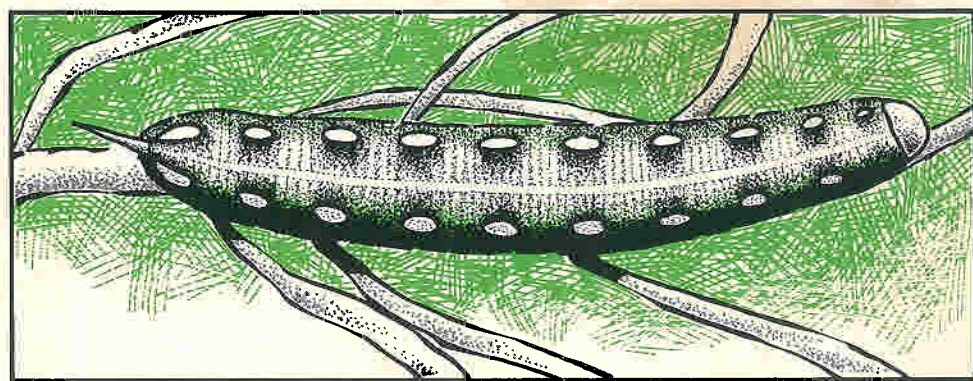
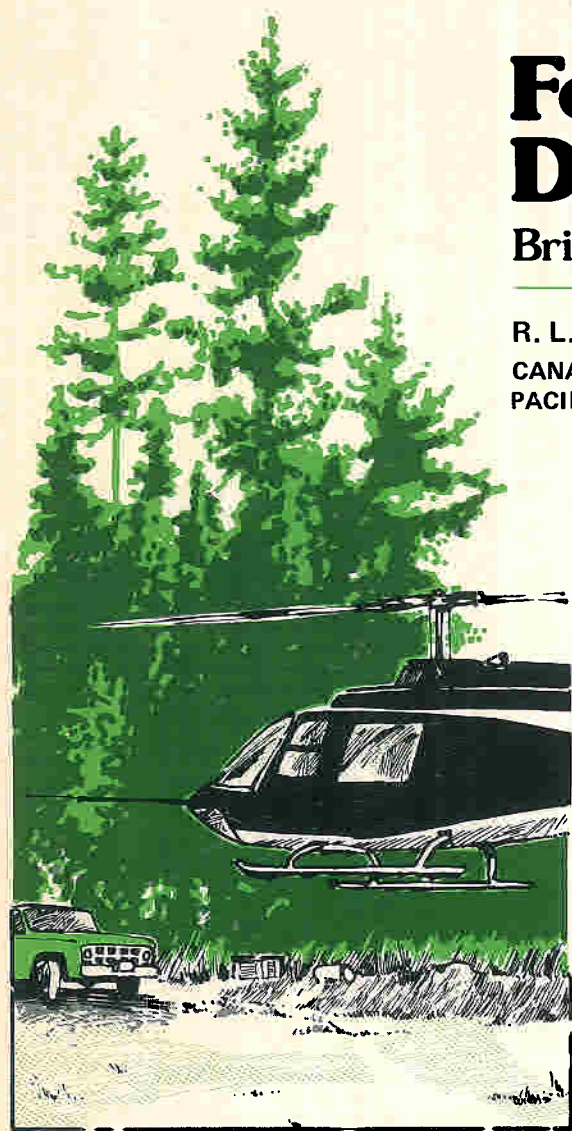




Forest Insect and Disease Conditions

British Columbia and Yukon / 1980

R. L. FIDDICK AND G. A. VAN SICKLE
CANADIAN FORESTRY SERVICE
PACIFIC FOREST RESEARCH CENTRE



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ABSTRACT

This summary of forest pest conditions in British Columbia and the Yukon in 1980 was compiled from records and field reports of 11 Forest Insect and Disease Survey technicians. Emphasis is on damaging pests that are or may become major management problems.

RESUME

Ce sommaire relatif à l'état des ravageurs forestiers en Colombie-Britannique et au Yukon en 1980 fut catalogué à partir des archives et des rapports sur les travaux effectués dans le champ par 11 techniciens des insectes et maladies des arbres. L'accent est mis sur les ravageurs qui sont ou pourraient devenir de sérieux problèmes de gestion.

