Forest Insect and Disease Conditions

Vancouver Forest Region 1985

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Government of Canada
Canadian Forestry Service

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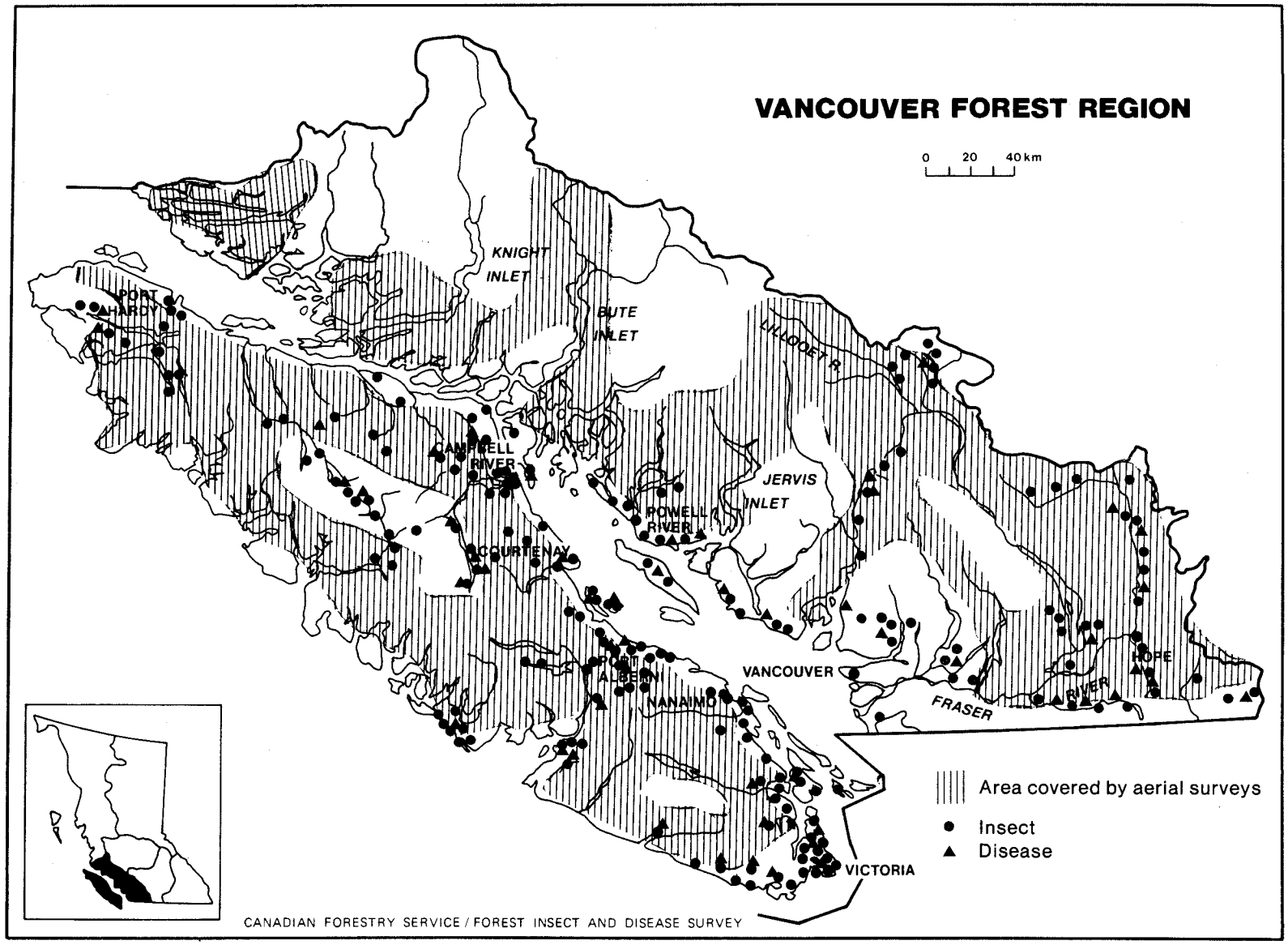
SUMMARY

This report outlines forest insect and disease conditions in the Vancouver Forest Region in 1985 and attempts to forecast population trends of some potentially damaging pests.

Mountain pine beetle killed an estimated 85 900 m^3 of lodgepole pine in the Region, a fourfold increase from 1984. **Western spruce budworm** populations remained low with no defoliation recorded for the fifth consecutive year. Light defoliation of immature hemlock, Douglas-fir and amabilis fir in a new outbreak of **western blackheaded budworm** occurred in the Statlu Creek drainage. For the first time in three years **balsam bark beetle** caused mortality was recorded by aerial surveys, covering an estimated 390 ha.

The forest pest survey field season extended from mid-May to late September. A total of 409 insect and 154 disease collections were submitted to PFC by FIDS survey personnel. Map 1 shows the locations where one or more samples were collected and the areas covered by 24 hours of fixed wing and helicopter surveys. A total of 95 special collections included larch sawfly, bark beetle, tent caterpillar and winter moth for parasitism studies; western gall rust for age classification; mass collection of cones and spruce budmoth. A few of the special surveys were: inspection of provincial parks; acid rain study plots; white pine cone crop assessments; nematode surveys; black stain root disease samples to determine distribution.

The number of standard FIDS three-tree beating samples from all hosts which contained larvae increased to 45% from 24% in Mainland forests and to 82% from 64% on Vancouver Island.



Map 1. Areas covered by aerial surveys and locations where one or more forest insect and disease samples were collected in 1985.

DOUGLAS-FIR PESTS

Douglas-fir beetle, Dendroctonus pseudotsugae

Douglas-fir beetle attacks decreased in mixed stands in the Region to 156 ha in 1985 from 235 ha in 1984. A total of 18 infestations of scattered light attack occurred in areas ranging from 5-22 ha in size, with the majority of mortality occurring in the Fraser Valley (Table 1).

Table 1. Location and area of Douglas-fir trees killed by Douglas-fir beetle as determined from aerial surveys, Vancouver Forest Region, 1985.

Location	Number of Infestations	Area (ha)
Hannah Lake	11	45
Ainslie Creek	3	45
Maselpanik Creek	1	18
Head of Bute Inlet	1	22
West of Pemberton	2	26
TOTAL	18	156

Root rot weakened trees are the main host of the Douglas-fir beetle in the Fraser TSA. Of the seventeen beetle attacked trees that were sampled for root disease, 100% were infected by Phellinus weirii and 14% by Armillaria sp. Not all infected trees were beetle-attacked, 62% of the dead trees in root rot-beetle infested pockets were free of beetle attack. In the past, root rot killed trees may have been mistakenly diagnosed as Douglas-fir beetle killed.

Brood sampling of windblown, infested Douglas-fir in the Ainslie Creek and Klesilkwa Creek drainages gave 'R' values of 1.6 and 1.2, respectively. The value 1.6 indicates an increasing population and 1.2 a static population. These beetle populations will probably attack down or weakened trees in 1986 with healthy trees remaining untouched. As tree mortality will remain at low levels, control measures will not likely be implemented.

On Vancouver Island, the only evidence of current beetle attack was in the "Aug. Fire" at Strathcona Park, by Vernon Lake and in association with root rot centers. A resurvey of the "Aug. Fire" indicated a 2% partial attack on fire scarred trees. Two downed trees were severely attacked. No healthy trees were attacked within or near the fire area. The beetle was found at Vernon Lake but only on 10-20 windthrown trees. Seven P. weirii root rot centers also harboured beetle populations, but only in infected trees as a secondary pest. No attack on healthy trees is anticipated in any of the areas in 1986.

Western spruce budworm, Choristoneura occidentalis

For the fifth consecutive year Douglas-fir stands were not defoliated. Larval populations were down in the Mainland district, 8% of the beating collections contained budworm larvae averaging 1.7 larvae/sample, compared to 14% with an average of one larva in 1984.

On Vancouver Island larval populations increased slightly; 5% of beating collections contained an average of four budworm larvae per sample compared to only two larvae collected in 1984.

Five pheromone-baited flight traps, using E/Z-11-tetradecenal in each of nine stands in the Region, attracted an average of 16.6 male adults (range 0-59) per location (Table 2). This is a slight decrease from 1983 when 18.2 moths per trap were collected but a sharp increase from 1984 when 3.3 moths per trap were collected. The large increase in male adults may point to a slight increase in larval populations in 1986, but defoliation is not expected.

Table 2. Number of adult male western spruce budworm in pheromone-baited traps, Vancouver Forest Region, 1985.

Location	Number of adults/trap	
	Range	Average
Powell River	39-59	49.2
Squamish	13-24	16.6
Skagit Valley	14-27	19.6
Ucluelet	0	0
Rathtrevor Park	5-32	19.8
Port Hardy	0	0
Gold River	12-33	24.4
Snowdon Creek	0-39	15.3*
Jordan River	1-13	4.2
TOTAL	0-59	16.6

*one trap missing

Douglas-fir tussock moth, Orgyia pseudotsugata

For the second consecutive year there has been no defoliation of conifers by tussock moth in the Vancouver Region. No larvae were found in standard beating samples throughout the Region and populations are expected to remain low in 1986.

