a leafroller recorded on hybrid poplar.

QUEEN CHARLOTTE ISLANDS
1991

J. Vallentgoed

SUMMARY

Western blackheaded budworm populations remained at low levels since the last infestation collapsed in 1987, only a single budworm larvae was found in a sample at Tow Hill on Graham Island. Small pockets of **hemlock sawfly** remain in scattered locations on the Queen Charlotte Islands, trace defoliation of young growth was noted near Marie Lake on Graham Island. Elsewhere populations remain at low levels following the collapse in 1988. **Hemlock dwarf mistletoe** remains a chronic problem throughout the Islands, even in young stands. Minor **tip die-back** most of which was caused by abiotic factors such as late frost, was common in many areas throughout the Queen Charlotte Islands.

Spruce aphid damage increased following three years of low populations, up to 100% of Sitka spruce were moderately infested in some areas. An unknown agent causing **decline in Sitka spruce** resulted in reduced leader growth and premature foliar loss over some 1000 ha near Copper Creek on Moresby Island. Galls formed by the **Cooley spruce gall adelgid** were found for the first time on Sitka spruce in the Queen Charlotte Islands. Ornamental Douglas-fir foliage was infested for the second consecutive year following the first infections ever found on the Queen Charlotte Islands in 1990. Light **spruce needle blight** infections were found on two-year-old and older foliage at scattered locations throughout the Islands.

Conifer seedling weevil damage on Graham Island declined from high levels recorded in 1990.

Several pests currently at **endemic levels** or of **historical minor importance** were recorded and are included in a table at the end of this report.

HEMLOCK PESTS

Western blackheaded budworm
Acleris gloverana

Western blackheaded budworm populations have remained low since the infestation collapse in 1987 and are expected to remain at endemic levels in 1992. For the first time in several years a single budworm larva was found, at Tow Hill, in a standard FIDS larval sample. No larvae were collected in 13 other standard samples at accessible sites throughout the Queen Charlotte Islands.

With continued concern over losses incurred from this pest a young stand, in the Tarundl Cr. drainage, was assessed to determine the long term effects of the epidemic in conjunction with spacing. In this stand, unique because it was spaced in 1986 during the peak of the outbreak, it was noted that larvae were moving from the spaced trees onto the crop trees during spacing and the project was discontinued after an estimated 15 ha were completed. Subsequent assessment determined that the combination of the budworm feeding on the newer foliage, the sawfly feeding on older foliage (ratio of sawfly to budworm was 2.7:1 on Graham Island in 1987) and spacing concentrating the populations on crop trees resulted in almost complete defoliation at this site in 1986. There was some evidence of beginning recovery in 1987 when the feeding activity in this area was already much reduced.

Assessments of the stand in 1991 indicate complete recovery with no evidence of mortality, top kill or major branch dieback. Minor branch-tip dieback affecting a few branches in the mid and lower crowns of 14% of trees was attributed primarily to other causes such as Sirococcus strobilinus. An assessment of growth rates (based on one core from each of 10 plots) over this period indicate a dramatic growth reduction centered around 1987, the year following the most severe feeding (figure 1). Radial increment averaged 1.14 mm in 1987, only 38% of the growth recorded in 1984, the year before the outbreak. The collapse of the infestation after 1987 in conjunction with the spacing resulted in rapid and dramatic recovery with increment in 1990 averaging 7.15 mm, over six times the 1987 growth rate.

This stand was severely defoliated for only one year. What would have resulted after two or three years of similar attack is uncertain. While losses over approximately three years were significant, evidence from infestations over the years supports the suggestion that young vigorous stands in the 20 year age bracket suffer considerably less than do older stands. Numerous permanent plots, some in similar young stands, established during the epidemic could further clarify the picture of blackheaded budworm in young stands.