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Summary

The Forest Insect and Disease Survey of the Canadian Forestry Service annually conducts a general survey to monitor the occurrence, incidence and fluctuation of important forest insects and diseases and their subsequent damage. This report provides an overview of the pest conditions in British Columbia and the Yukon in 1980, with some predictions of expected pest levels in 1981. It summarizes the field records and observations made by experienced pest survey technicians with confirmation and support by laboratory staff. More detailed information by provincial forest region is available in seven file reports based on the following district assignments during 1980:

E.V. (Ernie) Morris	Vancouver Mainland
R.O. (Roly) Wood	Vancouver Island
D.F. (Don) Doidge	East Prince Rupert
H.P. (Peter) Koot	West Prince Rupert
J.S. (Jack) Monts	Prince George and Yukon
D.B. (David) Buller	Prince George (after mid-July)
S.J. (Stan) Allen	Cariboo
R.J. (Dick) Andrews	North Kamloops
L.S. (Leo) Unger	South Kamloops
R.D. (Bob) Erickson	West Nelson
C.S. (Colin) Wood	East Nelson

Mountain pine beetle infestations expanded in pine stands in the Interior of the Province, most markedly in the Cariboo and Kamloops Forest regions, and the number of trees killed in the Nelson Region more than doubled over that of 1979.

Spruce beetle is epidemic in the Bowron-Willow River drainages in the Prince George Region where numerous white spruce have been killed. In contrast, population declines were evident in the McLeod-Carp lakes area and north of Fort St. James. Spruce beetle attacks occurred over a slightly greater area in the Prince Rupert Region, but were generally much lighter.

Douglas-fir bark beetle attacks continued in spruce budworm defoliated stands; however, this is not considered a hazard to healthy stands.

Spruce budworm infestations increased in the Fraser-Skagit River area, in the Vancouver Region, the Cache Creek-Ashcroft area, in the Kamloops Region and continued in the southeast corner of the Cariboo Region.

Larch casebearer infestations continued in the Kamloops and Nelson regions. However, the larch sawfly caused much less defoliation than expected in the East Kootenay.

Surveys for European pine shoot moth again located infested trees in several towns in the Okanagan.

Amabilis fir trees, at Keta Lake and Big Tree Creek near Kelsey Bay, severely defoliated by sawflies in 1978 and 1979, were attacked by bark beetles in 1980.

The winter moth epidemic on shade and fruit trees in the Greater Victoria area continued and additional parasites were released.

Cone crops were variable in the Province in 1980, and a large percentage of Douglas-fir and spruce cones were damaged by insects.

Weather damage occurred at several locations and was particularly conspicuous early in the season on the east coast of Vancouver Island, near Campbell River.

Blister rust, gall rust, atropellis canker and root diseases continue to be major problems in management of young stands. A needle disease of true firs was conspicuous at many locations in the Interior and on Vancouver Island.

Pine Pests

MOUNTAIN PINE BEETLE

Dendroctonus ponderosae

Mountain pine beetle infestations in the Province exceeded 156 750 ha in 1980, up from 82 000 in 1979 (see map). The largest increases in areas affected were in the Kamloops Region, 37 000 ha from 23 000, and in the Cariboo Region, 63 000 from 31 000, excluding the 18 000 ha in the Klinaklini Valley on which most of the mature pine was killed between 1973 and 1977. However, the most concentrated areas of recently-killed lodgepole and western white pine are in the East Kootenay, where the number of mature trees killed more than doubled in 1980 to 10 million on 28 500 ha from 4.5 million on 22 000 ha in 1979. Based on 42 cruise strips and the number of trees attacked in 1980 in relation to 1979, the infestations will continue in 1981.

In the Nelson Region, an estimated 3,600 infestations, ranging in size from a few scattered trees to several hundred hectares, occurred over 33 400 ha (Table 1).

