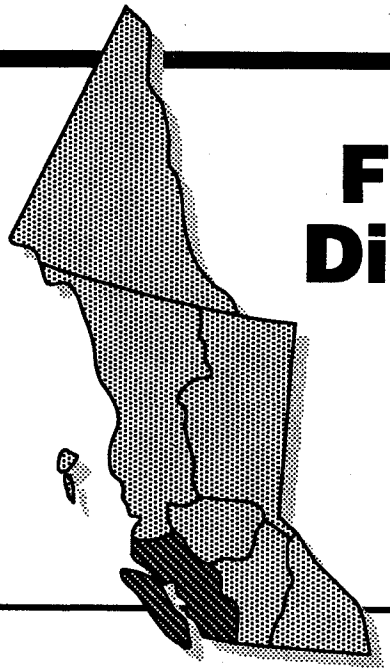
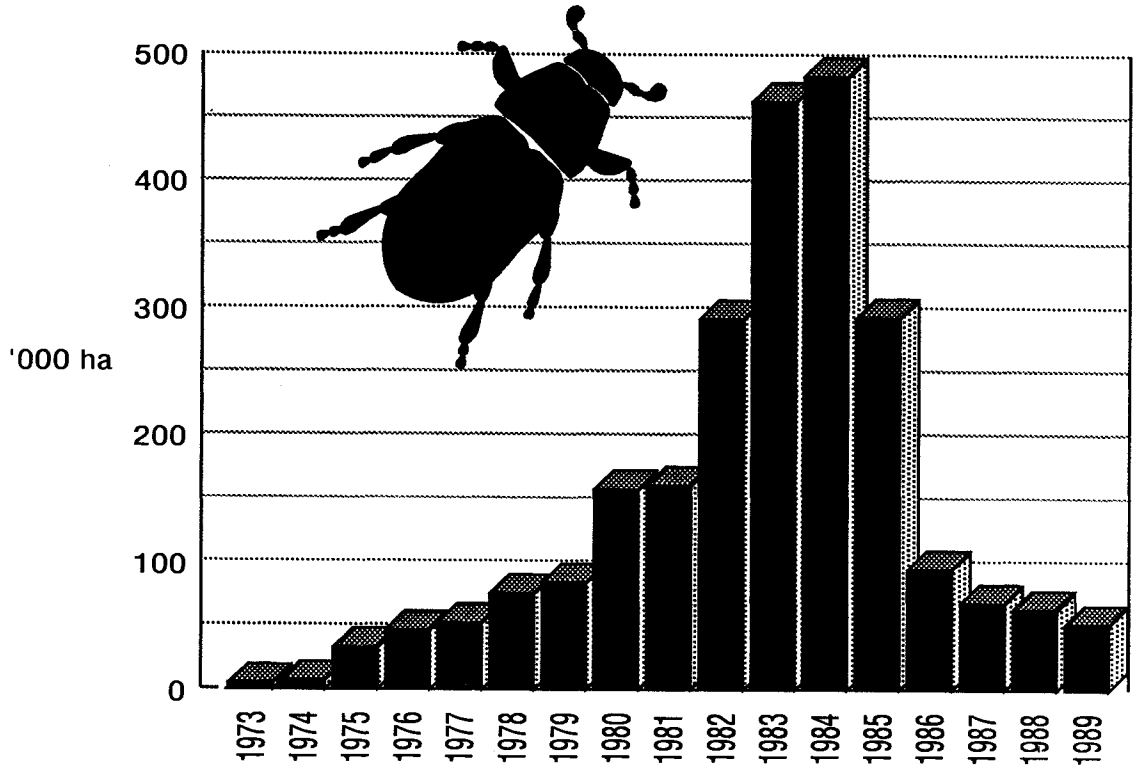


Forest Insect and Disease Conditions

Vancouver Forest Region
1989

N. Humphreys & D.H.L. Clarke



Mountain Pine Beetle in British Columbia

Forestry Canada Forêts Canada

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INTRODUCTION

This report outlines the status of forest pest conditions in the Vancouver Forest Region for 1989 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).

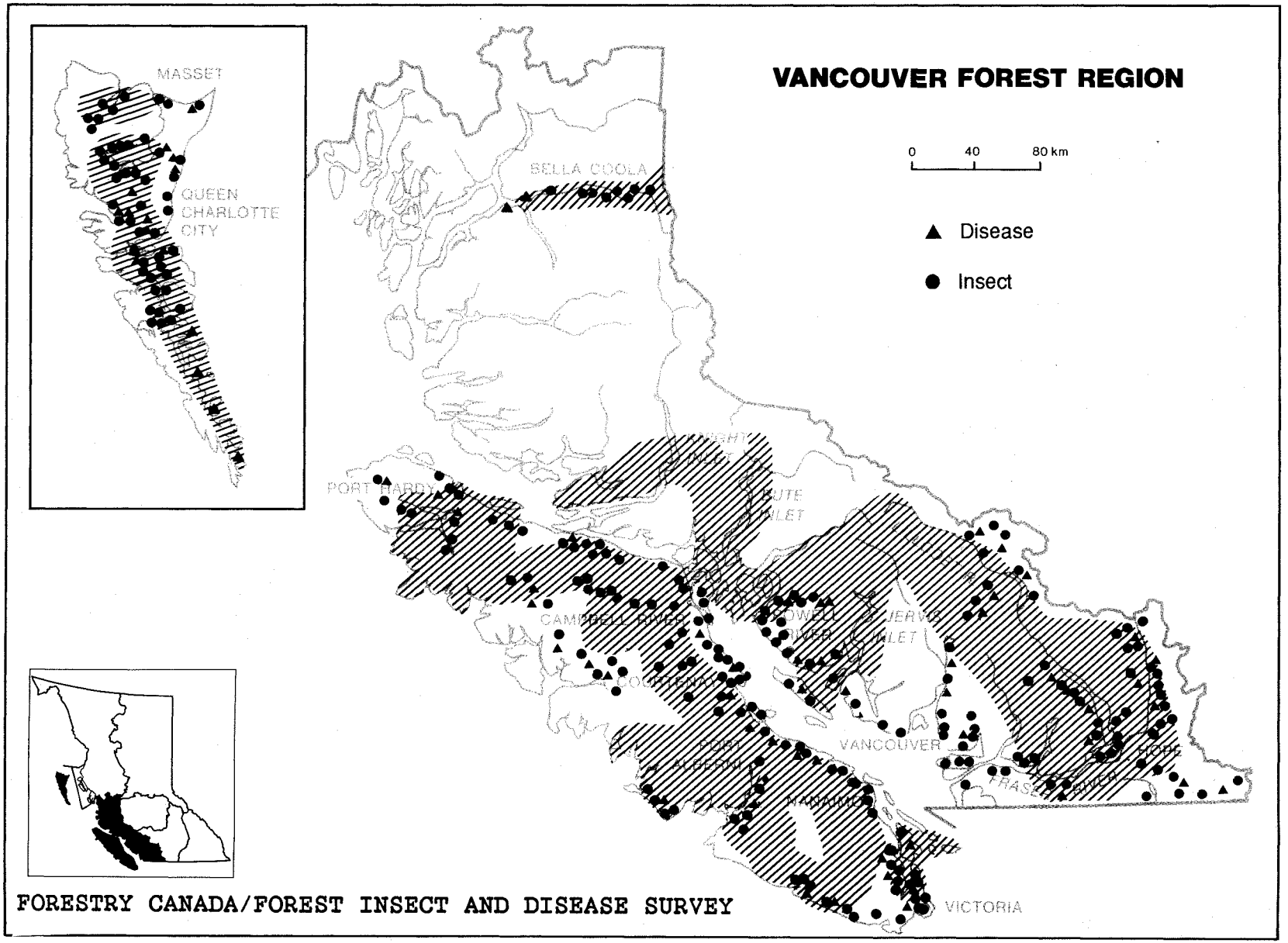
Annual surveys of the Queen Charlotte Islands to assess forest disease and defoliator damage were conducted by Prince Rupert FIDS Ranger Rod Garbutt and FIDS Ranger Coordinator Colin Wood from August 1 to 12th. A special three-day helicopter survey funded by the South Moresby Forest Replacement Fund (SMURF) evaluated the long term effects of the recently collapsed infestations by the blackheaded budworm and the hemlock sawfly. Insect and disease data from the mid-coast forest district was collected by the Cariboo FIDS Ranger, Bob Erickson.

The forest pest survey field season extended from mid-May to early October. A total of 435 insect and 175 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 and 19.5 hours of helicopter surveys. A total of 22 special collections included spruce budworm parasites, western winter moth, winter moth, pine sawfly, fall webworm, blackheaded budworm, alder cones, and diseases and insects of weed species.

Numerous special surveys were conducted including: inspections of provincial parks, ecological reserves and seed orchards, acid rain plot monitoring, spruce budworm and gypsy moth pheromone trapping, young stand surveys, Rhizina and Armillaria root disease surveys, European pine shoot moth quarantine surveys, apple ermine moth distribution surveys, fume damage plot assessment and public/industry extension calls.

Personnel of the B.C. Forest Service, MacMillan Bloedel Ltd., Fletcher Challenge Canada Ltd., Western Forest Products Ltd., and Scott Paper Ltd. assisted with ground and air transportation, and with defoliator larval and egg 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 1989.

SUMMARY

Western spruce budworm lightly to moderately defoliated Douglas-fir over 4885 ha in the Birkenhead Lake-Blackwater Creek area, up from 3640 ha in 1988. The area of **Douglas-fir beetle** attacks increased for the first time in 5 years to 174 ha. **Ambrosia beetles** attacked an estimated 100 overmature Douglas-fir beetle infested trees east of Lillooet Lake. **Fir coneworm**, a major cone pest, have been found infesting the boles of immature Douglas-fir at Port Alberni and Sechelt. **A bark beetle** killed an estimated 8% of the 2-4 year old Douglas-fir saplings over 25 ha between Lund and Powell River.

Mountain pine beetle killed an estimated 14 000 lodgepole pine over 545 ha in 53 infestations, a decrease from 20 000 trees over 845 ha in 68 infestations in 1988. The **pine needle sheathminer** defoliated young lodgepole pine over a wide area in the Vancouver Region for the fourth consecutive year. **European pine shoot moth** was found in a single Douglas-fir shoot near Richmond, for the first time in N. America. A **pine needle cast** fungus severely infected young lodgepole pine trees over 10 ha along Uztlius Creek. A **pine sawfly** severely defoliated 15 to 20 year old lodgepole pine over a 15 ha plantation at Spuzzum Creek northwest of Yale. **Gouty pitch midge** infested 5% of the 3 m high lodgepole pine trees along several kilometers of the Mowhokam River road. A **broad-nosed weevil** defoliated western white pine over a wide area on Texada Island and the Sunshine Coast. **Porcupines** killed an estimated 3% of the 10 to 15-year-old lodgepole pine over 10 ha at 9 mile of the Uztlius Creek road and 5% of the 10-year-old lodgepole pine over 10 ha at 13 mile of the Mowhokam River main road.

The **western blackheaded budworm** defoliated 7400 ha of western hemlock on northern Vancouver Island up from 4830 ha in 1988. **Hemlock sawfly** caused light defoliation of western hemlock over a small area on the Queen Charlotte Islands. **Sirococcus shoot blight** defoliated mostly immature trees in several locations in the Vancouver Region.

The **balsam bark beetle** in conjunction with a pathogenic fungus caused scattered mortality over 1165 ha up from 470 ha in 1988. Active populations of the **balsam woolly adelgid** were recorded in several locations in the region. Damage by a **balsam shoot boring sawfly** increased significantly and killed high numbers of new shoots on true fir in higher elevation forest stands near Sechelt, Chilliwack and North Vancouver. The **balsam twig aphid** was epidemic on young true fir trees in at least two plantations in the Vancouver mainland district.