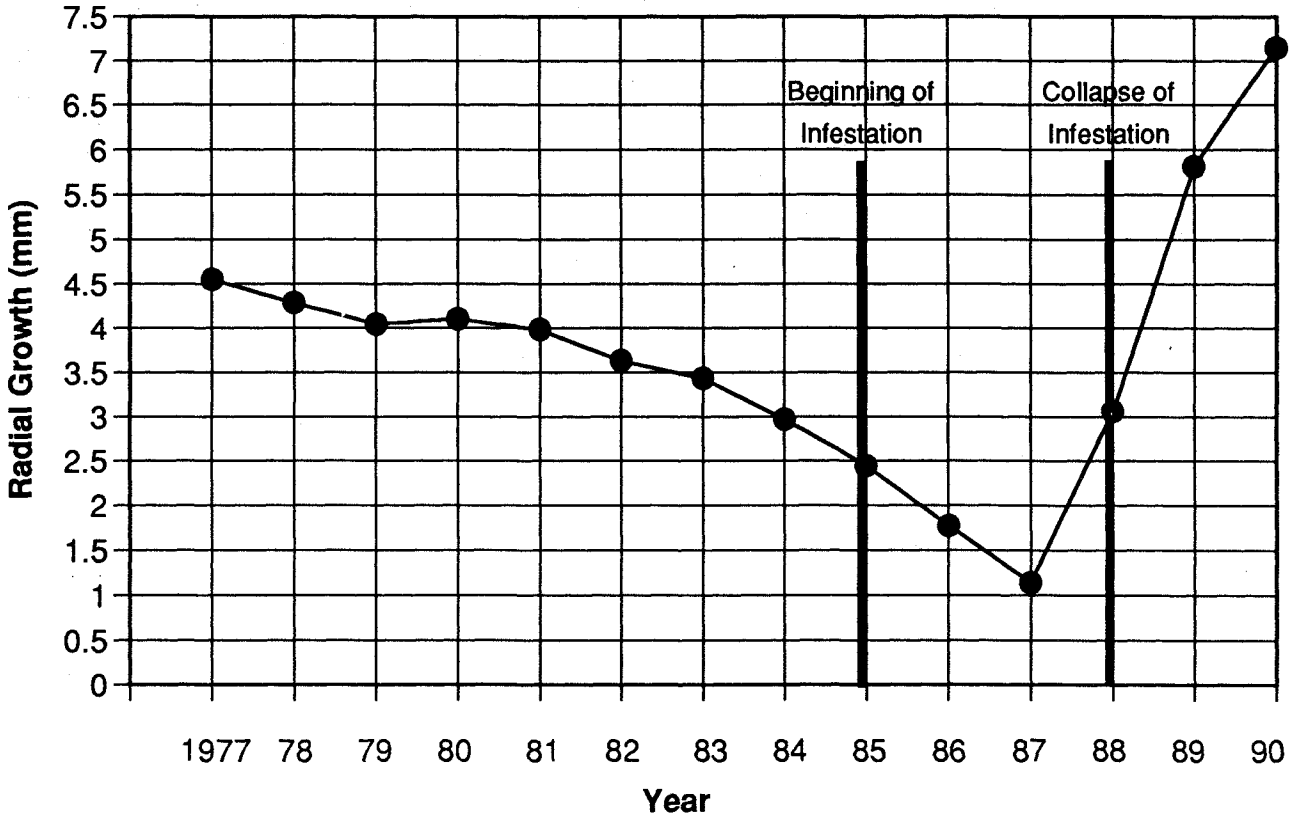


Fig. 1 Radial increment of western hemlock in Tarundl Cr. plots defoliated by western blackheaded budworm and hemlock sawfly. Queen Charlotte Islands, 1991.

Hemlock sawfly
Neodiprion tsugae

Small pockets of residual sawfly populations have remained throughout Graham Island, similar to 1990, following the collapse of the hemlock sawfly infestation in 1988. Trace defoliation was noted on young western hemlock at Marie Lake, where 130 larvae were counted from a standard sample. In mature stands at Hangover and Gregory creeks, 25 and 16 larvae respectively were found in standard samples in understory regeneration; trace spot defoliation was noted. In 22 other standard three-tree beating samples throughout the district, a maximum of four larvae and no defoliation was noted.