In the Flathead River Valley in East Kootenay, more than 75% of the mature lodgepole pine on 15 000 ha has been killed since 1976. Significant increases occurred in stands in adjacent drainages, including the Elk River Valley, Michel, Corbin, Morrissey, Lodgepole and Ram creeks, where little beetle activity was evident prior to 1980 and the current trend of expansion and intensification could develop into additional widespread outbreaks. Another large area of mature forests, in which initial outbreaks occurred, lies north of the International border, west to Yahk and north to Cranbrook and includes Hawkin, Freeman, Ward, Gilnockie, Caven and Plumbob creeks. Scattered groups of two to ten beetle-attacked trees were recorded in Elko, Grasmere, Roosville and Jaffray areas.

In the White-Kootenay River drainages, including Elk Creek, extensive tree mortality has occurred since 1972 and infestations have expanded into the Lussier, east and middle Forks of the White River, Palliser and Cross River valleys and along the Kootenay River into Kootenay National Park.

Active infestations continued in the Colum-

bia River Valley from Columbia Lake to Bugaboo Creek, including the east side of Steamboat Mountain, and have expanded and intensified in large areas of mature lodgepole pine along the west slope of the mountain.

North of Golden, beetle-killed lodgepole and western white pine occurred over increased areas in the Waitabit Creek - Blaeberry River valleys, from Donald north along Columbia Reach to Mica Dam and along Bush Arm into Bush River Valley.

Localized groups of two to 15 recently killed lodgepole pine were recorded, for the second year, in and near the west entrance to Yoho National Park, which is adjacent to extensive areas of mature pine on both sides of the Park boundary.

In the West Kootenay, infestations were recorded on 3 770 ha, up from 1 860 in 1979. The major areas of beetle kill were in the Kettle River Valley, where new small infestations occurred in leave blocks and in some side valleys. In Chapleau Creek, near Slocan, a five-fold increase occurred and most mature lodgepole pine over 100 ha could be killed within 2 years. North of Revelstoke infestations in western white pine increased to encompass 640 ha in Goldstream, Carnes and Downie creeks, despite logging in the latter area. Small isolated infestations occurred in white pine throughout the Slocan-Trout-Arrow-Duncan lakes area.

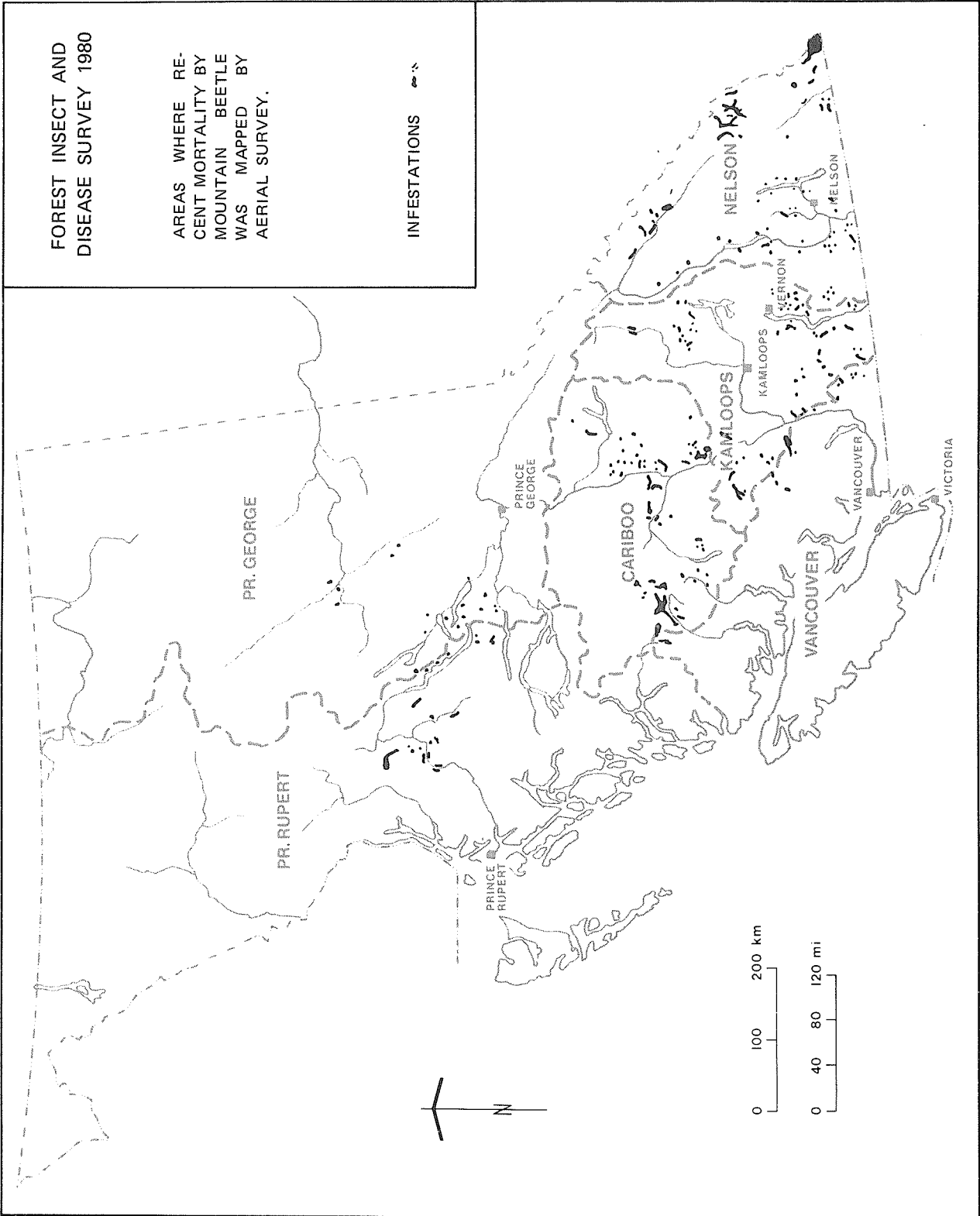
Infestations are expected to continue and expand in all areas.