Pheromone-baited flight traps, using Z-6-heneicosen-11-one, were located at 13 sites in the Region. One Douglas-fir tussock moth adult was trapped in Victoria, all other sites were negative, but rusty tussock moth and a conifer tussock moth were common (Table 3). The latter two species are not considered destructive and are not expected to cause any serious defoliation in 1986.

Table 3. Number of adult tussock moths in pheromone-baited traps, Vancouver Forest Region, 1985.

Location	Number of adults per trap					
	Orgyia pseudotsugata		Orgyia antiqua badia		Dasychira sp.	
	Range	Average	Range	Average	Range	Average
Powell River	0	0	3–19	7.8	3–10	6.2
Sechelt	0	0	3–16	9.0	11–21	13.6
Devine	0	0	1–10	5.2	3–13	7.6
Coquihalla River	0	0	2–5	3.4	1–9	5.0
Kent	0	0	5–12	7.7	11–15	13.0
Skagit	0	0	7–21	13.4	16–31	23.8
Victoria	0–1	0.2	-	11.8	-	-
Port Alberni	0	0	-	12	-	5
Qualicum Beach	0	0	-	15.2	-	2.4
Comox	0	0	-	14.2	-	10.6
Cassidy	0	0	10–17	13	2–16	9.4
Elk Falls	0	0	13–21	16.4	0–12	4.4
Duncan	0	0	1–9	5.2	13–25	19.6

Laminated root rot, Phellinus weirii

Laminated root rot, caused by the fungus Phellinus weirii was responsible for killing 1 000 Douglas-fir trees over 148 ha, as estimated by aerial surveys. A total of 19 areas were mapped with 17 root rot centers located on the east side of the Fraser River between North Bend and Hope, covering 135 ha. The remaining two areas covered 13 ha in the Ghostpass Creek drainage near Mt. Dewdney. Secondary attack by Douglas-fir bark beetles is common in infected trees.

On Vancouver Island, although no root rot areas were mapped during aerial surveys and no specific ground surveys were initiated, the root rot P. weirii continues to be a major pest in Douglas-fir stands. Infection centers were noted in conjunction with other survey work, on Mt. Maxwell (Saltspring Island) both in and near the park, eight root rot centers from .1 to 1 ha in size were noted near and adjacent to the park access road. In the Buttle Lake area five spot infestation centers affecting young regeneration were found. On an access road in the Museum Creek area of the Alberni Valley, three root rot centers from .2 to 1 ha in size were found within 2 km. Two areas of mortality affecting three and 20 trees,

respectively, were noted along Highway 28 near Campbell River. Secondary attack by bark beetles was found at seven of the above sites.

Swiss needle cast, Phaeocryptopus gaeumannii

Predominantly light infections of this native needle disease, which affects all but the current year's foliage of Douglas-fir and results in premature needle loss, was again widely distributed on Vancouver Island in 1985 (Table 4). It was first identified as a major cause of premature needle loss in 1979 when 1 000 ha in Upper Klanawa River Valley were severely infected.

Premature needle drop occurred at most locations varying from 5 to 95% per infected tree. At Snowdon Seed Orchard, needle loss per tree averaged 30% (range 5-95%), at Quinsam Seed Orchard 20% (range 5-80%) and at Memekay River 10% of older needles were cast. Other locations had only minor needle loss.

Infection rates of Swiss needle cast at all seed orchards averaged 62% of trees affected, a slight increase from 1984 with an average of 58%. At Dewdney Seed Orchard infection was 100%, up from 98% in 1984, when a fungicide was applied. At Snowdon Seed Orchard 97% of trees were infected after a spring spray program, similar to the 100% infection rate in 1984.

Branch and tree mortality caused by Phaeocryptopus gaeumannii has not been observed; however, repeated severe infection of some trees at one seed orchard has resulted in poor condition requiring possible removal.

Table 4. Location and intensity of Swiss needle cast infections of Douglas-fir, Vancouver Forest Region, 1985.

Location	Percent of trees affected	Infection intensity*
Dewdney Seed Orchard	100	light/severe
Pacific Seed Orchard	10	light
Tahsis Seed Orchard	48	light
Koksilah Seed Orchard	50	light
Harmac Seed Orchard	30	light
Quinsam Seed Orchard	98	light/moderate
Snowdon Seed Orchard	97	moderate/severe
Beaver Point (Saltspring I.)	30	light
Glintz Lk. Rd.	80	light
Helliwell Park	70	light
John Hart Lake	100	light
Little Qualicum River	98	light/moderate
Memekay River	90	light

*Light - up to 30% needles infected; Moderate - 31-60% needles infected; Severe - 61%+ needles infected

CONE AND SEED PESTS

The cone crop was generally light to medium on Vancouver Island in 1985. An average of 17.5% of the 355 Douglas-fir cones examined were infested by cone and seed pests. Sidney Island cones were 70% infested while only 2.5% of cones at Quinsam Seed Orchard contained pests (Table 5). Populations by pest were generally low with 6% of cones infested by Megastigmus spermotrophus, 5.5% by Contarinia oregonensis, 4.5% by Contarinia washingtonensis, and 2% each by Barbara colfaxiana and Dioryctria abietivorella. The seed bug Leptoglossus occidentalis, present in high numbers in 1984, was not found in four early surveys in 1985 and no populations were noted during cone collections in August.

Douglas-fir growth anomalies

Growth anomalies affected 2 to 4% of trees in a young Douglas- fir plantation over approximately 35 ha near Bear Creek reservoir. These anomalies, not readily attributable to known causes, continue to be common in plantations, especially in areas along Highway 19 between Kelsey Bay and Woss. Typical visible conditions in all affected areas include twisted stems, multiple leaders without expression of dominance, crooked tops, shepherd's crook, bushy tops and occasional fasciation.

Causal agents have not yet been determined.

Meria needle disease, Meria laricis

The presence of this pathogen was confirmed from only two of six seed orchards sampled for this needle disease on Vancouver Island. At Pacific Forest Products and Mt. Newton seed orchards, samples from 4% of trees proved to contain some M. laricis spores. Infection rates were trace to very light. No confirmation of the disease was possible at four other sites, where five to eight percent of trees showed typical symptoms such as browning of needle tips or brown tips with yellow base divided by a green band.

At all sites extent and intensity, based on visual symptoms, was very light, much reduced from 1984. This may be related to a relatively dry early spring in 1985. Cool, damp conditions next spring during spore dispersal may see an increase of this needle fungus on Douglas-fir in 1986.

Silver-spotted tiger moth, Lophocampa argentata

Partial defoliation of single branches of Douglas-fir occurred only occasionally on Vancouver Island from Victoria to Campbell River and only one larva was found in three-tree beating samples. The number of colonies of Lophocampa argentata larvae was reduced for the second year in a row. No evidence of the insect was found on the Mainland.

Cause of the near collapse is attributed to several natural control factors. Approximately 58% mortality was caused by disease and

Table 5. Incidence of Douglas-fir cone and seed pests, Vancouver Island, Vancouver Forest Region, 1985.

Location	No. of cones examined	% Cones infested by pest					% Cones infested*
		C. oregonensis	B. colfaxiana	D. abietivorella	M. spermotrophus	C. washingtonensis	
Sidney Island	20	-	-	5	30	55	70
Mt. Washington	50	-	-	4	2	-	6
Mt. Maxwell	20	20	-	5	15	-	40
Dewdney Seed Orchard	25	8	-	-	-	8	16
Quinsam Seed Orchard	40	2.5	-	-	-	-	2.5
Snowdon Seed Orchard	40	7.5	-	-	-	5	12.5
Tahsis Seed Orchard	40	-	2.5	5	2.5	-	7.5
Pacific Seed Orchard	40	5	-	-	7.5	-	10
Koksilah Seed Orchard	40	7.5	-	10	-	-	17.5
Harmac Seed Orchard	40	10	15	5	10	2.5	32.5
% Cones infested		5.5	2	2	6	4.5	17.5

*Some cones infested by more than one pest.

parasitism. In two colonies reared, approximately 40% of 330 larvae were parasitized by a Diptera, Uramya halisidotae; in addition, 5% were parasitized by a Hymenoptera, Enicospilus merdorius. Microscopic examination of 18 smears revealed possible infection by CPV (cytoplasmic virus) in 15 slides. Further confirmation of the virus will be made by CFS at PNFI, Sault St. Marie. Similar affected larvae were stored in distilled water and will be used to create a foliar spray for testing and confirmation of virus on a 1986 colony. Approximately 14% of larvae were suspected to be diseased. Colonies are expected to remain in low numbers with limited damage in 1986.