Historical patterns of population behavior and current sampling results suggest that populations will remain at or near endemic levels in 1992.

Hemlock dwarf mistletoe
Arceuthobium tsugense

Hemlock dwarf mistletoe remains a chronic and common parasite of western hemlock throughout the Queen Charlotte Islands. In a spaced young stand (age approx. 25) near Honna River, light infection was found on 16% of crop trees. Most of the original overstory seed trees at this site were infected and while all were mechanically girdled, 25% of these infected/girdled trees were still alive and presumably producing mistletoe plants. The girdling was done in 1989, to late in any case to prevent infection of young trees. This legacy of a previous age will continue to cause problems for another rotation unless corrected.

At Gregory Creek in an old growth stand (part of the South Moresby Forest Replacement Account (SMFRA) project 13.3), 84% of western hemlock crop trees were infected of which 56% were light, 35% moderate and 10% severely parasitized (based on limited visibility inspection due to poor light and crown closure). The majority of young to intermediate regeneration in the plot areas were also infected. As a study site for alternative harvesting methods on steep slopes, the long term success of future crops would certainly be influenced by the presence of mistletoe left in the overstory throughout the site after selective harvesting.

Tip dieback in hemlock

Minor dieback was noted on western hemlock at Skidegate Lake, Deena Creek, Rennell Sound and Tarundl Creek and was reported to be generally common in other areas. A die-back fungus, Sirococcus strobilinus, was confirmed only at Hangover Creek. At Copper Creek, near Skidegate Lake and Tarundl Creek, abiotic factors such as late frost damage was determined to be the probable cause. Various agents can cause the dieback. Sampling and lab analysis on a site specific basis would be required to determine the cause and provide a possible remedy.

SPRUCE PESTS

Spruce aphid
Elatobium abietinum

Populations of spruce aphid increased in 1991 following three years of relative inactivity. In a young stand at Heather Lake, all Sitka spruce, representing an estimated 25% of the plantation crop trees, were infested. In the older foliage, the preferred food source for the aphid, over 80% of foliage was infested in 10% of trees, 10-80% of foliage was attacked in 70% of trees, while in the remaining 20% of trees less than 10% of older foliage was infested. Current foliage was lightly (<10%) infested in only 10% of trees. Throughout both Graham and Moresby Islands populations of aphids were noted and common at many locations. At Peel Inlet, 50% of saplings were moderately infested over a

2 ha area. Light attack was also common on roadside spruce in the Moresby Camp area. On Graham Island generally light population levels were noted from west of Queen Charlotte City to Tlell. In the Lawn Hill area, young regeneration was severely infested including up to 20% of current needles. Trace levels of attack were noted in the Port Clements area and small populations were also common at Tow Hill in roadside spruce.

While no branch dieback or mortality was noted in young trees at any of the sites, this could change with continued severe defoliation. Mortality of mature Sitka spruce has been recorded in the past in association with severe spruce aphid infestations. Attack levels in 1992 will depend primarily on overwintering conditions, as aphid populations are sensitive to periods of severe cold.

Decline in Sitka spruce

Reduced leader growth, chlorotic foliage and needle loss are common in much of the young-growth Sitka spruce over an estimated 1000 ha in TFL #2, north and west of Copper Creek. These conditions were noted in the Spur 30 area and along the mainline adjacent to Skidegate Lake.

While these crown symptoms are similar to root disease symptoms, no root disease or other disease or insect problems were noted to account for the widespread decline. Core samples at two locations indicated a rapid decline in radial growth in the last few years, with 1986 to 1990 growth approximately one half of the growth for the five years previous (1981-85). The two areas assessed were in spaced stands, where radial growth should have increased. Nutrient deficiencies or imbalances or the possibility that the sites are not suitable for Sitka spruce has been suggested, but no cause has been identified.