In the Kamloops Region, lodgepole pine mortality, caused by mountain pine beetle, occurred at 1 060 locations on 37 000 ha, up from 23 000 ha in 1979 (Table 1). Increased mortality occurred throughout the northern and western portion of the Region in the Goldbridge-Gun Lake and Bridge River-Downton Lake areas. In the southern portion of the Region, infestations expanded, with large areas of beetle kill in the Trout-Hayes creeks, Ashnola River, Mission-Belgo, Shorts-Whiteman, Lambly and Summers creeks. On 15 cruise strips, the number of trees attacked in 1980 increased significantly over 1979 and, together with large healthy beetle broods, indicates infestations will increase in 1981.

Table 1. Mountain pine beetle infestations by region and area and status of pines on 42 cruise strips, 1980.

Region	Location	Number of infestations	Area in ha	Status of pine on cruise ^{1/} strips in percent			
				H.	C.	R.	G.
Nelson	Flathead Valley	1,190	14 760	—	—	—	—
	Columbia R. from Columbia L. — Bugaboo Cr.	370	2 430	—	—	—	—
	White— Kootenay	1,500	10 600	—	—	—	—
	Elk R.	60	260	—	—	—	—
	Yahk — Cranbrook	110	560	—	—	—	—
	Golden	275	1 020	—	—	—	—
	Kootenay L. — Arrow L.	35	1 320	—	—	—	—
	Grand Forks — Upper Kettle	30	600	58	28	7	7
	W. Kettle R. to Rock Cr.	30	1 858	55	12	16	17
Kamloops	Ashnola R.	65	1 000	44	34	3	19
	West of Okanagan L.	338	14 330	53	24	13	10
	East of Okanagan L.	235	5 480	56	26	7	11
	Princeton — Merritt	100	950	—	—	—	—
	Ashcroft — Kamloops	10	230	—	—	—	—
	Blue R. — Barriere	70	600	—	—	—	—
	Goldbridge — Gun L.	157	12 750	50	29	12	9
	Lytton — Lillooet	85	1 660	—	—	—	—
Cariboo	Cariboo L. & R.	48	3 500	—	—	—	—
	Williams L.	160	4 200	86	2	2	10
	Dog Cr. — Jesmond	107	6 800	51	8	15	26
	Riske Cr. — Alexis Cr.	288	7 600	43	18	25	14
	Puntzi L. — Klinaklini R.	740	39 000	65	11	14	10
	Chilko — Tatlayoko L.	77	1 900	26	23	29	22
Pr. George	Ft. St. James	26	1 700	50	20	17	13
	Fraser L.	9	620	—	—	—	—
	Valemount	45	5 160	—	—	—	—
	Williston L.	10	520	—	—	—	—
Pr. Rupert	Kispiox to Cranberry R.	45	4 600	31	14	24	31
	Skeena R. — Bulkley R. — Babine L.	65	8 600	80	15	4	1
	Houston — Burns L.	5	300	—	—	—	—
Vancouver	Fraser Canyon	3	430	52	5	11	32
	Pemberton	4	200	—	—	—	—
	Manning Park	1	20	60	22	16	2
	Klinaklini R.	3	1 200	—	—	—	—