WESTERN HEMLOCK PESTS

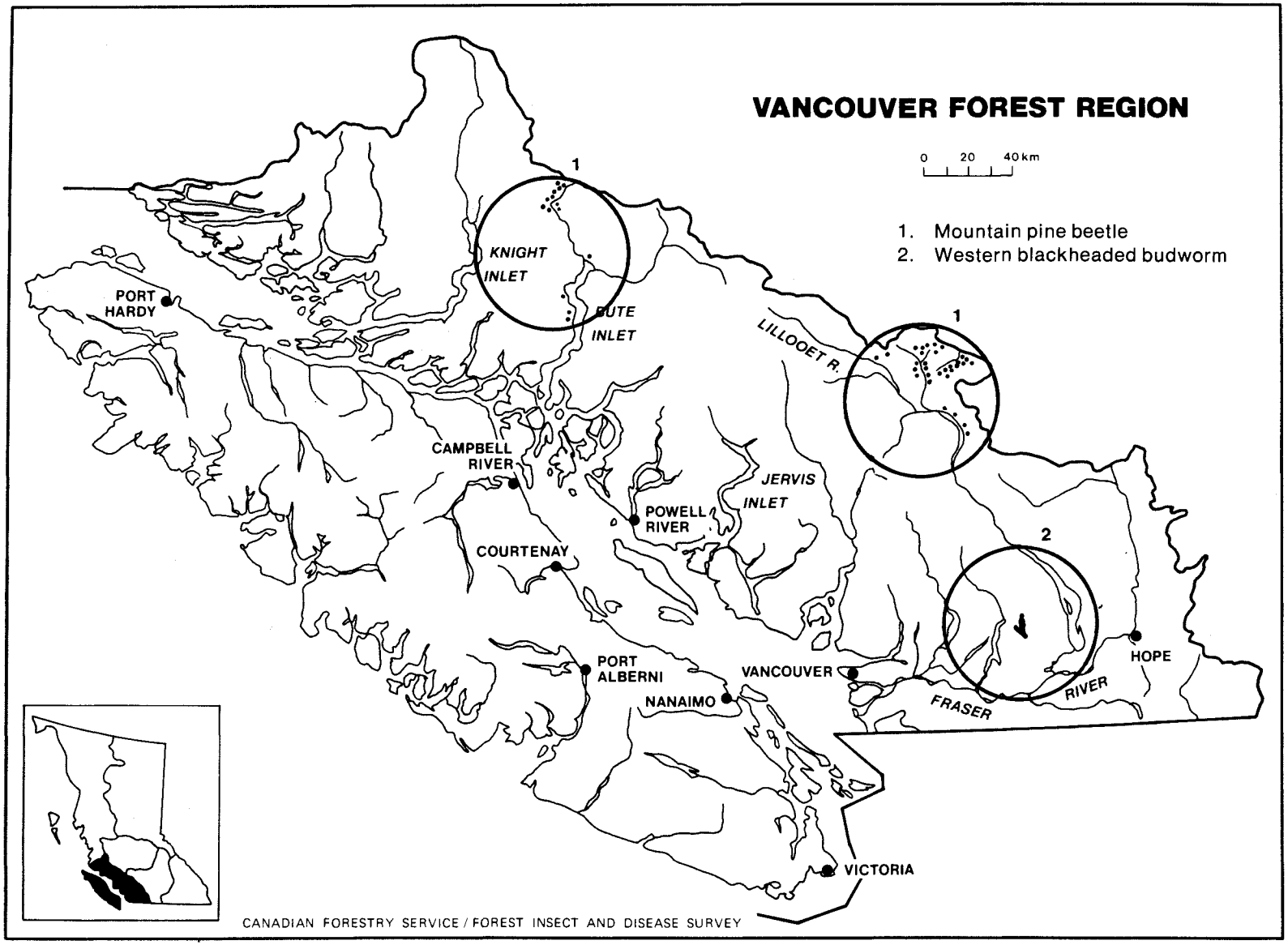
Western blackheaded budworm, Acleris gloverana

Blackheaded budworm lightly defoliated 5 to 30-year-old western hemlock, mountain hemlock, Douglas-fir and amabilis fir, over an estimated 2 000 ha between South Statlu and Blacklock creeks in the Chehalis Lake area on Vancouver Mainland (Map 2). Defoliation was visible on 5-50% of the new foliage on 60% of the western and mountain hemlock. Amabilis fir was defoliated to a lesser extent with larval feeding affecting 5-30% of the foliage on 20% of the trees and trace defoliation was evident on 10% of the Douglas-fir. Budworm pupae were evident by the third week of July indicating a slightly advanced life cycle possibly due to the unusually hot summer.

On Vancouver Island, where no defoliation was recorded, the number of positive collections of blackheaded budworm remained static. The average number of larvae per positive sample increased to five in 1985 from two to three in 1984.

A binocular ground assessment of mature and overmature western hemlock in Stanley Park showed defoliation of four trees in the forested area north of the Vancouver Yacht Club and west of Brockton Oval. Moderate defoliation had occurred in the upper crowns of two trees and light defoliation in the upper crowns of two others. This damage coincides with the wasteful feeding symptoms of A. gloverana but no actual insect samples were collected.

To determine overwintering egg populations and viability, two 45 cm hemlock branch samples from each of ten trees were collected at three different locations in the infestation area (Table 6). The number of eggs ranged from 0-4/branch, indicating trace defoliation for 1985. The low number of eggs could be due to the samples being collected too early in the fall, before the adult moths had finished egg laying. As a result, the defoliation forecast may be underestimated.



Map 2. Areas of recent tree mortality and defoliation detected during aerial and ground surveys, 1985.

Table 6. Location, average number of healthy blackheaded budworm eggs and predicted defoliation for 1985 based on twenty 45 cm branch samples per location.

Location	Avg. no. of healthy eggs/branch		Predicted defoliation[1]
	September sampling	January sampling[2]	
South Statlu Cr.	0.2	1.25	Trace
Blacklock Cr.	0.6	2.15	Trace
Tessaro Cr.	1.2	1.15	Trace
Chehalis R.		1.35	Trace

[1]Trace defoliation – less than 5 healthy eggs/45 cm branch
Light defoliation – 5–26 healthy eggs/45 cm branch
Moderate defoliation – 27–59 healthy eggs/45 cm branch
Severe defoliation – 60+ healthy eggs/45 cm branch

[2]January sampling confirms original results and defoliation predictions.

Western hemlock looper, Lambdina f. lugubrosa

Populations of hemlock looper on the Mainland declined to the lowest level in the past five years (Table 7), with no larvae collected from 28 beating samples. On Vancouver Island, only four larvae were found in a total of 34 western hemlock collections compared to two larvae found in 1984 collections.

Table 7. Percentage of western hemlock collections containing western hemlock looper and average number of larvae per positive sample, Mainland area, Vancouver Forest Region, 1981–85.

Year	Percentage of collections containing larvae	Avg. no. larvae per positive sample
1981	16	2.0
1982	30	9.0
1983	34	2.5
1984	5	2.0
1985	0	0

The last outbreak occurred in 1971 at Coquitlam Lake, and populations are expected to remain low in 1986.

Green-striped forest looper, Melanolophia imitata

The preferred host of the green-striped forest looper has traditionally been western hemlock, but for the last two years larval numbers in the Region have been higher from collections on Douglas-fir. In 1985, 21% of western hemlock samples contained an average of 2 larvae, compared to 18% and 2 larvae in 1984. Populations in Douglas-fir stands averaged 3 larvae in 35% of the collections and 2.6 larvae in 27% of the collections in 1985 and 1984, respectively.

Populations are expected to remain low in 1986 though past infestations have been characterized by rapid population increases.

Conifer sawfly, Neodiprion spp.

Throughout Vancouver Island populations were noticeably reduced with an average of three larvae found in 20% of samples as compared with 14 larvae in 23% of samples the previous year.

No defoliation of western hemlock occurred at Norm Lake where the conifer sawfly caused very light defoliation in 1984. The population at this site collapsed to 1 larva per standard sample in 1985 from 150 larvae in 1984 and 13 larvae in 1983. Moderate populations commonly found at Haihte Lake and Forbidden Plateau were reduced to zero.

Hemlock tip dieback

A tip dieback infected from 20% to 60% of western hemlock regeneration at Mt. Washington and Ralph River at Buttle Lake. Infection was generally light and scattered throughout the hemlock crowns, affecting approximately 5% of tips at each site.

The dieback, which affected branch tips of 2 to 25 cm and resulted in needle loss, was first reported in the Courtenay area of Vancouver Island in 1981. Possible associated causal agents include the shoot blight, Sirococcus strobilinus found at the Mt. Washington site and the tip blight, Xenomeris abietis also found at Mt. Washington and suspected but not confirmed at Ralph River.

While dead branch tips are common in areas of continued infection, tree mortality has not been recorded.

Phantom hemlock looper, Nepytia phantasmaria

The percentage of collections containing larvae has decreased to zero in 1985 from 2% in 1984. The phantom hemlock looper severely defoliated western hemlock at Coquitlam Lake in 1982. Populations are expected to remain low in 1986.