For the third consecutive year, **spruce beetle** populations declined mostly in the Manning Park area. The **spruce weevil** continued to cause leader mortality of Sitka spruce throughout the host's range. Defoliation of spruce trees by the **spruce aphid** continued at endemic levels in coastal stands. **Spruce needle rusts** and **needle cast** fungi infected young Sitka spruce in two areas on the Queen Charlotte Islands. **Spruce bud necrosis** from unknown causes was widespread on the Queen Charlotte Islands.

The incidence of **gall midge** damage on yellow cedar on Vancouver Island continued at levels similar to those in 1988. Scattered individuals and small patches of **dead yellow cedar** were seen on primarily the eastern slopes of Moresby and Louise Islands and on western Graham Island.

A total of 27 natural and planted stands were surveyed for pest problems, some of which were **deer browse, voles, balsam shoot boring sawfly and winter kill. Meadow voles** killed an estimated 80% of the newly planted western hemlock seedlings at a plantation near Squamish. **Gypsy moth** pheromone-baited traps were placed at 101 locations; a total of 22 gypsy moth were trapped in the region by Agriculture Canada and 2 by Forestry Canada. No **black army cutworm** adult male moths were collected in phermone-baited sticky traps at two locations on Vancouver Island. **Winter damage** caused an estimated 1800 ha of moderate and 7500 ha of severe defoliation of conifers from Hagensborg west to Restoration Bay on Burke Channel.

Defoliation of deciduous hosts by the **western winter moth** increased substantially in the Fraser Valley. For the first time **winter moth** was reported defoliating natural stands on the mainland. The **Bruce spanworm** was active in some areas of the lower mainland. Populations of the **western tent caterpillar** have remained at endemic levels for the last two years. Defoliation by the **forest tent caterpillar** decreased near Bella Coola and Chilliwack. The **satin moth** lightly defoliated exotic poplar over 25 ha at Mt. Thurston near Chilliwack. A **bud midge** caused widespread bud mortality on black cottonwood on the southern coast this year. An **oak leaf phylloxeran** and **jumping gall wasp** caused premature browning and early defoliation of Garry Oak on southeastern Vancouver Island. The **fall webworm** defoliated hardwood trees throughout the Chilliwack and Agassiz area and on southeastern Vancouver Island. **Poplar-willow borer** attacked willow and poplar throughout the hosts range in the Region. The **alder woolly sawfly** caused widespread severe defoliation of immature red alder in the Vedder Mountain area near Chilliwack. The **apple ermine moth** was recorded on Pacific crabapple and apple trees throughout most of the Vancouver Region. **Birch leafminer** reached epidemic levels on birch in two areas north of Vancouver. **Broadleaf maple dieback** or **leaf scorch** continued on scattered roadside and open growing trees throughout the host range in the Region. **Dogwood leaf blight** continued to cause defoliation of western flowering dogwood throughout the host range. **Septoria leaf spot** and **canker** fungus, infected an average of 10% of the leaves on all trees at Forsyth Point at the south end of Moresby Island. Near Marie Lake on Graham Island all red alder in a young pure stand were infected by **rough-bark canker** fungi.

Twelve seed orchards were surveyed two or more times for early detection of pests, some of which were **balsam woolly adelgid, Cooley spruce gall adelgid** and **Douglas-fir cone moth. Tree mortality** resulting from competition and shading out has occurred in 7 of the 10 ARNEWS (Acid Rain National Early Warning System) study plots in the region. Probable **fume damage** caused severe foliage discoloration of individual alder, salmonberry, huckleberry and salal plants within 2 km of the Port Alice pulp mill.

Collections and records were made of many pests currently at endemic levels, i.e. **Swiss needle cast, western gall rust, spruce budmoth, green-striped forest looper** and other insects and diseases. New records of occurrence and distribution of pests have also been included in this report.

Western spruce budworm
Choristoneura occidentalis

For the fourth consecutive year the area of western spruce budworm-damaged Douglas-fir increased to 4885 ha from 3640 in 1988, up from 2850 in 1987 and 1225 in 1986, in 18 pockets mostly east of Pemberton in the Soo TSA (Map 2).

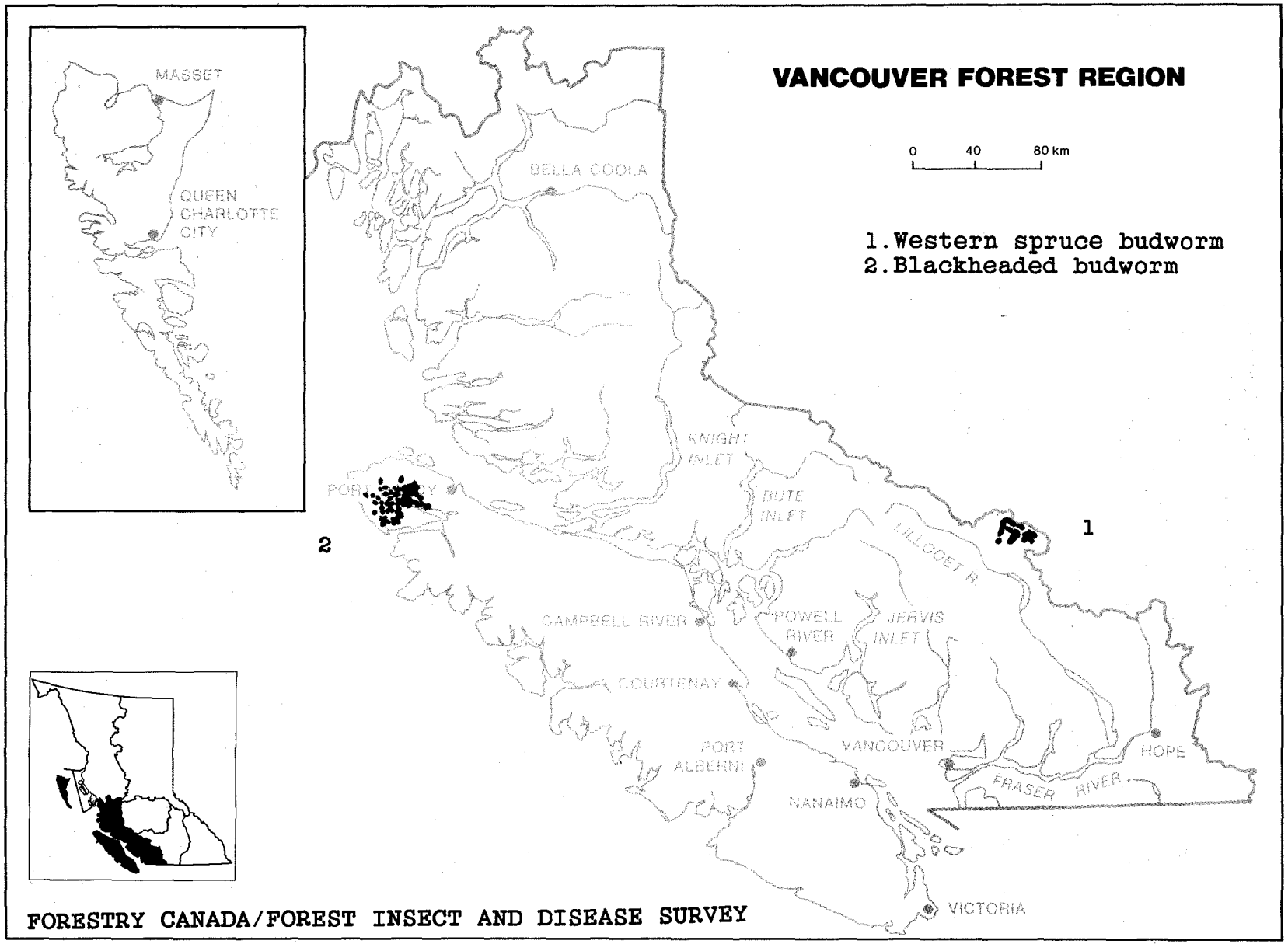
Defoliation continued to expand westward from the Haylmore-Blackwater and Phelix-Sockeye Creek drainages into the Tenas Creek and Birkenhead River drainages. For the first time since 1980 budworm defoliation was recorded in the Fraser Canyon with 30 ha of light defoliation mapped at Hannah Creek 20 km north of North Bend. Intensity of feeding was less than 1988 levels (Table 1), with light defoliation over 2760 ha in 12 infestations and 2125 ha of moderate defoliation in six infestations.

Table 1. Timber supply area, location, area and intensity of Douglas-fir defoliation by western spruce budworm, as determined from aerial surveys, Vancouver Forest Region, 1989.

T.S.A. and Location	Area of defoliation (ha)			
	Light	Moderate	Severe	Total
SOO TSA				
Birkenhead River		200	-	200
Haylmore creek	850		-	850
Phelix Creek	700	700	-	1400
N. Blackwater Creek	530		-	530
Sockeye Creek		175	-	175
S. Blackwater Creek	650	1050	-	1700
FRASER TSA				
Hannah Creek	30		-	30
Total	**2760**	**2125**	**-**	**4 885**

Top-kill of up to 3 m on mature trees and scattered mortality of understory Douglas-fir continued in drainages where defoliation has been recorded for three or more years, including Haylmore, Blackwater and Phelix Creeks, however, damage was limited to less than 5% of the trees in all areas. Based on previous outbreaks, mortality and top-kill will probably increase over the next few years even after the infestation subsides.

Increment cores taken from 5 semimature trees at three plots in the infestation area where light and moderate defoliation has been recorded for 4 years, showed considerable growth loss on defoliated trees. Ring width was measured over the last 10 years, 1980-89, budworm defoliation occurred from 1986-89. The average ring width at the three plots during non-defoliated years



Map 2. Areas where current defoliation was detected during ground and aerial surveys in 1989.

were 0.85, 0.82 and 2.32 at plots 1, 2 and 3 respectively. During years of defoliation average ring width decreased to 0.73, 0.815 and 1.81 mm, for a reduction of 14.1%, 0.01% and 21.9%. An average 12% growth reduction at the three locations is considerable and could be a major concern in the future if wood fiber becomes scarce.

The above figures were obtained from increment cores taken at breast height, ring width reduction may have been considerably greater at different heights on the bole. The sample size was also very small, a more accurate survey would have required at least 10 trees/plot with a preferred sample size of 25/plot. Climatic factors were also ignored when ring widths were measured.

The average number of egg masses, collected at six locations within infested areas near Pemberton, which averaged 93 egg masses/10 m^2 of foliage, (range 0-227), up 63% from an average of 57, (range 12-148) in 1988 (Table 2).

Table 2. Location, average number of western spruce budworm egg masses collected, increase, decrease and predicted defoliation for 1990, Vancouver Forest Region, 1989.

Location	Avg. no. of egg masses/10 m^2 of foliage/plot		percent increase/ decrease	Defoliation*	
	1989	1988		**1989**	1990(predicted)
Birkenhead River	**227**	-	new	**Trace**	Severe
Haylmore Creek	**0**	19	- 100	**Light**	Nil
Phelix Creek	**73**	148	- 51	**Light-Mod**	Moderate
N. Blackwater Creek	**64**	99	- 35	**Light**	Moderate
Sockeye Creek	**140**	56	+ 150	**Moderate**	Moderate
S. Blackwater Creek	**54**	35	+ 54	**Light-Mod**	Moderate
Average	**93**	**60**	**+ 63**		

*1-50 egg masses/10 m^2 - Light defoliation: discolored foliage barely visible from the air, some branch tip and upper crown defoliation.

51-150 egg masses/10 m^2 - Moderate defoliation: pronounced discoloration, noticeably thin foliage, top third of many trees severely defoliated, some completely stripped.

151+ egg masses/10 m^2 - Severe defoliation: bare branch tips and completely defoliated tops, most trees more than 50% defoliated.