Cooley spruce gall adelgid
Adelges cooleyi

This adelgid again moderately to severely infested several ornamental young Douglas-fir trees near Queen Charlotte City. In Sandspit, of nine semi-mature Douglas-fir, two were severely infested, two moderately and all others suspect. In Sitka spruce, the alternate host, seven of the young trees sampled at Sandspit were lightly galled. Only new galls were found, these were the first ever galls formed by this adelgid found on Sitka spruce on the queen Charlotte Islands. No galls were found on spruce within one kilometer of the site near Queen Charlotte City. Forest Service personnel also reported woolly adelgids present on ornamental Douglas-fir at other areas on both Moresby and Graham Islands.

Galls on young spruce can significantly impact on growth potential. Since both hosts are normally required to produce the gall forming generation of A. cooleyi, the complete removal of Douglas-fir from the district should provide control of this potentially serious problem. At last contact, removal of all Douglas-fir in the Sandspit area by industry was in the planning process.

Spruce needle blight
Lirula macrospora

Spruce needle blight infection on current or one-year-old foliage was not noted in the Queen Charlottes this year. At Peel Inlet two-year-old needles on 10% of Sitka spruce saplings over two hectares were lightly discolored by the disease. Similar trace-to-light occasional discoloration on older needles was noted in the Moresby Camp area, along Deena Creek, near the Yakoun River, and at scattered locations throughout the Islands.

This needle blight has a two year life cycle. Needles are infected shortly after flush, especially during cool wet springs, by spores released from mature fruiting bodies on two-year-old needles and spread by air currents or rain splash. There is no visual evidence of infection in the infecting year. The following year the one-year-old needles turn red; this is the stage at which the extent and intensity of disease is assessed. In the second year following infection, straw colored needles with mature fruiting bodies are apparent and release spores to again infect new flush and complete the cycle. Most needles drop off at this time but some may be retained for a further period. Widespread light to severe discoloration was recorded in 1988 and 1990, following normal or near spring conditions the previous year. Barring unusual circumstances, discoloration of one year old foliage could be widespread again in 1992.

MULTIPLE HOST PEST

Conifer seedling weevil
Steremnius carinatus

Feeding by adult conifer seedling weevils occurred for a second year, at much reduced levels, at a site near Collinson Lake on Graham Island. In 1990, 20% of Sitka spruce seedlings were reported killed over a 5 ha area within a much larger block. This year, only one young natural seedling was dead and girdled, the planted stock now one year larger showed only 8% partial girdling, possibly from late fall or early spring feeding. At a plantation on Deena Creek, 3% of large-stock Sitka spruce was partially girdled. One young natural hemlock was girdled and killed at this site.

Seedlings, especially small stock, are susceptible to root collar feeding damage in the first two years, after which the increased stem diameter makes them unpalatable to the weevil. No further damage is expected at the two sites assessed.

Sitka spruce, hemlock, western red cedar and true firs are all preferred hosts and loss could occur in any year in new plantations. The use of large stock in areas of historical weevil activity and the practice of planting very soon after logging to preclude weevil population build-up in stumps and slash could significantly reduce damage and mortality .

MINOR PESTS

Table 11. Pests currently endemic or historically of minor significance found on Queen Charlotte Islands, 1991.

Host and pest	Location	Remarks
SITKA SPRUCE		
Heart rot, *Phellinus pini*	Hangover Creek	up to 4% of mature trees infected, some mortality noted.
Large-spored spruce-Labrador tea rust *Chrysomyxa ledicola*	Port Clements	moderate-severe infections over .3 ha for 5th consecutive year, some minor branch dieback.
Spruce budmoth, *Zeiraphera* sp.	Queen Charlotte Islands	light damage on 5-10% of new flush at Tow Hill. Elsewhere, widespread trace-very light defoliation.
WESTERN HEMLOCK		
Armillaria root disease, *Armillaria* sp.	Gregory Creek	two overmature mistletoed trees disease-infected. May be more common than noted.
Heart rot, *Phellinus pini*	Gregory Creek	up to 4% of mature trees infected, some mortality noted.
Mammal damage	Tarundl Creek	Beavers girdled 8 young trees, creating substantial open space

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