Terminal crook disease, Colletotrichum acutatum

This introduced pathogen was not found on planted stock, residuals or natural regeneration western hemlock in the fourth annual follow-up examination of recently planted stock in the Northwest Bay area on Vancouver Island. The sites are believed to be unfavorable to the

establishment and spread of the pathogen which is an important nursery pest in New Zealand. Examinations will continue, if necessary, in 1986.

Porcupine Damage

Porcupine feeding has caused top-kill and mortality of 20 to 30-year-old western hemlock in the Span, Margaret and Alf Creek drainages south of Chehalis Lake. Less than 1% of the western hemlock over several hundred hectares is affected.

PINE PESTS

Mountain pine beetle, Dendroctonus ponderosae

An estimated 102 500 recently killed lodgepole pine (85 900 m^3) covering 4 195 ha were mapped by aerial surveys in the Region in 1985 (Table 8). The fourfold increase in number of trees may be a consequence of different aerial coverage methods and the use of prism plot cruising to extrapolate tree numbers. Previously, tree numbers had been estimated from the air only.

The major areas of tree mortality occurred in the Gates River-Birkenhead Lake-Devine area of the SOO TSA (Map 2, page 10). Smaller numbers of recently killed trees were recorded in the Inkitsaph and Ainslie Creek areas of the Fraser Canyon, Fraser TSA. The number of recently killed trees in the Homathko River infestations in the Quadra TSA increased and the area of the infestations remained constant.

Table 8. Location, area, number and volume of pine trees recently killed by mountain pine beetle determined from aerial and ground surveys, Vancouver Forest Region, 1985.

Timber Supply Area	Area (ha)	Number of trees killed	Volume of host killed (m^3)
Fraser	245	6 250	5 000
Soo	1 430	38 750	34 900
Quadra	2 520	57 500	46 000
Totals	4 195	102 500	85 900

Mountain pine beetle infestations have again been detected in Manning Park where it was thought that the pine beetle had been brought under control in 1983. The majority of the 250 red trees occurred in the Copper River drainage in the northeastern corner of the Park, with the scattered red trees spread over a large area between Goodfellow and Cambie creeks.

Five stands were cruised during September to determine the current attack levels and brood development (Table 9). The percentage of recently killed trees ranged from 2 to 26% while the range of current attack was

10-43%. The average current attack (24%), when compared with the average red attack (17%), indicates increased tree mortality in most stands for 1986.

Table 9. Status of lodgepole pine in stands infested by mountain pine beetle, Vancouver Forest Region, 1985.

Location	Percent of Trees Attacked				
	1985	1985 pitchout/partial	1984	Prior to 1984	Healthy 1985
Manning Park	10	7	2	8	73
King Cr.	25	7	24	20	24
Sockeye Cr.	25	5	26	9	35
Spetch Cr.	43	6	25	21	5
Devine	17	12	9	36	26
Regional Average	24	7	17	19	33

Assessments of broods in ten 1985 attacked trees at 5 locations in September indicate increasing populations in 1986 (Table 10). Two 15x15 cm bark samples at breast height from the north and south side of each tree contained an average of 9.4 larvae (range 5.3-14.0). Overwintering broods could be reduced by below average cold temperatures prior to emergence in May and June.

Table 10. 'R' values and 1986 population predictions. Vancouver Forest Region, September, 1985.

Location	dbh (cm)	Avg. no. larvae/ 225 cm^2 sample	No. galleries per sample	'R' values*	Population predictions
Manning Park	21.9	8.5	1.9	11.5	increasing
King Creek	39.3	7.8	1.0	7.8	increasing
Sockeye Creek	25.0	5.3	1.6	3.9	increasing
Spetch Creek	31.8	14.0	1.7	8.2	increasing
Devine	18.5	11.5	1.5	7.6	increasing

*2.5 and less = decreasing
2.6 to 4.0 = population static
4.1 plus = population increase

European pine shoot moth, Rhyacionia buoliana

Minor damage to Mugho and ornamental pines continued in several east coast locations on Vancouver Island. At the University of Victoria, where populations have persisted for over 10 years, four larvae were collected from two Mugho pines and minor damage was visible wherever this host occurred on the campus. Larvae were also collected at Civic Arena in Nanaimo where all Mugho pines were infested with an average of 20-30 tips per tree affected. Light, scattered attack again occurred on ornamental pines in the Comox area.

A pheromone-baited trapping program by FIDS and BCMAF using three different lure formulations resulted in positive, but highly variable trap catches of male European pine shoot moth adults at a number of locations (Table 11).

Table 11. Location, lure source and results of male European pine shoot moth trapping program, Vancouver Region, 1985.

Location	Lure source	# of Traps	Total moths trapped	Range	Traps In	Traps Out
U.Vic.	PFC[2]	2	89	23-66	24.5	29.8
	Oregon[3]	1	18	-		
Sooke	PFC	3	0	-	10.6	06.9
	Oregon	2	0	-		
Nanaimo	PFC	3	114	12-52	31.5	09.9
	Oregon	2	92	39-53		
Bowser	PFC	3	0	-	31.5	10.9
	Oregon	2	0	-		
Comox	PFC	3	103	0-59	31.5	10.9
	Oregon	2	4	1-3		
Cloverdale[1]	Oregon	1	12	-	19.6	6.8
	PFC	1	13			
	NRC[4]	1	25	-		
Richmond (Xmas tree farm)	Oregon	1	17	-	18.6	19.8
	PFC	1	9	-		
	NRC	1	8	-		
Richmond (Nursery)	Oregon	1	54	-	18.6	19.8
	PFC	1	29	-		
	NRC	1	30	-		
Mission	Oregon	5	1	0-1	19.6	19.8
	PFC	5	1	0-1		
	NRC	5	0	-		

[1] Information from Lower Fraser Valley received from H. Gerber, BCMAF.
[2] PFC - lure is E-9-dodecenol + E-9-dodecenol
[3] Lures received from Oregon. Formulation not available at this time.
[4] Lures received from National Research Council. Formulation not available at this time.

All traps and lures were satisfactory for indicating presence or absence of EPSM in the immediate vicinity; however, variability creates difficulties in using traps as a quarantine basis. The range of the different lures is unknown; therefore, the results, especially in those areas not specifically identified as infestation locations, were also inconclusive in determining distribution of the pest in the Region.

No shoot moths or associated damage were found in native lodgepole pine stands. Populations of this pest are expected to persist in ornamental pines on Vancouver Island in 1986.

Pinewood nematode, Bursaphelenchus xylophilus

In the Vancouver Region, quarantine surveys to determine the presence of the nematode consisted of stem disk, increment core and adult Monochamus sp. sampling, primarily of lodgepole pine and western white pine. Eleven areas where visibly weakened pine occurred were sampled, of which two tested positive for Bursaphelenchus sp. The samples from the Nanaimo area and Ross Lake which tested positive were subsequently identified as innocuous native species.

The pinewood nematode was responsible for mortality of pines over large areas in Japan during the past three decades. Export restrictions, related to this pest, of all coniferous raw materials necessitate data collection to obtain the required phytosanitary certificate. Nematode sampling will continue in 1986.

Pine sawfly, Neodiprion sp.

This sawfly lightly defoliated immature lodgepole pine in scattered areas between McGuire and Daisy Lake north of Garibaldi. Throughout the Lower Mainland, 29% of lodgepole pine collections contained an average of 6 larvae/sample. Infestations usually last only one to three years with no permanent damage. No change in populations is expected for 1986.

Pine Needle Diseases

Light infection by Lophodermella concolor of mainly 1984 needles occurred on 50% of regeneration lodgepole pine at Little Qualicum Falls Park. General roadside surveys in many areas with a large lodgepole pine component, indicated a continued presence but with much reduced severity of various needle diseases.

Pine needle diseases are expected to continue to infect lodgepole pine stands and cause premature needle loss in the Region in 1986.

TRUE FIR PESTS

Western balsam bark beetle complex, Dryocoetes confusus, Ceratocystis dryocoetidis

This insect-disease complex caused scattered light mortality of high elevation alpine fir over 384 ha in the Vancouver Region in 1985. The dead trees were located in the Eight Mile, Snass, Mowhokam, Spuzzum and Scar creeks covering 83, 23, 109, 44 and 40 hectares, respectively. The Birkenhead and Lillooet rivers had 7 and 78 hectares, respectively.

Alpine fir mortality was last recorded in the Vancouver Region during aerial surveys in 1982, when an estimated 4 000 ha were mapped. The discrepancy in area between 1982 and 1985 can be attributed to different aerial coverage and fluctuating beetle populations.

Fir budmoths, Zeiraphera spp.

Close examination of damage at several sites including White River, Duck Lake (Cameron Division) and Gerald Creek clearly indicated a sharp general reduction in extent of feeding damage from 1984 levels. Activity related to this pest has now been confirmed as widespread over much of central to north central Vancouver Island from Northwest Bay to the upper Adam River drainage to Gold River.