The number of egg masses decreased by an average of 62% in three locations and increased by an average of 102% in two locations in 1989. No egg masses were collected in the Haylmore Creek drainages and no defoliation is expected in 1990. The highest number, 227 egg masses, were collected at the Birkenhead River site where no defoliation was visible during aerial surveys. The infestation appears to be collapsing in the Haylmore-Blackwater Creeks area but expanding westward in the Birkenhead River drainage, a phenomenon that

follows the pattern of previous infestations in the area. No egg mass collecting was attempted in the Fraser T.S.A. at Hannah Creek due to inaccessibility of the site.

Larval parasitism by dipterous parasitoids increased to 14.6% and 12.2% from 6.0% and 6.8% in 1988 at Blackwater and Haylmore Creeks respectively while hymenopterous parasites decreased dramatically in the same areas to 1.0% and 0% from 38.8% and 34.2% last year. Overall parasitism averaged 13.9% down from 42.9% in 1988. Parasitism and disease are major factors in controlling budworm populations and probably precipitated the collapse of the budworm infestations at Haylmore Creek.

A project started in 1987 to detect increasing budworm populations continued in 1989. Pheromone-baited 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 (Table 3). Calibrating the traps to relate the number of moths, larvae and defoliation, is still in progress and will probably take several more years and a new infestation at the trap sites before reliable predictions can be made from either larvae or adult male moth numbers.

Table 3. Location, number of larvae/tree, number of adult male moths/trap and degree of defoliation at four spruce budworm pheromone calibration plots in the Vancouver Region, 1989.

Location	Avg. no. larvae/tree		Avg. no. moths/trap		Total tree defoliation at plots	
	1989	1988	**1989**	1988	**1989**	1988
Devine	**16.7**	17.4	**570**	677	**light**	light
North Bend	**0**	.04	**141**	25	**none**	none
Anderson R.	**0**	.2	**57**	6	**none**	none
Skagit Valley	**0**	.04	**18**	1	**none**	none

An increase in moth numbers from 1988 to 1989 has become evident. There has been almost a 6-, 10- and 18-fold increase at North Bend, Anderson river and Skagit Valley areas respectively. The largest number of moths, at a non-defoliated site, were 141 at North Bend, 20 km south of the 30 ha of budworm defoliation at Hannah Creek. While no definite conclusions can be reached from this year's plot data the increase in moth numbers does indicate an expanding population in the Fraser Canyon.

Douglas-fir beetle
Dendroctonus pseudotsugae

The area of Douglas-fir beetle attacks increased for the first time in 5 years to 174 ha from 37 ha in 1988, mostly in the Soo and Fraser TSA's.

The largest areas of beetle attack occurred in the Soo TSA along Lillooet Lake with 11 infestations totaling 77 ha. Three infestations of 5 to 20 ha containing from 30 to 100 trees were mapped on the eastern side of Lillooet Lake along Twin One and Lizzie Creeks. Eight areas of infestation of 0.5 to 5 ha

with 7 to 50 trees occurred along the western edge of the Lake between Billygoat and Ure Creeks. Five infestations between 0.25 to 5 ha and totaling 11 ha occurred at the southwestern end of Birkenhead Lake, with 1 to 10 trees.

In the Fraser TSA a total of 57 ha in 13 infestations were noted along the west side of the Anderson River between Hells Gate and Boston Bar, ranging in size from 0.1-6 ha and containing 1 to 25 trees. Pockets ranging in size from 0.25 to 9 ha with 2 to 30 trees and totaling 26 ha were mapped along the north side of Chilliwack River between Mt. Thurston and William Peak. Six infestations between 0.25 to 5 ha were mapped east of Chilliwack Lake along the western side of Maselpanik Creek south of Mt. Lockwood.

The infestation at Twin One Creek was the only site that was also surveyed on the ground, other sites were inaccessible. Over 100 overmature, 100+cm at dbh, Douglas-fir trees were killed by the beetle on the west side of Twin One Creek near the headwaters of the creek. Mortality occurred in 5 patches of 10 to 30 trees in strips running up the hillside. The beetle has been active in the area for at least 3 years and is continuing to attack adjacent healthy trees in the drainage. Recent road construction in the area has contributed to conditions favoring beetle populations as the beetle prefers hosts such as felled trees, slash, stumps, overmature trees and trees damaged by drought, logging and road building. Host material over 20 cm diameter is preferred. Removal and utilization of infested trees before the beetle emerge in the spring will reduce the populations. A trap tree program could also be initiated to help control the beetle. Mortality will continue for at least another year due to fresh attacks that were noted in 1989.

Ambrosia beetle
Gnathotrichus sp.

Ambrosia beetle attacked an estimated 100 overmature Douglas-fir trees infested with Douglas-fir beetle east of Lillooet Lake on the west side of Twin One Creek near the head waters of the creek.

The secondary attack by Ambrosia beetle is common and widespread in British Columbia. At Twin One Creek the "pinholes" from ambrosia beetle tunnels and the dark staining of the wood caused by a fungus associated with the beetle has seriously degraded the wood. Ambrosia beetle attacks will continue as long as the current Douglas-fir beetle epidemic exists in the area.

Pheromone trapping of the beetle is in progress at the "log sort" at the mouth of Twin One Creek. Trap logs can also be used to absorb ambrosia beetles in the area, but these logs will only be good for chipping after ambrosia beetle attacks. The ability of the ambrosia beetle to attack, survive and develop in green lumber has resulted in degraded exports.

Fir coneworm
Dioryctria abietivorella

This transcontinental major cone pest has been found infesting the boles of immature Douglas-fir on the Sunshine Coast and near Port Alberni.

At the Canfor Seed Orchard at Sechelt on the Sunshine Coast an estimated 40% of the stressed Douglas-fir were infested. Affected trees had been scarred

by chainsaws to induce cone crops, and coneworm larvae were found under pitch masses accumulating around the scar. The excessive pitch flow was caused by the larval mining, not the scarring. With 3-4 larvae per tree it is conceivable that continual larval mining could girdle the trees.

On Vancouver Island just outside of Port Alberni a 59 ha 4-year-old Douglas-fir plantation was lightly infested by the fir coneworm. An estimated 60% of the trees showed multiple leaders, cause unknown, the extraneous leaders and suspect branches were pruned during July/Aug 1989. A survey of the area in November showed girdling and frass accumulation at the site of the pruning scar at the base of the leader, on several of the treated trees. Leader mortality is expected. Surveys to obtain more complete information will be undertaken in 1990.

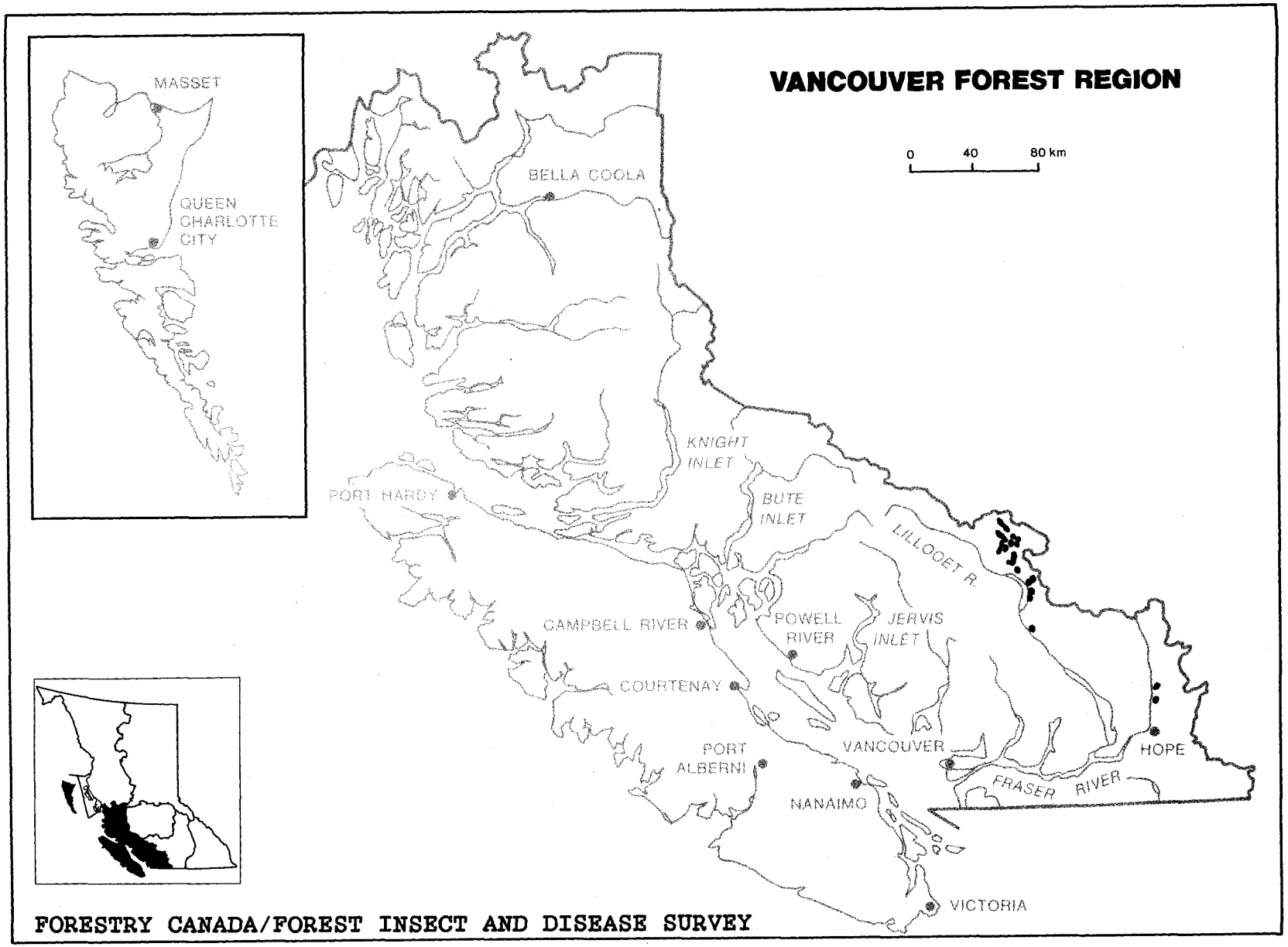
A bark beetle
Hylastes nigrinus

This bark beetle killed an estimated 8% of the 2 to 4 year old Douglas-fir saplings over approximately 25 ha at Southview Main between Lund and Powell River. Of the seedlings planted in 1987 approximately 50% were killed in 1988 and the remainder this year. This beetle is not considered to be a primary killer, however, suppressed, injured and drought-weakened saplings are susceptible to attack and killed by girlding at or below the root collar. Beetle attack causing further tree mortality will probably continue as long as tree vigor remains weak.

PINE PESTS

Mountain pine beetle
Dendroctonus ponderosae

Mountain pine beetle killed an estimated 14 000 lodgepole pine over 545 ha in 53 infestations in 1989, a decrease from 20 000 trees over 845 ha in 68 infestations in 1988 (Table 4). This is the third consecutive year of decline from a recent high of 4160 ha of mortality in 176 infestations in 1986. Volume loss was almost 10 000 m^3 a more than 30% reduction from 15 000 m^3 lost in 1988 (Map 3). This decrease follows the general trend occurring in most areas of British Columbia.



Map 3. Areas of lodgepole pine recently killed by mountain pine beetle determined by aerial and ground surveys in 1989.

Table 4. TSA, area, number and volume of pine trees recently killed by mountain pine beetle as determined from aerial surveys, Vancouver Forest Region, 1989.

TSA	Area (ha)		No. of trees killed		Vol. (m^3) killed		No. of infestations	
	1989	1988	**1989**	1988	**1989**	1988	**1989**	1988
Fraser	**25**	95	**600**	2 300	**500**	1 650	**3**	5
Soo	**520**	665	**13 000**	16 600	**9 400**	11 950	**50**	58
Sunshine Coast	*	85	*	2 000	*	1 400	*	5
TOTAL	**545**	**845**	**13 600**	**20 900**	**9 900**	**15 000**	**53**	**68**

* Previous pine beetle infestation areas not flown during 1989 aerial surveys.

Beetle ground cruises and surveys were not undertaken this year due to population decreases, host depletion and inaccessibility of sites. Also after the extraordinary decrease in beetle attacks along the Homathko River in the Sunshine Coast TSA from 820 ha in 1987 to 85 ha in 1988, it was considered unnecessary to fly the area during 1989 aerial surveys.

Fraser TSA

Infestations in the Fraser TSA declined in area by 75% to 25 ha. This is largely a result of host depletion and harvesting in the Boston Bar area. The active infestations occurred along the east side of the Fraser River between Hope and Squeah with 3 light infestations totaling 25 ha.

Soo TSA

In the Soo TSA the area of attack decreased by 22% to 520 ha while the volume of timber killed was reduced to 9400 m^3 from 11 950 m^3 in 1988. The majority of the reduction occurred in the Birkenhead Lake and River drainage, due to harvesting and host depletion as predicted in 1988. Infestations along Lillooet Lake remained approximately the same as in 1988.

Sunshine Coast TSA

After three successive years of decline in beetle attack from 2770 ha in 1986 to 85 ha in 1988, it was decided that aerial surveys of infestations in the Homathko River drainage were not warranted. This area is mostly inaccessible and 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.

Pine needle sheathminer
Zelleria haimbachi

The pine needle sheathminer lightly defoliated young lodgepole pine over a wide area in the Vancouver Region for the fourth consecutive year. Damage occurred from Texada Island in the west to the Mowhokam Creek drainage in the east to as far north as D'Arcy, and south to Harrison Lake. Young, 5 to 25-year old, open-growing pine were the preferred host but ponderosa pine in the northerly interior portions of the region were also lightly defoliated.

The percentage of trees attacked ranged from 10% in young stands along the Nahatlatch Creek to 70% at Twin One Creek east of Mt. Currie. Defoliation of the current years growth ranged from 2% at Keefers to 25% at Uztlius Creek, average 11% for the region.

This native moth of young 2-3 needle pines is not a rare species, but it and its damage are relatively inconspicuous unless the population is large. Parasitism plays an important role in controlling populations; the most numerous *Z. haimbachi* parasites come from the wasp families Ichneumonidae, Braconidae and Chalcididae. Historically, infestations have lasted only a few years. Young stands will continue to be monitored in 1990.

European pine shoot moth
Rhyacionia buoliana

For the first time in North America the European pine shoot moth was found attacking Douglas-fir. A pupa, pupal case, adult and two damaged shoots were collected from a single Douglas-fir tree in a mixed conifer Christmas tree plantation in Richmond.

Prior to 1988 it was thought that this shoot moth occurred only on 2 and 3 needle pines such as Scots, Austrian, Mugho, lodgepole and ponderosa; however, last year a report from Chile confirmed that European pine shoot moth was collected on Douglas-fir for the first time ever. No predictions have been made as to whether the shoot moth will become a significant pest of Douglas-fir.

The European pine shoot moth is established in ornamental pine trees from Victoria to Courtenay, in the lower Fraser Valley from Vancouver to Chilliwack and in the Okanagan Valley. Threat of damage to natural stands and the ever increasing pine plantations in B.C. warranted regulations to prevent the movement of infested pines to uninfested areas. These regulations lapsed in 1981. Surveys will continue in 1990.

A pine needle cast
Davisomycella ampla

This needle cast fungus severely infected 100% of the 5- to 10-year-old lodgepole pine trees over 10 ha at 8 mile of Uztlius Creek road. An estimated 50 to 60% of the old, pre-1989 needles were consumed. Discoloration, death and premature casting of needles are the most common symptoms of this disease and very apparent at this particular location. No mortality was noticed or expected as a result of the infection by the disease which does not affect the health of the tree unless heavy and repeated infection occur in successive years. Extensive defoliation can affect growth and shape of trees.

Pine sawfly
Neodiprion nannulas contartae

This pine sawfly has severely defoliated 15 to 20 year old lodgepole pine in a 15-ha plantation at 20 km of Spuzzum Creek northwest of Yale. An average of 80% of the old, pre-1989 foliage, was eaten, leaving small tufts of new foliage. No mortality is expected this year but if the infestation continues next year, trees could be killed outright or weakened and then succumb to other insects. Epidemics have been reported in Oregon during the 1940's and 50's, but not previously in the Vancouver Region.

Gouty pitch midge
Cecidomycia piniinopis

This shoot and bud borer infested approximately 5% of the 0.5 m to 3 m plantation lodgepole pine trees from 19 km to 22 km of the Mowhokam River road. Deformed new terminal and lateral shoots are evident at low levels throughout the stand, however no damage was found on adjacent ponderosa pine, the usual principal host. A weed control herbicide recently sprayed in the area also caused leader deformity of lodgepole and ponderosa pine. The shoot borer causes leaders to bend at almost right angles while the herbicide spray has resulted in a more circular deformity of the leaders. If the number of maggots are not sufficient to kill the terminal, the only injury is distorted annual rings, attacked trees are deformed but seldom killed. Populations fluctuate widely from year to year.

A weevil
Scythropus californicus

This broad-nosed weevil lightly and severely defoliated western white pine over a wide area on Texada Island and the Sunshine Coast. One hundred percent of the young 0.5 to 5 m high, white pine was attacked from Mouat Creek to Bobs Lake on Texada Island. Feeding was evident on 10-70%, (average 30%), of the old foliage on natural and planted trees.

Near Richardson Lake northwest of Sechelt 80% of the white pine was infested, causing death of 5-40%, (average 20%), of the old foliage on young 1-7 m naturally grown scattered individuals.

The weevils bite out chunks of the needle leaving a saw-toothed edge, causing the needle to die and drop prematurely. After egg hatch the larvae drop to the ground and feed on pine rootlets. The life cycle is believed to be 2 years.

Porcupine damage

Porcupines killed an estimated 3% of the 10 to 15 year old lodgepole pines over an estimated 10 ha at 9 mile of Uztlius Creek road and 5% of the 10-year-old lodgepole pine over the same area at 13 mile of the Mowhokam River main road. Basal scarring resulting from porcupine feeding was noted on approximately 4% of the trees at both locations. This is a relatively new phenomenon in the area and is probably related to an increase in the porcupine population due to an absence of their main predator, the marten.

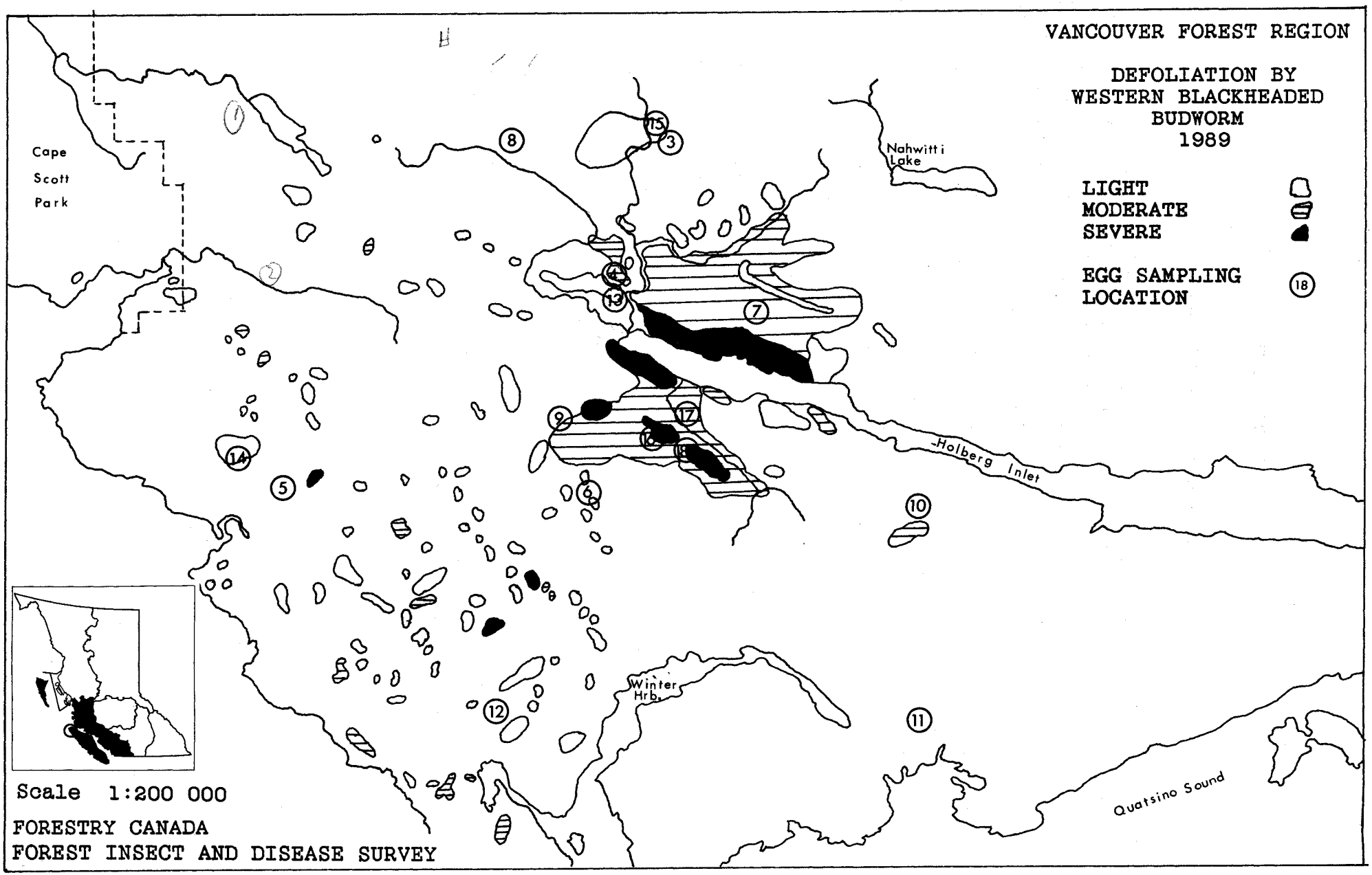
Western blackheaded budworm
Acleris gloverana

Increased blackheaded budworm populations defoliated western hemlock over an estimated 7400 ha near Holberg on northern Vancouver Island (Map 2). Out of 100 individual areas aerially sketchmapped, 2350 ha were lightly defoliated, 3950 ha were moderate and 1100 ha were severe (Table 5). While a decrease of 1550 ha was noted in the William Lake, Cape Scott Park area, a substantial increase of 2510 ha near Raft Cove and Winter Harbor and 1620 ha near Holberg caused an overall increase of 2580 ha in total area defoliated from 1988. For the first time, severe defoliation was evident over 1100 ha, while moderately defoliated areas increased by 1810 ha and lightly defoliated areas decreased by 340 ha (Map 4).

Table 5. Area, defoliation intensity and number of infested areas mapped for western blackheaded budworm, as determined from aerial surveys on northern Vancouver Island, 1989

	1989		1988		1987	
Defoliation intensity	**Area (ha)**	**No. of infestations**	Area (ha)	No. of infestations	Area (ha)	No. of infestations
Light	**2350**	**100**	2690	80	5	1
Moderate	**3950**	**16**	2140	1	0	0
Severe	**1100**	**8**	0	0	0	0
TOTAL	**7400**	**124**	4830	81	5	1

Egg sampling at 16 sites adjacent to recently defoliated stands found an average of 14 eggs (range 3 to 33) per 45-cm branch sample (Table 6) which indicates mostly light to moderate defoliation in 1990.