An average of 38% of leaders and top crown laterals of young amabilis fir showed feeding damage including foliage feeding, severe bark scoring and some top-kill caused by a budmoth, Zeiraphera spp. Areas where the most extensive current feeding damage occurred were Memekay River, Mt. Washington and Middle Memekay River where respectively 83, 72 and 70 percent of trees were attacked. At Duck Lake and White River, only 1984 feeding damage was found (Table 12).

Larval sampling at six sites to determine the causal agent resulted in 38 larvae found of predominantly three genera. These were identified as Zeiraphera spp. (12 larvae), Dioryctria abietivorella (4 larvae) and Acleris gloverana (14 larvae). Considering the distribution and damage, Zeiraphera spp. are now considered the primary damaging agents, the others only as minor feeders.

Rearing attempts to determine parasitism were unsuccessful due to the small number of larvae available; further surveys and collections will be made in 1986.

Table 12. Locations, numbers of amabilis fir trees surveyed, tops sampled, damage and larvae found, Vancouver Island, Vancouver Forest Region, 1985.

Location	# Trees surveyed	% damage	# Tops sampled	# Larvae found	Species identified
Duck Lake	100	0	6	3	D. abietivorella (3 larvae)
Moriarty Creek	30	60	10	6	Zeiraphera spp. (5 larvae) Neodiprion sp. (1 larva)
Memekay River	60	83	15	20	Zeiraphera spp. (5 larvae) A. gloverana (11 larvae)
Grilse Creek	50	79	9	4	Zeiraphera spp. (2 larvae) A. gloverana (1 larva)
Waco Creek	120	52	8	2	-
Middle Memekay R.	120	70	16	3	A. gloverana (2 larvae) ? Dioryctria (1 larva)
Quatchka Creek	100	17	-	-	
Oyster River	100	12	-	-	
Mt. Washington	100	72	-	-	
Gerald Creek	100	20	-	-	
White River	100	0	-	-	
Total	980	38% (Average)	64	38	

Balsam woolly aphid, Adelges piceae

A total of twelve nurseries in the Upper Fraser Valley which are commercial growers of Abies spp. were surveyed for balsam woolly aphid in 1985. No evidence of the aphid or aphid damage was detected in these nurseries or in adjacent natural stands. Aphid damage of amabilis fir was reported by the B.C. Ministry of Forests in the Hornet Creek area in 1984.

Three pulp mill locations and one commercial nursery on North Vancouver Island were surveyed for balsam woolly aphid in 1985. No evidence of the aphid was found. At Rathtrevor Park, which is inside the regulation zone but beyond the known infestation area, small populations of Adelges piceae were found on six of thirty young grand fir checked. No damage was visible.

In four seed orchards where a balsam component has been recently added, surveys revealed that 4% of seedlings at Dewdney Seed Orchard were infested. Aphids and gouting damage were evident.

An omnivorous leaftier, Cnephasia longana

Populations severely defoliated new flush on 86% of amabilis fir seedlings at the Yellow Point Seed Orchard near Nanaimo in the second year of attack. Populations of the pest were also found at Mt. Newton Seed Orchard where 18% of amabilis fir were lightly defoliated and 16% of western hemlock had one or two larvae each. At Lost Lake Seed Orchard 6% of Sitka spruce had one or two larvae but only a few needles were affected.

A late August survey at Yellow Point Seed Orchard showed good recovery and no mortality or branch dieback of affected firs. However, favorable weather conditions in 1986 could again result in serious early feeding damage to amabilis fir stock, with the associated loss in growth capacity, both at Yellow Point and Mt. Newton seed orchards. Monitoring in mid-March will be required to determine if control measures are needed when feeding commences.

Fir needle rust, Pucciniastrum epilobii

Grand fir in two plantations at Tamihi Creek east of Cultus Lake were lightly infected by this rust. An estimated 100% of the 6-year-old trees covering 70 hectares will lose 1-5% of the total foliage due to infection. Negligible growth loss is expected. The abundance of fireweed, the rust's alternate host, ensures continued infections.

SPRUCE PESTS

Spruce beetle, Dendroctonus rufipennis

Spruce beetle attacks in 1983-84 killed mature Engelmann spruce over an estimated 337 hectares on Vancouver Mainland, as determined by 1985 aerial surveys. Tree mortality was light and scattered over 9 areas in the Maselpanik, Log, Mowhokam and Smokehouse Creek drainages covering 28, 36, 40 and 233 hectares, respectively. This pest is less of a threat in these areas than elsewhere, because spruce is a minor species in the infestation locations.

As high stumps can be a factor in beetle population increases, in the Ainslie Creek area, where the spruce type is more prevalent, Engelmann spruce stumps in a 50 hectare clear cut were examined for beetle broods. Of the 60 stumps examined, 98% contained beetles. The average height of these stumps was 1.2 metres with diameters ranging from 28-116 cm and an average diameter of 52 cm. A dramatic increase in beetle populations is not expected as the majority of the broods were located at or below the root collar with the upper portion of the stumps relatively free of beetles. The exposed stumps at Ainslie Creek are not considered as productive for beetles as those shaded by debris or residual trees.

Spruce weevil, Pissodes strobi

At six spruce plantations on Vancouver Island an average of 18% of the leaders were attacked in 1985 (range 5-35) and 38% (range 3-80) prior to 1985 (Table 13), similar to 1984 (avg. 17% current, 42% previous) and 1983 (avg. 17% current, 41% previous).

The incidence of current attack increased to 5% of leaders in 1985, up from 2% in 1984 at Holiday Cr. (Gold R. Main); 32% up from 29% at Sayward Provenance Trials (where only 4% of this approximately 10 to 12-year-old plantation was healthy) and 35% up from 25% in a natural spruce regeneration area north of Vernon Lake near Frost Lake. At Cobble Hill Seed Orchard, the stock is just beginning to reach a size susceptible to weevil attack resulting in 6% current attack, predominantly in one particularly vigorous family.

Table 13. Incidence of spruce weevil attack in spruce plantations, Vancouver Island, Vancouver Forest Region, 1985.

Location	# Trees	Percent of trees attacked			
		1985	1985 + previous	Previous only (1984 and prior)	Total
Sayward Provenance Trials (BCMF)	100	-	32	64	96
Holiday Cr. (Gold R. Main)	100	5	0	3	8
Frost L. (Nimpkish Rd.)	100	24	11	44	80
Staghorn Creek (Kennedy L.)	50	4	6	80	90
Kennedy River	50	6	6	76	88
Cobble Hill Seed Orchard	50	6	0	0	6
Average		8	11	42	61

Repeated attack damage was common at several plantations including Sayward Provenance Trials, Frost Lake, Staghorn Creek and Kennedy River, with trees occasionally showing evidence of up to four previous attacks. The resultant crooks, other deformities and the possibility of stem decay brings into question the potential merchantability of the spruce at rotation age at locations where weevil attack is obviously high and often repeated during the lengthy period of host susceptibility. No general predictors have been developed for this pest; its continued success can probably best be extrapolated from previous findings in any given area.

Spruce aphid, Elatobium abietinum

Spruce aphid populations were sharply reduced and little defoliation occurred in coastal Sitka spruce and ornamental spruces on Vancouver Island. The populations ranged from Victoria to Port Hardy, along the west coast to Port Renfrew and in the Ucluelet-Tofino area.

At Tahsis Seed Orchard, 9% of spruce had very small aphid populations in February and by June only 2 to 6 aphids were found on 40% of stock resulting in trace defoliation in 1985 compared to epidemic levels of aphids and up to 90% individual tree defoliation in 1984. In six surveys at four other seed orchards an average 22% (range 0-50) of young trees harboured very small populations, but no defoliation occurred. Near Port Hardy occasional aphids were found on 80% of spruce in one plantation. No populations were found at Otter Point, Jordan River or Port Renfrew. No defoliation occurred at these sites. It has been speculated that a cold winter and cold early spring had some deleterious influence on populations of this pest. Surveys will continue in 1986.

Spruce gall aphids, Adelges spp., Pineus spp.

Surveys of galls on spruce at three seed orchards found an average of 11 galls (range 2-35) per sapling size tree of the species Adelges cooleyi as well as an average of four galls (range 0-24) per tree of the species Pineus similis. Adelges sp. gall production was highest at Tahsis Seed Orchard (avg. 17 galls/tree) where up to 50 to 100 galls per tree had been previously reported and lowest at Lost Lake with an average of two galls/tree. Pineus sp. galls averaged 10 per tree at Sayward Provenance Trials while none were found at Tahsis Seed Orchard.

Important in nurseries, seed orchards and new plantations, on spruce seedlings and saplings because they kill tips of branches and tend to stunt and deform trees, gall aphids are commonly thought to be of the species Adelges cooleyi. These require the alternate host Douglas-fir to complete their complicated life cycle. The common presence of Pineus similis, which requires no alternate host, suggests a possible shift in approach where management for gall aphids is considered of value.

Spruce budmoths, Zeiraphera spp.