Map 4. Areas where western hemlock was defoliated by western blackheaded budworm and locations where eggs were sampled in 1989.

Table 6. Egg counts, actual and predicted defoliation in 1988 and 1989, and 1990 forecast for the western blackheaded budworm on northern Vancouver Island.

Map No.	Location	Avg. No. eggs per 45 cm 1989	1988	Defoliation Predicted 1989	Actual 1989*	Predicted 1990
1	William Lk.	-	4	trace	nil	nil
2	San Joseph Main	-	37	moderate	nil	nil
3	NE 62	5	20	light	light	trace
4	Goodspeed R	16	34	moderate	moderate	light
5	Ronning Creek	14	28	moderate	light	light
6	South Main	20	84	severe	light	light
7	NE Main	33	166	severe	moderate	moderate
8	Stranby R	3	33	moderate	nil	trace
9	San Joseph R.	32	133	severe	moderate	moderate
10	Hathaway Creek	11	55	moderate	moderate	light
11	Koprino	4	-	-	nil	trace
12	Leeson Lk.	19	-	-	light	light
13	Goodspeed R (WFP)	16	-	-	light	light
14	Ronning Creek (WFP)	14	-	-	light	light
15	NE 62 (WFP)	5	-		light	trace
16	S 100	11			severe	light
17	S Main	13	-	-	moderate	light
18	S100 A	26	-	-	moderate	light
	Average	14	59			

* Based on aerial surveys conducted during August 1989.

In the past, mostly semimature to mature stands were attacked, however, during ground and aerial surveys completed in cooperation with Western Forest Products Ltd. during August of 1989, it was noted that all age classes of western hemlock were affected. Light to moderate defoliation was also noted on scattered individual Amabilis fir and Sitka spruce. During additional aerial surveys on August 23 in cooperation with MacMillan Bloedel, no defoliation was evident south of Quatsino Sound.

The last outbreak on Vancouver Island was from 1970 to 1973 when hemlock and amabilis fir were defoliated over 164 000 ha from Jordan River to Holberg. Previous outbreaks have resulted in mortality and dieback of some overmature hemlock. While consecutive years of severe defoliation could result in top-kill and tree mortality, none has been evident to date. This will not be fully evident until the infestation subsides. Historically, blackheaded budworm infestations have declined after 3 to 5 years of attack, and this may still be the case in this situation. Forestry Canada in cooperation with industry will continue to monitor the infestation.

In an analysis of five sites, larval parasitism was extremely variable and results are only preliminary as rearing is still in progress. Overall parasitism was low, averaging 13% between locations and ranging from 1% to 51%

between locations. The majority of parasitism (11%) was due to a single species of the egg-larval parasitoid, Ascogaster sp. Monitoring and further analysis will continue.

Spray trials to test the efficacy of Bacillis thuringiensis (B.t.) were undertaken in a cooperative study between Western Forest Products Ltd., B.C. Ministry of Forests and Forestry Canada. In addition, study plots to determine the effects of the budworm defoliation on the growth and mortality of western hemlock have been established.

Queen Charlotte Islands

No larvae were collected in standard three-tree beating samples of western hemlock on either Graham or Moresby Island in 1989 following the collapse of budworm-sawfly populations in 1988.

In 1985, 10 long term study plots were established on southern Moresby Island and its archipelago to monitor the affects of successive years of defoliation by the budworm and hemlock sawfly. These were revisited in 1989 and increment cores were taken from 10 trees at each site to determine the affects of defoliation on radial growth and monitor tree recovery following the collapse of populations in 1987. Information with respect to this study is contained in a special F.I.D.S. report (see Appendix X).

Assistance in establishing the plots and conducting aerial surveys was provided by Western Forest Products Ltd., and in part by MacMillan Bloedel Ltd. Funding for the re-examination was provided by the South Moresby Forest Replacement Fund.

Hemlock sawfly
Neodiprion tsugae

Trace hemlock sawfly defoliation occurred in a previously infested young stand of western hemlock above South Bay on Graham Island. Elsewhere on the Islands populations collapsed after four successive years of defoliation, and only a few larvae (maximum 8) were collected in standard FIDS three-tree beating samples.

A total of 48 pupae were collected at the South Bay site and the pupae will be reared throughout the winter to allow parasites to mature and emerge. Historical patterns suggest that populations will remain low in 1990.

Sirococcus shoot blight
Sirococcus strobilinus

This shoot blight fungus of western hemlock defoliated new tips on mostly immature trees north of Vancouver and near Mission. Infected trees were noted again in the Capilano watershed where an estimated 20% of the 0.5 to 3 m western hemlock were affected along Andrews Creek, with an average 10% of the new shoots killed. At Mt. Crickmer, near Mission, natural stands of over-stocked western hemlock were similary infected.

On the Queen Charlotte Islands an increased incidence of the blight killed an average 10% of young growing tips on primarily understory western

hemlock at scattered locations from Louise Island northwest to Rennel Sound. The most severe infection killed an average 30% of the tips on all young understory trees at the Hanna Road-Rennel Sound junction.

Infections are promoted by cool wet weather during the period of bud flush and early shoot development.

TRUE FIR PESTS

Western balsam bark beetle-fungus complex
Dryocoetes confusus
Ceratocystis dryocoetidis

The balsam bark beetle in conjunction with the pathogenic fungus Ceratocystis dryocoetidis caused scattered light-severe mortality over 1165 ha up from 470 ha in 1988 (Table 7). The increased area of mortality is mainly a result of increased coverage during aerial surveys. Tree mortality was recorded in the Fraser, Soo and Mid-Coast TSA's over 995 ha, 100 ha and 70 ha respectively.

Table 7. TSA, location, area, number and estimated volume of balsam trees recently killed by western balsam bark beetle-fungus complex determined from aerial surveys, Vancouver Forest Region, 1989.

TSA and Location	Area(ha)	Number of trees killed	Volume of host killed (m^3)
Fraser TSA			
Ainslie Cr.	90	900	50
Anderson River	60	600	40
Kookipi Cr.	100	1 000	60
Log Cr.	185	1 800	2 000
Maselpanik Cr.	10	100	140
Mowhokam Cr.	210	2 100	2 300
Spuzzum Cr.	40	400	30
Tulameen River	300	2 900	3 300
Soo TSA			
Horlick Cr.	50	500	600
Birkenhead River	40	400	500
Haylmore Cr.	10	100	100
Mid-Coast TSA			
Talchako River	70	3 500	4 000
TOTAL	**1 165**	**14 300**	**13 130**

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 defies a consistent and accurate assessment. Studies have indicated that the beetle rarely attacks more than 10 trees per ha in one year.

Balsam woolly adelgid
Adelges piceae

Continuing surveys in the Vancouver Forest Region noted active adelgid populations on true fir for the first time in the China Creek drainage south-east of Port Alberni, Qualicum Beach, Mt. Crickmer near Mission and at Grey Creek north of Sechelt; however, all areas were within existing quaratine regulation zones.

Near Mt. Crickmer, dead, deformed and trees in general decline are common in scattered stands over a wide area. The adelgid has also infested true fir over several hectares at Grey Creek. In both cases mature amabilis fir is the host species, with no damage or evidence of the adelgid on young (less than 25 years old) adjacent stands.

Along China Creek southeast of Port Alberni, near the boundary of the quarantine zone, symptoms including several dead trees and dead foliage in the upper and mid crown were noted over approximately 2 ha of amabilis fir. The adelgid was absent in samples from the area however this pest had previously been recorded on the opposite side of the valley.

At Saanich Seed Orchard, 35% of young amabilis fir trees were moderately infested causing gouting and deformed growth. At Mt. Newton Seed Orchard no adelgids were found in samples, however 10% of the young amabilis were infested.

No evidence of the adelgid was found at 10 other locations sampled on Vancouver Island in 1989; however, scattered areas of mature amabilis and grand fir on southern Vancouver Island have shown a general decline in vigor, including some mortality, dead tops and sparse foliage. These symptoms may be a result of adelgid feeding, however further surveys of this quarantined pest are necessary to identify the causal agents in 1990.

A Balsam shoot boring sawfly
Pleroneura sp.

Sawfly populations increased significantly for the second consecutive year, killing high numbers of new shoots of amabilis fir in higher elevation forest stands near Sechelt, Chilliwack and North Vancouver.

Near Granet Lake, southwest of Powell River, 60% of the buds on 80% of the amabilis fir over about 50 ha were killed. At Chipmunk Creek near Chilliwack 5-40% (average 20%) of the lateral shoots on 70% of 20-year-old trees were killed. This sawfly also attacked 65% of the young, 2 to 5 m high amabilis fir over a wide area in the Gray Creek and Richards Lake region 10 km north of Sechelt where about 10% (range 5-30%) of the new shoots were affected. An average 5% of the new shoots, on young trees were infected and killed over several hectares along Andrews Creek in the Capilano watershed and 15-20% of new shoots on 60% of the young planted amabilis fir at Jamieson Creek.

Mining by the sawfly causes shoot deformity and usually kills the shoot. Infested shoots turn a reddish brown, resembling frost damage, and the dead parts of the shoots will eventually fall off. 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 axes and feed until mid-summer, then drop to the ground to spin cocoons.

The sawfly has not previously been considered a noteworthy pest of true firs in British Columbia. In 1988 it was recorded near Holberg on Vancouver Island for the first time.

Balsam twig aphid
Mindarus abietinus

The balsam twig aphid was epidemic in young true fir stands near Chilliwack and Sechelt and endemic elsewhere in the region.

At a 10-year-old grand fir plantation at Liumchen Creek southeast of Chilliwack 100% of the trees were affected to some extent with 90% of the leaders and 30% of the laterals showing distortion from aphid feeding. Additionally this greenish-yellow powdery aphid infested an estimated 25% of the amabilis fir in the Gray Creek drainage near Sechelt causing light to severe distortion and stunting of the new foliage and twigs. Low populations were evident in most other young true fir.

Heavy feeding on Christmas trees may render them valueless for harvest. Artificial control is not practical or necessary under forest conditions. In Christmas tree plantations, nurseries and on ornamentals, control may be required to assure desirable tree shape or good growth, particularly of the main leader or terminal.

SPRUCE PESTS

Spruce beetle
Dendroctonus rufipennis

For the third consecutive year, spruce beetle populations in the region have declined however east of of Bella Coola in the upper Musatsum Creek area a 5 ha stand of mature Sitka spruce contained aproximately 25 infested trees. Intermixed windthrown and healthy trees may be susceptible to attack in 1990. Elsewhere in the Region due to host depletion and logging activity the spruce beetle is no longer evident at Manning Park, Upper Tulameen, Hubbard Creek, and Holding Creek drainages. Surveys for this pest will continue in 1990.

Spruce weevil
Pissodes strobi

The spruce weevil continues to cause leader mortality of Sitka spruce throughout the host's range in the Region.

Surveys in 1989 recorded an average of 43% of the leaders of Sitka spruce were attacked at eight locations. At six locations on Vancouver Island the

weevil killed an average 40% of the leaders of the 2 to 10 m Sitka spruce (Table 8). Near Bella Coola in a 10-year-old plantation of 1 to 3 m high Sitka spruce 44% of the leaders were infested. Near the Musatsum River 60% of the leaders were affected (20% current and 40% old attack) in a 60 ha stand of 7-year-old spruce. There is potential for a reduction of merchantable timber at rotation age due to crook, stem decay and other deformities resulting from weevil attack. Surveys and clipping programs will continue in 1990. Studies to reduce weevil populations are currently underway by research staff at PFC.

Table 8. Location and percent of spruce weevil attack in some Sitka spruce stands, Vancouver Island, Vancouver Forest Region.

Location	Trees attacked (%)
Carnation Creek	50
U.B.C. Research Farm	30
Loss Creek Provincial Park	60
Gold River	50
Mahatta River	25
Woss Lake	25
Bella Coola	44
Musatsum Creek.	60
Average	**43**

Spruce aphid
Elatobium abietinum

Defoliation of spruce trees by the spruce aphid continued at endemic levels in coastal areas of the Region. Defoliation of ornamental and native spruce occurred at scattered sites from Port Hardy to Hope. On Moresby Island near Skijump Creek aphid damage to the needles of Sitka spruce declined to only 1-5% of the older needles on 40% of the spruce trees. In several other areas in the Region which had sustained damage in prior years no damage was noted in 1989. The continued decline of aphid populations can largely be attributed to the unusually late and cold winter weather.

It is expected that the intensity of defoliation in 1990 will again be linked directly to fluctuations in climatic factors, particularly the length and severity of winter cold spells. Forestry Canada will continue to monitor this pest in 1990.

Spruce needle rust
Chrysomyxa ledicola

Young roadside Sitka spruce were severely infected by the large-spored spruce-Labrador tea rust, Chrysomyxa ledicola for the second consecutive year in the lowland area between Tlell and Port Clements on the Queen Charlotte Islands. An average of 40% (range 5-100%) of the 1989 needles were infected on 80% of

the trees. The more seriously infected trees were quite striking in early August with the golden hue of the sporulating rust fungus. Infections on the more slowly growing trees beyond the highway right-of-way were also infected but less showy because the trees supported a smaller proportion of new needles.

Spruce needle casts
Lirula macrospora
Lophodermium piceae

At Skidegate Lake on Moresby Island older lower crown needles on scattered young Sitka spruce were lightly to moderately infected by the needle cast fungus Lirula macrospora and to a lesser extent Lophodermium piceae. The result was minimal with only minor premature needle loss.

Spruce bud necrosis

Surveys in young Sitka spruce stands throughout the Queen Charlotte Islands found repeated incidence of unflushed terminal and lateral buds. In surveyed plantations in the Copper River drainage an average of 10% of lateral and 3% of terminal buds remained unflushed. Samples examined at the Pacific Forestry Centre have failed to yield any insect or disease associated with the bud necrosis. The same phenomenon affects Sitka and Interior spruces in the Prince Rupert and Prince George Forest Regions.

CEDAR PESTS

A gall midge
Contarinia n. sp.

The high incidence of gall midge damage on yellow cedar at the Saanichton Seed Orchard were similar to levels recorded in 1988. This is in contrast to the dramatic increase which took place in 1988. This year an average of 15% of the tips, including vegetative growth as well as male and female reproductive structures were damaged, compared to 15% in 1988, and 2% in 1987. The biology and damage caused by this new species and populations will be monitored again in 1990.

Yellow cedar mortality

For many years the phenomenon of yellow cedar dieback on the Queen Charlotte Islands has been studied but as yet no causal organisms have been isolated. Compounding this problem is the more recent unexplained whole tree mortality of yellow cedar. During aerial surveys in 1989 scattered individuals and small patches of dead yellow cedar were seen on primarily the eastern slopes of Moresby and Louise Islands and on western Graham Island. Only trees over 40 years old appear to be affected. Samples of discolored foliage from dying trees in the mountain pass on the road to Rennel Sound were examined at PFC, however, no pathogens or insect pests were identified. Environmental factors possibly linked to slow climate change were cited as a likely cause of the mortality. Further, more detailed studies are planned for the future.

MULTIPLE HOST PESTS

Pests of young stands

Twenty-seven young stands, both planted and natural, were examined by FIDS in the Vancouver Forest Region in 1989, to identify and quantify pest problems. Pests, diseases or other problems found during these surveys have been summarized in Table 9. A more detailed description has been compiled as an appendix to this report and is available upon request.

Table 9. Summary of pests in young stands in the Vancouver Forest Region, in 1989.

Host species	No. of stands[1]	Pest or problem	Number of sites with pest	Number of sites pest-free	Trees affected Avg. Percent	Trees affected Range	Damage Index[2] Avg.	Damage Index[2] Range
Douglas-fir	23	Cooley spruce gall adelgid	17	2	59	3-100	2	2-3
		Deer browse	9	-	26	2-81	4	2-4
		voles	1	-	52	52	5	5
		winter damage	5	-	44	19-88	5	3-8
		winter kill	3	-	7	2-10	5	4-6
		mortality	4	-	10	2-15	6	6
		weevil	1	-	12	12	6	6
		western spruce budworm	1	-	19	19	3	3
		needle cast	1	-	20	20	2	2
		budmoth	1	-	3	3	2	2
		multiple leaders	1	-	5	5	3	3
		broken top	1	-	2	2	3	3
Sitka spruce	5	Environmental	1	4	26	26	3	3
Amabilis fir	4	Balsam shoot boring sawfly	2	1	80	60-100	2	2
		multiple top	1	-	6	6	2	2
		chlorosis	1	-	12	12	2	2
		snow damage	1	-	96	96	4	4
Grand fir	5	Winter kill	1	2	55	-	4	-
		foliar fungi	2	-	30	14-45	2	2
		mortality	1	-	7	7	6	6
		winter damage	1	-	44	44	3	3
		blackheaded budworm	1	-	11	11	2	2
Western red cedar	13	Deer browse	4	7	57	20-100	3	2-4
		Voles	2	-	100	100	5	5
		A foliar fungus	1	-	100	100	3	3
		cedar mite	1	-	60	60	2	2

Host species	No. of stands[1]	Pest or problem	Number of sites with pests	Number of sites pest-free	Trees affected Avg. Percent	Trees affected Range	Index[2] Avg.	Index[2] Range
Western white pine	5	An aphid	2	2	23	13-32	2	2
		weevil damage	2	-	54	8-100	2	2-3
		blister rust	1	-	18	18	5	5
		deer browse	1	-	5	5	2	2
		needle blight	1	-	5	5	2	2
		chlorotic needles	1	-	1	1	2	2
Mountain hemlock	1	Snow damage	1	-	56	-	4	-
Western hemlock	13	Voles	2	9	50	38-80	6	5-6
		Blackheaded budworm	1	-	100	100	3	3
		mistletoe	1	-	21	21	4	4
		dead top	1	-	3	3	2	2
Lodgepole pine	5	pine needle sheathminer	1	2	6	6	2	2
		winter damage	1	-	10	10	2	2
		multiple top	1	-	100	100	2	2
Noble fir	1	mortality	1	-	5	5	2	2
Yellow cedar	1	tip miner	1	-	8	8	2	2
Black cottonwood	1	bud necrosis	1	-	100	-	4	-

[1]Number of surveyed stands in which tree species comprised more than 20% of the stand.

[2]Severity index:
1. pest-free
2. damage negligible or very short term
3. loss of current growth potential
4. some net loss of volume and/or significant long term loss of growth potential
5. life threatening
6. recently dead

Deer or other animals were the most damaging pest encountered in young Douglas-fir stands where terminal or lateral bud damage was observed on an average of 26% of the trees in 9 of 23 stands. The Cooley spruce gall adelgid, Adelges cooleyi, was the most common pest, infesting 17 of 23 stands but causing little significant damage.

Environmental damage affected 26% of the trees at only one of five Sitka spruce plantations, the remainder were pest free.

A balsam shoot boring sawfly, Pleroneura sp. infested an average 80% (60-100%) of the amabilis fir trees at 2 of 4 plantations and killed 15% of the lateral shoots.

Of five plantations of Grand fir, 55% of the trees at one site were killed due to severe winter weather conditions, while at two sites the rust fungus Pucciniastrum epilobii infected 30% (range 14-46%) of the trees.

Four out of thirteen plantations of Western red cedar were browsed upon by animals. An average of 57% (range 20-100%) of the trees were severely damaged with multiple leaders and damaged lateral branches. Two sites were damaged by voles where about 10% of leaders had been clipped. The disease Didymascella thujina infected 100% of the western red cedar at one site, but caused only minor damage.

An unknown species of aphid infested 23% (range 13-32%) of the foliage on Western white pine at 2 of 5 locations, but caused insignificant damage.

Snow caused damage to 56% of the mountain hemlock trees in one stand.

Of 13 locations of western hemlock stands 9 were pest free, however at two sites voles clipped leaders, probably causing death, to 50% (range 38-80%) of the trees. At one location the blackheaded budworm, Acleris gloverana, lightly defoliated 100% of the young trees.

The pine needle sheathminer damaged 6% of the seedlings at 2 of 5 sites examined, causing little damage.

Unknown causes killed 5% of the trees in one plantation of noble fir.

A tip miner infested 8% of the yellow cedar seedlings, causing little damage.

Severe bud necrosis, caused by an unknown agent, was recorded on 100% of the black cottonwood trees at one plantation. An average of 30% of the buds were dead.

Vole damage

Meadow voles killed an estimated 80% of the newly planted western hemlock seedlings at Crawford Creek west of Squamish. Completely clipped stems on 95% of the affected trees leaves little chance for seedling recovery. Voles were still feeding when the site was visited in June: the rodents were sighted scurrying along their overgrown pathways, so it is feasible that 100% of the seedlings could have been killed by the end of the summer. The natural western hemlock regeneration above 0.5 m in height were untouched. If this site is to be regenerated again, use of a much larger stock could prevent further damage.

Vole damage was also recorded on 50% of the 0.3-1 m high saplings at a 2-ha plantation at Ring Creek 1 km east of the power lines on Diamond Head road. Voles clipped lateral and terminal leaders and caused basal scarring on 50% of the Douglas-fir, western hemlock and western red cedar. Multiple tops resulting from the vole feeding were common at this site. Feeding occurred over the last 2 to 3 years, however no current, 1989, damage was noted. The majority of the

trees at this site have survived the vole attacks with only 2% mortality recorded.

Meadow voles are very prolific, producing five or more litters a year, averaging five young per litter. Cyclical in nature, vole numbers peak approximately every 4 years. Under favorable conditions their numbers can reach over a thousand per hectare.

Gypsy Moth
Lymantria dispar

Gypsy Moth pheromone-baited sticky traps attracting male moths were placed at 101 locations in mainly provincial and municipal parks throughout the Vancouver Region by the Forest Insect and Disease Survey. A total of 24 male gypsy moths were trapped in the region, 22 by Agriculture Canada and 2 by Forestry Canada; 14 were on Vancouver Island and 10 on the mainland (Table 10), compared with the seven gypsy moths trapped in the Vancouver Region in 1988.

This is the second consecutive year that moths have been caught at Parksville and West Vancouver. The catches at Thetis Lake, Saanich, Fort Langley, Manning Park, Cultus Lake and Jericho were all new. At Chilliwack moths have been trapped in several previous years. To date, populations have not become established in British Columbia and defoliation has not been observed. The major concern of the forestry sector continues to be quarantine restrictions such as those in force during 1985 in parts of Oregon.

Table 10. Locations where adult male gypsy moths were trapped in sticky traps baited with sex pheromones in the Vancouver Region, 1989.

Location	No. moths	No. traps
Chilliwack	1	1
Jericho (CFB)	1	1
Cultus Lk.	1	1
Manning Park	1	1
Ft. Langley	1	1
West Vancouver	5	1
Parksville	8	1
Saanich	5	1
Thetis Lk.	1	1
Total	**24**	**9**

Approximately 7850 sticky traps were monitored throughout British Columbia in the fourteenth year of a cooperative program with Agriculture Canada (Plant Health), B.C. Ministry of Forests, and FIDS, Forestry Canada. A total of 25 moths were caught across British Columbia this year compared with 12 moths in 1988 and 216 in 1987. Three successful aerial and partial ground applications of *Bacillus thurigiensis* were completed in 1988 by Agriculture Canada at Kelowna, Colwood and Parksville.