Populations of Zeiraphera partially defoliated and caused browning of the new flush to Sitka spruce buds along the southwest and west coasts of Vancouver Island.

Based on an estimated 500 buds collected for rearing at each of three sites, approximately 48% of buds at the Jordan River site were infested by Zeiraphera vancouverana and Zeiraphera unfortunana, 17% of the buds at Otter Point near Sooke were infested by Z. vancouverana and 22% at a site near Port Renfrew by Z. vancouverana and Z. unfortunana. Near Ucluelet an estimated 5% of buds were infested in all shoreline spruce and at Long Beach an average of 30% of new flush showed feeding damage. Damage was generally down slightly from 1984 levels.

The needle miner Epinotia hopkinsana was also present in buds in coastal Sitka spruce but only as a very minor component at the three sites sampled. This spruce pest was also identified at the Tahsis Seed Orchard where an average of one or two buds were infested on 30% of stock.

Budmoth larvae identified as Z. hesperiana were also found singly on Douglas-fir at four locations on the Island.

Populations in spruce stands are likely to continue in 1986 but damage should remain minimal.

CEDAR PESTS

Cedar leaf blight, *Didymacella thujina*

Discoloration of 5 to 30-year-old western red cedar foliage occurred over several thousand hectares in the Vancouver Region in 1984-85. Grey and reddish brown foliage is evident in the Blacklock, Statlu and South Statlu creek areas. Discoloration was most severe on trees in dense stands and on understory regeneration; open growing trees were less susceptible. The presence of the black fruiting bodies and the greater amount of grey foliage as compared to red foliage indicate that the infection spread occurred mostly in 1984, a much wetter year than 1985. Defoliation is more visible in the fall when the infected twigs drop, but damage is not expected to be serious. Cedar is a minor species in this area of predominantly western hemlock and alpine fir.

MULTIPLE HOST PESTS

Seedling weevil, *Steremnius carinatus*

Mortality and girdling of conifers by the seedling weevil at 12 1985 Vancouver Island plantations surveyed from San Mateo Bay to Holberg ranged from 0 to 12% of seedlings, average 5% (Table 14), a reduction from 1984 when attack ranged from 4-50%, average 15%.

Attack was most pronounced at a Quatchka Creek plantation where 12% of the stock was attacked including 21% mortality of 1-0 amabilis fir plugs. At a Tsitika River site, 40% of amabilis fir 1-0 plugs were killed but these represented only a small component in the plantation with an overall attack of only 9%. Two plantations, Thames Creek and Ruth Lake, which were free from attack were in the relatively drier CDFb (Coastal Douglas-fir wetter) or CwHa (Coastal Western Hemlock drier) biogeoclimatic subzones.

Survival surveys of twenty-eight 1984 plantations in the Holberg area by industry recorded up to 11% (average less than 1%) mortality of primarily one-year-old grand fir, some amabilis fir and western hemlock in the fourth consecutive year of weevil infestations in the area, a sharp reduction from the up to 90%, average 5%, mortality found the previous year.

Attack in 1985 was generally light but was found to be quite extensive with evidence of damage found in the areas of Sarita, Mt. Washington, Gold River, Woss, Kelsey Bay and Holberg. Expanding surveys in 1986 may uncover a still wider distribution of this plantation pest.

Table 14. Incidence of girdling of conifers by a seedling weevil, S. carinatus in 1985 plantations, Vancouver Island, Vancouver Forest Region, 1985.

Location by Timber Supply Block	Stock type	No. seedlings examined	No seedlings[1] H	PG	G
Broughton					
Kaipit Creek	Df[3] 2-0 BR[2]	100	96	2	2
Tolnay Creek	Df 2-0 BR	80	79	1	0
	Df 1-0 plug	20	19	1	0
Pegattem Creek	wH 1-0 plug	60	56	3	1
	aF 2-0 BR	40	37	2	1
Kaprino Creek	Df 2-0 BR	50	46	3	1
	aF 2-0 BR	50	46	3	1
Piggot Creek	Df 1-0 plug	67	66	0	1
	S 1-0 plug	33	32	0	1
Sayward					
White River (WR385A)	aF 1-0 plugs	71	68	0	3
	wH 1-0 plugs	29	27	0	2
White River (VIC5)	Df 2-0 BR	100	98	2	0
Tsitika River	Df 2-0 BR	35	34	1	0
	Df 1-0 plug	45	42	3	0
	wC 1-0 plug	10	9	0	1
	aF 1-0 plug	10	6	0	4
Ruth Lake	Df 1-0 plug	80	80	0	0
	Df 2-0 BR	20	20	0	0
Kyuquot					
Quatchka Creek	aF 1-0 plug	24	18	1	5
	wH 1-0 plug	37	32	2	5
	gF 1+1 BR	39	38	0	1
Nanaimo					
Thames Creek	Df 2-0 BR	100	100	0	0
Barkley					
San Mateo Bay	wH 1-0 plug	41	34	5	2
	Df 2-0 BR	20	16	4	0
	wC 2-0 BR	39	39	0	0

[1] H = Healthy; PG = Partially Girdled; G = Girdled.
[2] BR = bare root
[3] aF = amabilis fir; wH = western hemlock; Df = Douglas-fir; gF = grand fir; wC = western red cedar; S = spruce general.

Previous survey results suggested certain patterns of attack for which 1985 surveys provide some confirming evidence (Table 15). The small diameter 1-0 plugs appear to be much preferred to larger stock (there is reduced feeding after one full year of growth), and amabilis fir was the host of choice although western hemlock, Douglas-fir, spruce, western red cedar and grand fir were all attacked. Reasons for apparent preferences or the reduced attack in 1985 are not clear although climatic conditions, especially precipitation, seem to influence activity. No reliable predictors are available to project 1986 infestation levels.

Table 15. Percentage of weevil attack by host and stock type, Vancouver Island, 1985.

Stock type	Host aF[1]	wH	Df	wC	S	gF
1-0 plugs	12.4	10.8	2.4	10	3.3	-
2-0 BR	7.7	-	3.2	0	-	-
1+1 BR	-	-	-	-	-	2.6

[1] aF = amabilis fir; wH = western hemlock; Df = Douglas-fir; wC = western red cedar; S = spruce; gF = grand fir

Plantation examinations

A total of 11 stands of natural and planted regeneration were examined for pest problems in 1985 (Table 16). Major pests included: Cooley spruce gall aphid on Douglas-fir and spruce; blackheaded budworm defoliation of western hemlock, Douglas-fir and alpine fir, and deer browse and climatic damage, common on most species.

Monitoring of pest problems in young stands will continue in 1986.

Table 16. Pests of young stands, Vancouver Forest Region, 1985.

Location	Host[1]	Age	Stand type	No. trees examined	Per cent trees affected	Pests present	Damage intensity
Bear Cr.	wH	12	natural	14	-	-	-
	wC			17	100	Didymascella thujina	light
	Df			58	4	Deer browse	moderate
Hornet Cr.	Df	6	natural	57	28	Adelges cooleyi	moderate
					9	Deer browse	moderate
	wH			47	-	-	-
	wC			2	50	Didymascella thujina	light
	lP			6	-	-	-

Location	Host[1]	Age	Stand type	No. trees examined	Per cent trees affected	Pests present	Damage intensity
North Cr.	Df	8	natural	46	33	Adelges cooleyi	light
	lP			27	4	Synanthedon sequoiae	light
	alF			2	100	Mindarus abietinus	light
	wwP			2	-	-	-
Ross L.	lP	10	natural	62	10	Endocronartium harknessii	moderate
					2	Atropellis piniphila	light
	Df			72	8	Adelges cooleyi	light
	alF			1	-	-	-
Silver Tip	mH	10	natural	76	-		
	Df			8	50	Adelges cooleyi	light
	wC			7	57	Climatic injury	light
	wwP			2		-	-
	alF			1	-	-	-
	wS			1	100	Adelges cooleyi	severe
Foley Cr.	wH	8	natural	62	-	-	-
	alF			20	100	Pucciniastrum epilobii	moderate
	Df			4	25	Climatic injury	light
	wC			1	-	-	-
Mt. Jasper	alF	7	natural	55	38	Mindarus abietinus	light
					62	Pucciniastrum epilobii	light
					13	Acleris gloverana	trace
	wH			62	100	Acleris gloverana	trace
Welch Cr.	wH	10	natural	101	-	-	-
	yew			8	-	-	-
Oyster R.	Df	7	planted	26	4	Rhabdocline pseudotsugae	light
					50	Adelges cooleyi	light
					23	Cinara sp.	light
					15	Deer browse	light
	wH			45	11	Unknown defoliator	light
	wC			17	-	-	-
	aF			12	33	Fir budmoths	light
					42	Climatic damage	light
	wwP			4	50	Cronartium ribicola	severe
					25	Needle cast	light

[1] wH = western hemlock; wC = western red cedar; Df = Douglas-fir; lP = lodgepole pine; alF = alpine fir;
wwP = western white pine; wS = white spruce; aF = amabilis fir; mH = mountain hemlock.