Black army cutworm
Actebia fennica

No black army cutworm adult moths were collected in pheromone-baited traps at Woss Lake (2 traps) and near Cowichan Lake (3 traps).

This pest has not previously been recorded on Vancouver Island but has caused extensive damage in the Interior of the province. In all areas of the province where the cutworm has been active in past years, populations declined in 1989.

Winter damage

Winter winds caused an estimated 1800 ha of moderate and 7500 ha of severe defoliation and scattered blowdown from Hagensborg west to Restoration Bay on Burke Channel. Mainly western hemlock, western red cedar and amabilis fir of all age classes were affected near Bella Coola, however along Burke Channel Douglas-fir and lodgepole pine were also damaged.

The damage was a result of the weather changing from unseasonably warm and wet to extremely cold and windy at the end of January and beginning of February 1989. The dry, cold wind blowing from the Chilcotin plateau desiccated the needles, buds and small branches of the trees in the affected area. This resulted in needle loss of western hemlock, Sitka spruce and western red cedar and dramatic discoloration of Douglas-fir and lodgepole pine foliage. Blowdown of western hemlock, Sitka spruce, and western red cedar occurred in the Clayton Falls Creek and to a lesser degree in the Thorsen Creek drainage.

Foliage dried and dropped in February and March along Clayton Falls Creek where the most severe damage occurred. Western hemlock, Douglas-fir and lodgepole pine were severely discolored on both sides of Burke Channel; however most of the damage occurred on the northwest side, which was more exposed to winds from the east. In this area the foliage stayed on the trees longer than at areas closer to Bella Coola.

To assess the damage, six mature dominant hemlock were felled at Clayton Falls Creek. On the severely defoliated tress, 80% of the buds were killed as well as many of the smaller branches. Bud and branch mortality decreased as defoliation diminished. A variable prism plot cruise at the location showed 57% of the stems/ha (330 m^3/ha) probably dead, 20% (118 m^3/ha) fading; and 22% (140 m^3/ha) healthy. The sapwood of each tree was examined by stripping sections of the bark and recording the moisture content. Trees recorded as "probably dead" had dry sapwood; the fading trees were moderately dry and the healthy trees were moist.

Based on the cruise information at Clayton Falls Creek there could be 77% mortality of all species over approximately 1000 ha of damaged stands. Since there was no refoliation of the damaged trees over the summer they have probably used up their food reserve, making them doubtful survivors.

There were no secondary insects observed in large enough numbers to be an additional hazard, however secondary fungi will infect the damaged but surviving trees to cause stain and heart rot. Fletcher-Challenge in consultation with the British Columbia Forest Service at Bella Coola will salvage-log the damaged

stands that are predicted to die.

DECIDUOUS TREE PESTS

Western winter moth
Erannis tiliaria vancouverensis

Defoliation of deciduous hosts by the western winter moth increased substantially in 1989. Broadleaf maple and some willow, birch and alder, were severely defoliated over several hundred hectares from Chilliwack to Boston Bar. The largest infestation was in Sasquatch Provincial Park extending over an estimated 500 ha from the east end of Deer Lake to the west side of Harrison Lake, with broadleaf maple, birch and vine maple totally defoliated. Scattered 5 to 50 ha patches of defoliation were common along the Fraser Canyon and Coquihalla Highway.

Once the overstory maple had been defoliated the larvae dropped to the understory vine maple and alder and continued feeding; in some areas the looper was also feeding on salmonberry, swordfern, nettles and huckleberry on the forest floor. Larval feeding finished by late June and the larvae pupated in the soil. The buff colored adults appeared from mid-September through to October in large numbers in the Hope area indicating another infestation year for 1990. Females, though wingless, are very active climbing trees to oviposit.

This is the second year of severe defoliation in Sasquatch Park, where maples over 110 ha were defoliated in 1988. Light feeding and defoliation was noted for the last 2 years in the Fraser Canyon and Skagit Valley. Infestations rarely exceed 3 years, thus the current infestation should decline after 1990. Growth loss will be the main impact to trees severely defoliated for 2 to 3 consecutive years. Trees usually refoliate by mid-July. Only trees already under severe stress are likely to die. The current population is being monitored for parasites, disease and viral infection; initial findings indicate the presence of a pathogen which has contributed to larval mortality in past infestations. Surveys will continue in 1990.

Winter moth
Operophtera brumata
Bruce spanworm
Operophtera bruceata

For the first time the winter moth has been reported defoliating natural stands on the mainland. This introduced pest has caused serious defoliation of deciduous trees, primarily Garry oak, for more than 15 years on southern Vancouver Island.

Larval populations severely defoliated white birch stands for 5 km along Highway 99 north of the Deas Island Tunnel and for 1 km along the New Westminster highway east of Highway 99. Moderate defoliation of fruit trees and deciduous ornamentals was evident from Ladner to Tsawassen, with some trees being totally defoliated.

A program of biological control was initiated in the greater Victoria area in 1979 and is being considered for the mainland in 1990.

The closely related native species, the Bruce spanworm, was also active in some areas of the lower mainland, on broadleaf maple in North Vancouver and on vine maple near Hope.

As the two species cannot be distinguished in the larval stage they must be reared to pupae or adults for a positive identification. Surveys will continue in 1990 to monitor the infestations.

Western tent caterpillar
Malacosoma californicum pluviale

Populations of this colonial defoliator have remained at endemic levels for the last two years after four consecutive years of severe defoliation. Isolated individual colonies were visible in various parts of the region on deciduous trees and shrubs. Historically populations have remained at low levels for approximately five years after infestations subside.

Forest tent caterpillar
Malacosoma disstria

Defoliation by the forest tent caterpillar decreased at Bella Coola and Chilliwack. In the Bella Coola area the tent caterpillar lightly defoliated scattered deciduous trees and shrubs over a wide area from Stuie to Bella Coola where in 1988 most deciduous trees were severely defoliated.

The Chilliwack infestation occurred in conjunction with the satin moth, *Leucoma salicis*. These two pests lightly defoliated exotic poplar over 25 ha on the northeastern slopes of Mt. Thurston where severe defoliation over 200 ha occurred last year. A population collapse was predicted in 1988 as a disease and/or virus was prevalent in both populations. Surveys will continue in 1990 to monitor this pest.

Satin moth
Leucoma salicis

The satin moth, an introduced defoliator, in conjunction with the forest tent caterpillar, *M. disstria* lightly defoliated exotic poplar over 25 ha on the northeastern slopes of Mt. Thurston southeast of Chilliwack. This was down from 1988 when severe defoliation over 200 ha was reported in the same area; the forest tent caterpillar is not usually active in southwestern British Columbia. The collapse of the infestation was predicted in 1988 because 90% of the larvae of both insects were infected by a nuclear polyhedrosis virus.

Light defoliation has had little effect on tree growth however, two or more years of moderate to severe defoliation causes a severe reduction in radial growth and may cause considerable branch and twig mortality. Usually, as was the case this year, little tree mortality is caused by satin moth defoliation as the trees refoliate and create enough foliage to carry on photosynthesis. Although the satin moth is primarily a pest of shade, park or windbreak trees, native stands of trembling aspen and black cottonwood have been severely defoliated and limited top-kill and tree mortality have occurred.

Periodic, localized outbreaks have occurred on Vancouver Island and the southern interior from 1921 to 1985 but none are forecast to occur in 1990.

A bud midge
Dasineura new sp.

Increased populations of this bud midge caused widespread bud mortality on black cottonwood just before bud flush on the southern coast where it was reported for the first time last year.

At a proposed poplar plantation at Vedder Crossing, 100% of the naturally regenerated black cottonwood were infested and an average 35% (range 5-90%), of the buds were killed over approximately 30 hectares. Top-kill and some tree mortality on up to 5% of the seedlings was evident. The same damage was also seen at various sites along the lower Fraser River below Hope and at several locations on Vancouver Island. So far, no reports have been made of the bud midge infesting exotic poplars. Surveys for this pest will continue in 1990.

An oak leaf phylloxeran
Phylloxera nr. *coccinea*
and
Jumping gall wasp
Neuroterus saltatorius

These two insects have caused premature browning and early defoliation of Garry Oak with increasing severity over the past 3 years on southeastern Vancouver Island. In early June, yellow to brown spotting first appeared on the foliage and by mid-July affected leaves were mostly brown and began to drop. In August defoliated trees often produce a new but weaker replacement flush of leaves.

Damage caused by these insects can be readily distinguished by examining infested leaves. The lower surfaces of foliage infested by the phylloxeran aphid are covered with small orange insects whereas foliage affected by the jumping gall wasp have large numbers of small, 1.0 to 1.5 mm galls attached to the leaf.

Phylloxera damage on Garry Oak and an occasional English oak, *Quercus robur*, has been reported in the Victoria area for the past 15 years. Damage begins as yellow spots in June, successive generations eventually cause complete browning of the leaves by mid to late July. Severely attacked trees are completely defoliated. Individual trees may be repeatedly attacked over many years while other nearby oaks show no visible symptoms of attack.

For the last 3 years damage by the gall wasp has increased. Damage symptoms appear similar to that of the phyloxeran except that each leaf spot has a gall associated with it on the underside of the leaf. These galls drop to ground from June into July, causing a sound not unlike a light rain falling. Once on the ground the galls begin to "jump" due to the movement of a larva inside each gall. This has resulted in them being known as "jumping galls" or "flea seeds". Mortality caused by either insect has not yet been recorded although many severly affected trees appear to lack vigor and are weakly foliated.

Occasional deep irrigations may be useful to increase the vigor of affected trees. Damage could be reduced on small high value trees by applying a systemic insecticide* in late May. Control measures would not be practical or necessary on large mature trees.

*Note: No insecticide is specifically registered for use against these insects.

Fall webworm
Hyphantria cunea

Populations of this common defoliator of hardwood trees increased in the Chilliwack and Agassiz areas and on southeastern Vancouver Island this year. Webworm tents were common on walnut, willow, alder, poplar and various fruit trees. The large webs covering up to 1 m^3 of foliage and up to 30 per tree were common throughout the Chilliwack area.

In severe infestations, larvae may defoliate entire trees. Branches bearing webs can be cut off and the colonies burned. Insecticides registered for use against leaf-chewing insects should be effective if sprayed on the feeding areas, particularly if applied about the time the young caterpillars are spinning tents in early summer.

Poplar and willow borer
Cryptorhynchus lapathi

This European weevil attacked willow and poplar throughout the hosts range in the Vancouver region. Dead, and dying willow, and to a lesser extent poplar, were evident, mostly along road sides, from Yale and Pemberton in the north to Vancouver in the south.

This pest does not always kill the plant but causes dieback and multiple tops. Larval feeding weakens the stems making them susceptible to breakage during high winds and snowfalls, which is more of a concern in ornamental plantings. Infestations have been recorded periodically in southern British Columbia since 1930.

Alder woolly sawfly
Eriocampa ovata

The alder woolly sawfly caused widespread severe defoliation of immature red alder in the Vedder Mountain area near Chilliwack. This European species now established in British Columbia, was thought to be only a minor pest that skeletonized the lower leaves on young alder; however, defoliation of 10-100% of the trees in scattered patches was recorded among mostly roadside alder stands on Vedder Mountain. The larvae were still actively feeding in late September, and were very obvious due to the white woolly secretions covering their bodies.

Because not much is known about this recently discovered species no predictions have been made for 1990. Alder is a very hardy tree species and even complete defoliation will probably not significantly affect the infested trees.

Apple ermine moth
Yponomeuta malinella

Increased populations of the apple ermine moth were recorded on Pacific crabapple and apple trees throughout most of the Vancouver Region for the first time during quarantine related surveys. This colonial defoliator, introduced to North America from Europe was first found in British Columbia in a nursery at Duncan in 1981.

In 1989, larvae of the apple ermine moth were collected in the Greater Victoria area, north to Courtenay, on the southern Gulf Islands, at North Vancouver, at D'Arcy north of Pemberton, north of Powell River, throughout the Fraser Valley and north to Boston Bar in the Fraser Canyon. Defoliation was most severe in the mainland with complete defoliation of all trees in an orchard not an uncommon occurrence particularly at Mt. Currie near Pemberton where whole trees were engulfed in larval webbing. On Vancouver Island defoliation was light with one to three tents per tree.

Larvae emerge in the spring from hibernacula formed on the egg mass laid the previous year. Later instars feed gregariously within webs spun on branches. At maturity larvae within a colony pupate in white-spindle shaped cocoons loosely joined within the larval webbing. Near the end of June, the females lay eggs in masses on bark and cover them with a secretion which forms a hard covering.

Very low levels of parisitism (less than 1%) by a tachinid fly were recorded in larval rearings.

Tents containing larvae or cocoons should be removed from infested apple and crabapple trees and burned.

The number of pupae on infested trees indicate continuing poulations and severe defoliation of infested hosts in many parts of the region in 1990.

Birch leafminer
Fenusa pusilla

This introduced leafminer reached epidemic levels on birch in the Coquitlam watershed and near Alouette Lake.

Leafminer damage was evident in every clear-cut in the Coquitlam watershed where white birch has regenerated the site. An average 50% of the foliage on 90% of the trees were blotched and wrinkled from feeding larvae. The same damage was noted on ornamental birch at Alouette Lake in Golden Ears park. As white birch is not a commercial tree species on the coast and is usually considered a weed, control may not be necessary or even desirable.

Broadleaf maple dieback

Broadleaf maple dieback or leaf scorch continued to discolour foliage and kill branches on trees throughout the host range in the region. Roadside, open-growing and trees well within the stand were affected.

Leaf scorch damaged from 5-100% of the foliage in all areas surveyed. While 100% of the leaves on individual trees may be affected, an adjacent tree can appear apparently healthy.

The cause of the dieback is still unknown. In the eastern United States a fastidious, xylem inhabiting bacterium was found to be causing similar damage in red maple, Acer rubrum. Tests using the electron microscope to determine if a similar organism is involved here are underway.

Dogwood leaf blight
Gloeosporium sp.

This leaf blight fungus continued to cause defoliation of western flowering dogwood in 1989. As in past years, infection was widespread throughout the host range in the region, but at lower levels than in previous years. Infections at Stamp Falls and Buttle Lake Provincial Park caused 15% and 10% defoliation respectively. Additionally 75% of the foliage showed symptoms of the disease. No new mortality was recorded in the region in 1989. Other localized infections occurred at scattered locations and these will be surveyed again in 1990.

Septoria leaf spot and canker
Septoria alnifolia

Sitka alder leaf blight, caused by Septoria alnifolia, affected an average of 10% of the leaves on all red alder at Forsyth Point at the south end of Moresby Island. About 5% of the leaves on 10% of the alder were also infected in the area of South Bay. Though the disease is well known on Sitka alder the collections on red alder constitute a new host record.

Rough-bark canker
Didymosphaeria oregonensis

Near Marie Lake on Graham Island all red alder in a young pure stand had rough-bark stem and branch cankers. Despite an abundance of cankers the trees appeared to be healthy. The cankers will survive only until the bark has become hard and thick, and are only found on young trees. Overall damage was slight.

SPECIAL SURVEYS

Seed orchards

Twelve seed orchards in the Vancouver Region were surveyed two or more times during 1989 for 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.

Major insects and diseases are listed in Table 12. A complete detailed list of all pests has been compiled as an appendix to this report and is available upon request.

The **Cooley spruce gall adelgid,** Adelges cooleyi, lightly to severely infested an average of 26% (range 1-80%) of the Douglas-fir at eight of the nine locations where Douglas-fir was surveyed. The most severe infestation was noted at Harmac, where 80% of the trees were severely infested. At four locations the **fir coneworm,** Dioryctria abietivorella, lightly to moderately infested 17% (range 4-20%) of the Douglas-fir cones examined. At four locations the **Douglas-fir cone moth,** Barbara colfaxiana, lightly to severely infested 24% (range 4-80%) of the Douglas-fir cones examined. At three locations the **Douglas fir cone midge,** Contarinia oregonensis, moderately to severely infested 62% (range 36-100%) of the Douglas-fir cones examined.

Table 12. Major insects and diseases in seed orchards of the Vancouver Region, 1989.

Host	No. of orchards surveyed	Pest	Frequency	Average percent trees or cones affected	Percent Range	Severity
Douglas-fir	9	Cooley spruce gall adelgid, Adelges cooleyi	8	26	1-80	light to severe
		Fir coneworm, Dioryctria abietivorella	4	17	4-20	light to moderate
		Douglas fir cone moth, Barbara colfaxiana	4	24	4-80	light to severe
		Douglas-fir cone midge, Contarinia oregonensis	3	62	36-100	moderate to severe
Western hemlock	8	Hemlock wooly adelgid, Adelges tsugae	2	9	1-18	moderate
Yellow cedar	3	A gall midge, Contarinia n.sp.	1	50	1-100	light to severe
Amabilis fir	4	Balsam wooly adelgid, Adelges piceae	3	20	10-35	light to moderate

The **hemlock woolly adelgid,** Adelges tsugae, moderately infested an average of 9% (range 1-18%) of the western hemlock at two of the eight orchards surveyed.

A **gall midge,** Contarinia n. sp., lightly to severely infested an average of 50% (range 1-100%) of the Yellow cedar at one of three locations surveyed.

The **balsam woolly adelgid,** Adelges piceae, lightly to moderately infested an average of 20% (range 10-35%) of the amabilis fir at three of four locations

surveyed.

Surveys will continue in 1990 and significant problems will be reported as noted at that time.

Acid rain plots

The 10 ARNEWS (Acid Rain National Early Warning System) study plots were visited several times each during 1989, as has happened since 1984. No **acid rain** symptoms, including damage to vegetation that cannot be diagnosed as biotic or abiotic were observed in 1989. **Tree mortality** (Table 13) has occurred in 7 of the 10 plots but all deaths can be attributed to natural causes, competition and shading out. The highest incidence of tree mortality was at UBC research forest where 18 (35%) of the plot trees, mostly understory western hemlock, have died since 1984. Very few significant insect or disease symptoms were noted this year except for **Phellinus root disease** which infected an estimated 10% of the Douglas-fir at the Salt Spring Island plot. **Armillaria root disease** was suspected to be killing amabilis fir off-plot trees at the Coquitlam West site.

Table 13. Tree mortality recorded in ARNEWS plots from 1984-1989 in the Vancouver Region, 1989.

Plot and plot number	Year estab-lished	Number of trees: Original Plot	Number of trees: Died since plot estab-lishment	Tree species	Remarks
U.B.C. Forest - 902	1984	50	12	wH	Shaded out
		5		wrC	Shaded out
		1		wB	Shaded out
Shawnigan Lake. - 901	1984	130	16	D-fir	Shaded out
Salt Spring Island - 903	1984	102	13	D-fir	Shaded out
			1	D-fir	*Phellinus weirii*
Jones Lake - 909	1985	60	2	wH	Shaded out
			1	wH	Blowdown
			1	D-fir	Unknown
John Hart Lake - 904	1985	31	0	-	-
Seymour River - 911	1986	38	2	D-fir	Unknown
Seymour River - 912	1986	52	1	D-for	Snow damage
Capilano River - 910	1986	75	1	aF	*Pseudohylesinus* sp.(Bark beetle)
Coquitlam River - 914	1986	65	0	-	-
Coquitlam River - 913	1986	71	0	-	-
TOTAL		**674**	**56**		

These plots are part of a national system to gather baseline data on acid rain in Canada's forests. The data is needed to clearly and accurately detect early signs of acid rain damage and to annually monitor for changes in forest conditions.

Fume damage

Foliage discoloration in scattered patches and previously noted cumulative damage, i.e. dead snags over 300 ha, were visible near the Port Alice pulp mill in 1989. Within 2 km of the mill an average of 70% (50 to 100%) of the foliage of individual alder, salmonberry, huckleberry, and salal plants were discolored. Previous surveys indicated 60% of the western hemlock were affected. At 4 locations within 6 km of the mill a gradual decline in forest health is evident. Symptoms such as dead tops, dead lateral branches, shortened needles, dead branch tips and up to 50% foliage loss occurred in an average 15% (10 to 100%) of trees examined. This area will continue to be monitored by FIDS in the ensuing years.

Several fume damage assessment plots were established in the Port Alice area by the BCFS in conjunction with the Ministry of Environment. During 1988 foliage samples of western hemlock and Douglas-fir were collected to be analyzed for terpene composition and sulfur content. While all the analysis are not yet completed some preliminary results for western hemlock indicate that samples at a remote site (Alice Lake) have a higher sulphur content (either organic or inorganic) than samples collected at close proximity to Port Alice. In both Douglas-fir and western hemlock total sulphur content increases with the increasing age of the foliage.

MINOR PESTS

Collections and records were made of many pests currently at endemic levels (Table 14). These pests include Swiss needle cast, western gall rust, spruce budmoth, green-striped forest looper and other insects and diseases.

Table 14. Pests currently at endemic levels, Vancouver Forest Region, 1989.

Pest	Host	Location	Damage	Status
Douglas-fir tussock moth, Orgyia pseudotsugata	D-fir	Vancouver Region	none	endemic
Green-striped forest looper, Melanolophia imitata	D-fir			endemic
Phantom hemlock looper, Nepytia phantasmaria	D-fir	Lower Mainland	low numbers of larvae collected	endemic
Pine butterfly, Neophasia menapia	D-fir	Vancouver Region	none	endemic
Silver spotted tiger moth, Lophocampa argentata	D-fir	Vancouver Region	single scattered colonies	static

Pest	Host	Location	Damage	Status
Swiss needle cast, *Phaeocryptopus gaeumannii*	D-fir	Vancouver Region	scattered light defoliation throughout region	endemic
Western gall rust, *Endocronartium harknessii*	lP	Vancouver Region	infection as high as 90% in scattered areas	endemic
Sequoia pitch moth, *Synanthedon sequoiae*	lP	Sunshine Coast	light attacks common	endemic
Spruce budmoth, *Zeiraphera* sp.	sS D-fir aF	Vancouver I. QCI	light defoliation in scattered patches on the west coast and QCI	endemic
Dwarf mistletoe, *Arceuthobium tsugense*	wH	Vancouver Region	widespread	endemic
Cypress tip moth, *Argyresthia* sp.	Ornamental juniper, cedar and cypress	Vancouver I.	light damage of foliage at several widespread locations	static
Cypress twig mite, *Trisetacus chamaecypari*	yC	Vancouver Region	widespread in most yellow cedar stands	increasing
Cedar leaf blight, *Didymascella thujina*	wrC	Vancouver Region	light infections in most areas of the region; damage is rarely serious	static
Larch sawfly, *Pristiphora erichsonii*	wL	Lower Mainland	scattered light defoliation at UBC Research Forest and Stanley Park	static
Alder flea beetle, *Altica ambiens*	aL	Vancouver Region	scattered patches of severe wide-spread defoliation	increasing

NEW RECORDS OF OCCURRENCE AND DISTRIBUTION

A total of 11 disease collections and 1 insect collection in 1989 were new records in the Vancouver Forest Region. Most of the new disease records were relatively minor foliage or bark disorders or saprophytes. Six collections were on deciduous hosts, three on conifer hosts and the remainder on soil and duff. An additional 22 diseases were recorded for the first time on new hosts; 12 on conifers and 10 on deciduous trees and shrubs.

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