DECIDUOUS AND ORNAMENTAL TREE PESTS

Winter moth, Operophtera brumata

Although egg hatch, which normally occurs near mid-March, was delayed by adverse weather conditions until April 2, defoliation of deciduous trees on southern Vancouver Island by the introduced species Operophtera brumata, continued for the 15th consecutive year, and was similar to previous years in extent but reduced in intensity in the Greater Victoria, Colwood and Saanich Peninsula areas. Defoliation of primarily Garry oak, also broadleaf maple and fruit trees, was generally trace to light with pockets of moderate defoliation in Victoria.

Larval populations and minor feeding damage on Garry oak, broadleaf maple and fruit trees continued at Duncan. Larvae were found at two locations on Saltspring Island and for the first time in Nanaimo, where two adults trapped in 1984 first confirmed the presence of the pest in this area. The 1985 adult trapping program using 100 mg per rubber septa of the pheromone 1,3Z, 6Z, 9Z nonadecatetraene confirmed the presence of winter moth in many locations from Victoria to Nanaimo and confirmed the presence of the pest on the mainland with five adults trapped at Tsawwassen townsite and 11 at Richmond.

Between 1979 and 1982 a parasite release program in the Greater Victoria area released almost 30,000 larval parasites, Cyzenis albicans and Agrypon flaveolatum. These are now established in infested stands and are also becoming evident at non-release locations.

The incidence of parasitism of 1985 winter moth larvae remained unchanged with an average of 48% (range 15-71%) similar to 48% (range 20-79%) in 1984 but up from 42% (range 5-78%) in 1983. The parasite C. albicans affected 44% of the winter moth population, similar to 1984; A. flaveolatum emerged from 3% of pupae, no change from 1984. A native Hymenoptera, Phobocampa sp., parasitized only 1% of larvae compared to 2% in 1984 (Table 17). The continued reduction of defoliation in 1985 at most release sites suggested increased effectiveness of the parasites. The large number of moths seen flying starting approximately December third, the lack of increase in the parasitism rate plus past adverse winter weather conditions may suggest cautious optimism in attributing the reduction in defoliation entirely to biological control or in predicting increased effectiveness for 1986.

At 5 new sites in the Greater Victoria area where 475 C. albicans were released, rearings of 1985 collections resulted in 36% parasitism by C. albicans. At 5 other sites where no releases were made, rearing of 1985 collections resulted in 39% parasitism by C. albicans. Natural spread of this introduced parasite from early release sites would appear to be the main factor in results found at these 10 sites. At the Duncan non-release site, the presence of 23% parasitism by C. albicans would tend to confirm this.

Table 17. Number and percent parasitism of winter moth from larval collections at parasite release sites in Greater Victoria area 1983–1985, Vancouver Forest Region, 1985.

	No. of adults			Adults %		
	1983	1984	1985	1983	1984	1985
No. of larval collections	31	34	33	-	-	-
Winter moth pupae processed	7 393	6 828	5 971	-	-	-
Winter moth adults reared	3 508	3 514	3 080*	47	51	52*
Parasites						
Agrypon flaveolatum	152	234	200*	2	3	3*
Cyzenis albicans	2 765	2 946	2 622	37	43	44
Phobocampa sp.	100	134	69	1	2	1

*awaiting x-ray confirmation

Gypsy moth, Lymantria dispar

Agriculture Canada trapped 14 adult gypsy moths in 13 traps at the Chilliwack Forces Base, one at Cultus Lake and one near Abbotsford in 1985. Based on 1984 positive catches and the presence of egg masses in 1985, aerial applications of Bacillus thuringiensis had been applied in the summer in designated areas of Courtenay and Chilliwack.

The Forest Insect and Disease Survey cooperated with Agriculture Canada in an annual survey for male gypsy moth adults in the Vancouver Region. Traps baited with a sex attractant pheromone (Z-7, 8-epoxy-2-methyl-octadecane) were placed at 32 mainland locations and at 14 locations on Vancouver Island, but all were negative.

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 potential quarantine restrictions such as those currently in force in parts of Oregon. Pheromone trapping programs and, if necessary, egg mass surveys, will continue in 1986 in cooperation with Agriculture Canada.

Western oak looper, Lambdina f. somniaria

Following five successive years of defoliation and a sharp decline in population in 1984, the western oak looper infestation on 16 ha of the Mt. Maxwell Ecological Reserve on Saltspring Island completely collapsed in 1985.

Cause of the collapse was inconclusive but partly attributed to parasites and disease. In 1983 parasites and virus/disease attacked almost 30% of larvae and pupae; rearing efforts in 1984 were unsuccessful when the collections failed to mature. In 1985 sampling in June and August found only two larvae from six trees sampled.

The trace of leaf skeletonizing in Garry oak was attributed primarily to a moderate population of a microlepidoptera Telphusa sedulitella found in early summer three-tree beatings. There was no evidence of defoliation of mature Douglas-fir which was defoliated in 1981 and 1982 and no evidence of attack by Douglas-fir bark beetle. Western oak looper populations are expected to remain at endemic levels in 1986.

Western tent caterpillar, Malacosoma c. pluviale

The area of tent caterpillar defoliation expanded for the fourth consecutive year in the Vancouver Region. Light to severe defoliation of deciduous trees and shrubs and fruit trees was common in the Lower Mainland extending from Ladner to Abbotsford and north into the Horseshoe Bay area. Moderate defoliation of red alder was common from Gibsons Landing to Powell River including Bowen and Texada Islands.

Tent caterpillar on Vancouver Island caused light to severe defoliation of roadside deciduous trees, shrubs and fruit trees as well as some ground vegetation including ornamentals of various species in the Greater Victoria area and Saanich Peninsula. Pockets of severe defoliation of various roadside deciduous trees and shrubs were also noted in the Duncan and Nanaimo areas with light to moderate localized defoliation common along much of the east coast from Victoria to Campbell River including the Gulf Islands.

A ratio of approximately three new egg masses to one old egg mass was noted at a location in the Cedar area and near Mill Bay, as well as a one-to-one ratio at a Victoria location. Egg mass rearing programs are currently in place to determine presence and extent of parasitism. Barring adverse climatic conditions or extensive parasitism, high to increasing populations could continue for several years in the Region. Tree mortality is not usually associated with this pest.

Fall webworm, Hyphantria cunea

Populations of this colonial defoliator generally declined for the second consecutive year on the Lower Mainland and east coastal areas of Vancouver Island. Late in the summer, webs were common on alder, willow and cottonwood in the Chilliwack-Agassiz area. Occasional webs were noted from 30 km north of Campbell R. south to the Malahat area. Webs and light feeding damage were most common in the Nanaimo and Maple Bay areas, particularly on apple and willow.

Fall webworm is not considered an economically important pest, and populations are expected to be common again in 1986.

Dogwood leaf blight, Gloeosporium sp.

Infection of dogwood trees by this leaf blight decreased for the second consecutive year in the east coastal areas of Vancouver Island and Vancouver Mainland. Infections were generally light in lower crowns at John Dean Park and at Petroglyph Park near Nanaimo, with up to 10% branch dieback of young trees in one area following several years of repeated moderate-severe infection. Infections may continue in 1986 with moist spring weather contributing to the success of this disease.

Cypress tip moth, Argyresthia cupressella

For the 10th consecutive year, the tip moth continued to be active in southwestern B.C. In 1985 extensive foliar browning, branch and occasional tree or shrub mortality continued similar to 1984.

Moderate to severe discoloration of cupressaceous trees and shrubs such as Italian, Leyland, Lawson and Monterey cypresses, Oriental cedar and some species of juniper occurred in the spring from Saanich Peninsula to Esquimalt, including Victoria. Light to moderate discoloration including some branch dieback continued in Duncan, Nanaimo, Comox-Courtenay, Campbell River and in urban areas of the Lower Mainland.

Infestations in currently affected areas could continue in 1986. A systemic insecticide applied in March and April and again at egg hatch in July could effectively reduce damage and control high populations.

Pacific willow leaf beetle, Pyrrhalta carbo

Approximately 4 300 ha of mostly willow in the Sproat Lake area were lightly to severely skeletonized by the Pacific willow leaf beetle, Pyrrhalta carbo, the first reported outbreak on Vancouver Island since 1969. Areas of infestation extended from the lower reaches of the Taylor River through Taylor Flats and along much of Sproat Lake. An estimated 1 200 ha were severely attacked with approximately 85% of foliage skeletonized and 10% defoliated, 2 400 ha were moderately infested and 700 ha lightly attacked.

Occasional major outbreaks have been recorded throughout B.C. from 1944 to 1967, the last covering the period from 1955 to 1969 with occasional reports of 100% defoliation. Locations involved were from Alberni north to Kelsey Bay and south to Nanaimo. While infestations have lasted for several years, attacking mainly Salix but also Populus, Alnus and Betula species, no mortality has been reported. In 1986, skeletonizing by leaf beetle larvae may continue and even spread but no mortality is expected.

SPECIAL SURVEYS

Seed Orchards

High value seed production areas, which included a number of species, required several surveys throughout the field season for early detection of pests, damage assessments, determination of damage potential and discussion of management options. Surveys resulted in over twenty different pest species recorded during a total of 24 visits to 12 seed orchards (Table 18). Of these pests, only six were sufficiently serious in extent, intensity or damage potential to warrant consideration for management action. Swiss needle cast, Phaeocryptopus gaeumannii, caused an average of 30% needle loss per infected tree at Snowdon Seed Orchard, 20% at Quinsam Seed Orchard and 15% at Dewdney Seed Orchard. An omnivorous leaftier Cnephasia longana, attacked new flush on over 90% of young amabilis fir stock at Yellow Point Seed Orchard for the second year in a row, causing significant growth reduction. Spruce weevil, Pissodes strobi, although attacking only six percent of spruce stock, has the potential to cause serious damage in future; spruce aphid, Elatobium abietinum, caused little damage in 1985 after seriously defoliating all spruce at Tahsis Seed Orchard in 1984. Cooley spruce gall aphid, Adelges cooleyi, with spotty very high populations on Douglas-fir at Tahsis, Mt. Newton and Pacific Forest Products Seed Orchards, was considered a candidate for control by some. Balsam woolly aphid, Adelges piceae, caused severe gouting on only 4% of amabilis fir seedlings at Dewdney Seed Orchard but has the potential to cause serious damage, including mortality, if not managed.

Surveys of seed orchards in 1986 will continue with emphasis on matching survey timing to host species and related pests.

Table 18. Pests of Seed Orchards, Vancouver Forest Region, 1985.

Seed Orchard	Host[1]	Pest	Intensity[2]	% Trees affected
VANCOUVER ISLAND				
Dewdney	Df	Cooley spruce gall aphid	light	58
		twig miners	light	18
		Rhabdocline needle cast	mod.	9
		Swiss needle cast	severe	100
		chlorosis (Mg deficiency?)	light	4
	sS	spruce aphid	severe	50
	aF	balsam woolly aphid	severe	4
		balsam twig aphid	light	4
		unknown needle pathogen	light	4

Seed Orchard	Host[1]	Pest	Intensity[2]	% Trees affected
Mt. Newton	Df	Cooley spruce gall aphid	light/mod.	94
		Meria needle disease	light	4
		chlorosis (micro-nutrient def.?)	light	28
		drought/graft incompatability	light	18
	aF	omnivorous leaftier	light	10
		balsam twig aphid	light	4
		tip chlorosis (moisture stress)	light	2
	wH	omnivorous leaftier	light	16
		tip dieback (moisture stress)	light	4
Tahsis	Df	Cooley spruce gall aphid	mod/severe	100
		Swiss needle cast	light	78
		budmoths	light	18
		spider mite	light	18
		cone bug	-	neg.
	sS	spruce aphid	light	40
		needle miner	light	30
		spider mite	light/mod	12
	aF	balsam twig aphid	light	86
Lost Lake	sS	spruce aphid	light	44
		omnivorous leaftier	light	6
		chlorosis-abiotic	light	18
	wH	tortricids	light	7
		chlorosis (abiotic)	light	5
		tip dieback (moisture stress)	light	6
	wC	chlorosis (moisture stress)	light	38
		Epinotia hopkinsana	light	18
		split stems (frost? herbicide?)	light/mod	18
Pacific Forest Products	Df	spruce gall aphid	light/mod	100
		Swiss needle cast	light	18
		Meria needle disease	light	5
		chlorosis (micro-nutrient def.?)	light	6
		cone bug	-	neg.
Cobble Hill	sS	spruce weevil	severe	6
		pineus gall aphids	light	10
		mult. buds/bushy growth (boron? genetics?)	mod.	42
		deer browse	light	56
		spruce aphid	-	neg.

Seed Orchard	Host[1]	Pest	Intensity[2]	% Trees affected
Koksilah	Df	Cooley spruce gall aphid	light	96
		Swiss needle cast	light	50
		spider mite	light	4
		chlorosis (abiotic?)	light	16
		cone bug	-	neg.
Yellow Point	sS	spruce aphid	light	20
		omnivorous leaftier	light	8
	aF	omnivorous leaftier	severe	92
Harmac	Df	Cooley spruce gall aphid	light	100
		Swiss needle cast	light	30
		twig miner	light	12
		cone bug	-	neg.
Quinsam	Df	Swiss needle cast	severe	98
		Rhabdocline needle disease	light	8
		cone bug	-	neg.
	wH	omnivorous leaftier (?)	light	8
Snowdon	Df	Swiss needle cast	severe	97
		Meria needle disease (?)	light	8
		Rhabdocline needle disease	light	6
		cone bug	-	neg.
VANCOUVER MAINLAND				
Sechelt	Df	Cooley spruce gall aphid	light	72
	wH	-	-	neg.

[1] aF amabilis fir
Df Douglas-fir
sS Sitka spruce
wH western hemlock
wC western red cedar

[2] light - small populations/light infection/little or no damage
mod. - moderate populations/moderate infection/some damage or loss occurs
severe - large populations/severe infection/serious loss or potential loss - action indicated

Exotic plantations

Several pests were evident in three plantations of native and introduced conifers established between 1956 and 1960 at the UBC Forest in Haney (Table 19). These were re-examined for the first time since 1971 to determine the performance of the different species and what, if any, pests were present. Snow has broken and deformed numerous stems in both the Scots pine and Japanese larch plantations. The Scots pine plantation has also been severely infected by western gall rust causing mortality that is expected to continue in the future. Western larch has been the most successful of the three species, despite defoliation by the larch sawfly.

In one of two small larch plantations in the Gold River area on Vancouver Island examined for pests and long term performance, light infections of needle cast were found on 10% of the trees. Both plantations exhibited good growth and no other pest problems were visible.

Table 19. Condition of trees and pest status in Exotic Plantations, Vancouver Forest Region, 1985.

Plantation	Tree species	Year established	Previously examined	Condition of previous examination	Results of 1985 examinations
UI ? 166	Scots pine *Pinus sylvestris*	1959	1971	6% of stems infected by western gall rust; 42% suffering from snow damage.	12% of trees killed and 82% infected by western gall rust, 64% deformed by snow. Average diameter - 14.2 cm; average height 6.3 m.
UBC XP 195	Japanese larch *Larix leptolepis*	1956	1971	11% of trees damaged by snow	Light to moderate defoliation of 90% of the trees by larch sawfly, 62% exhibiting snow damage. Average diameter - 22.1 cm; average height 10.2 m.
UBC Junction E+K roads	Western larch *Larix occidentalis*	1960	unknown		Moderate to severe defoliation by larch sawfly of 100% of the trees which are otherwise healthy and vigorous.
Gold River (2 sites)	Larch species *Larix* spp.				Average diameter - 12.1 cm; average height - 5.4 m. 10% of trees at one site lightly infected by Meria needle disease.

Black stain root disease, Verticicladiella wageneri

On Vancouver Island, sampling for black stain root disease continued in 1985, augmenting current sparse distribution and impact records. Of eight locations where pockets of stressed, dying or recently dead young Douglas-fir were found, two areas sampled were confirmed as Verticicladiella wageneri. Three 15-year-old Douglas-fir near Blenkin Memorial Park on Quadra Island were infected. Near Mt. Washington, three 25-year-old trees sampled were confirmed as black stain root diseased, while 10 others in this disease center were dead or showed typical root disease related crown symptoms.

Root samples from six locations on the Sunshine Coast exhibited no sign of the purple-black stain associated with this root disease when examined by the pathology lab at PFC. The samples were collected from semi-mature Douglas-fir trees showing signs of stress attributed to root rot. Incidence of this disease is on the increase, particularly in Douglas-fir plantations.

Rhizina root rot, Rhizina undulata

At Kaipit Creek near Woss Lake on a broadcast burned plantation, 2% of Douglas-fir seedlings were killed by the root disease Rhizina undulata. Nine areas on Vancouver Island from San Mateo Bay near Bamfield to Kaprino Creek near Holberg were surveyed and 900 seedlings checked to augment distribution information on this conifer seedling pest.

R. undulata caused mortality was last recorded in the region in 1982 when 41 of 100 Douglas-fir seedlings surveyed were killed in a 40 ha plantation near Tony Lake in the Powell River area. The disease occurs on sites which have been burned prior to planting and infections increase with increased severity of burn.

Acid rain plots

Two ARNEWS (Acid Rain National Early Warning System) study plots were established in the Vancouver Region in 1985 in addition to three plots put in place in the Region in 1984, and brings to nine the total number of plots in B.C. to date. Six more plots are planned provincially for 1986.

These plots are part of a national system to gather baseline data on acid rain in Canada's forests, to clearly and accurately detect early signs of acid rain damage and to annually monitor for changes in forest soil, vegetation and trees which may be related to acidification of precipitation, fog or clouds or other atmospheric pollutants.

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