^{1/} H - Healthy trees not attacked by beetles
C - Current attack (in 1980)
R - Red trees, attacked in 1979
G - Gray trees, attacked prior to 1979



In the Cariboo Region, areas on which significant lodgepole pine mortality occurred increased to 63 000 ha from 31 000 in 1979. About 1420 separate infestations were mapped, 70% of them in the Chilcotin plateau area (Table 1). The greatest increases were recorded west and southwest of Puntzi Lake to the Tatla-Bluff lakes area and in the McClinchy-Charlotte lakes area. Spread of the beetle into the latter area has occurred since 1978. Almost all the mature pine has now been attacked at Beaumont Lake, Riske Creek, Tatla-Bluff lakes and in the Gaspard Valley. A slight drop occurred in the number of trees attacked in 1980 on cruise strips compared to 1979. However, the population is sufficiently high to continue at an epidemic level (Table 1).

In the Prince George Region, 90 separate infestations were recorded over 8 000 ha, mainly in two areas. North of Fort St James, scattered infestations in lodgepole pine expanded in 1980 and currently cover about 1 700 ha. The infestations are small at present; however, most occur in mature stands and there is potential for further expansion. Near Valemount, infestations expanded to 800 ha in susceptible lodgepole pine stands at Swift Creek and are expected to continue. South of Valemount along McNaughton Lake, the beetle has killed most of the western white pine on 4 400 ha from Bulldog Creek to Baker Creek.

In the Prince Rupert Region, 115 infestations totalling 13 500 ha were widely scattered along the Kispiox and Cranberry rivers, along the Skeena and Bulkley rivers and in the Babine Lake area. At Harold Price Creek, the infestation, which has persisted since 1974, expanded onto the flats on the north side of the creek and currently covers more than 2 000 ha. Five small infestations occurred in the Houston area for the first time since the successful control program in 1974-75. Examinations on nine cruise strips indicate the infestations will continue in 1981.

In the Vancouver Region, 11 localized infestations in lodgepole pine were recorded on about 1 850 ha. Light attacks occurred on 1 200 ha at three locations in the upper Klinaklini River Valley. Near Pemberton, infestations, ranging in size from 15 to 65 ha, occurred in the Haylmore Creek - Gates River area and in the Fraser Canyon at Mowhokam - Ainslie creeks. A small recent infestation was recorded near Eastgate in Manning Park.

PINE ENGRAVER AND TURPENTINE BEETLES

Ips spp. and *Dendroctonus valens*

In the Nelson Forest Region, pine engraver beetles and, to a lesser extent, turpentine beetles killed more than the 5 000 immature ponderosa and lodgepole pine trees at widespread locations. North of Cranbrook, ponderosa pines which were predisposed by a 1979 range fire were killed by engraver beetles.

At least 75% of the butts and stems of felled ponderosa and lodgepole pine over 100 ha were heavily attacked by both beetles near McGinty Lake, east of Kimberley. In a spaced stand near Skookumchuck, 10% of the less than 7-cm-diameter ponderosa pine trees were killed by engraver beetles; about 2% of the residual trees were attacked by turpentine beetles.

In numerous other areas of the district, pockets of two to 15 trees were killed in association with intensive stand management or bark beetle harvesting programs. The accumulated slash and existing overwintering populations of these secondary beetles creates the potential for continuing but generally light tree mortality.

WEEVILS IN LODGEPOLE PINE

Two species of weevils are potential problems in young lodgepole pine stands in the Province.

In the Cariboo Region, near Alex Graham Mountain, a lodgepole terminal weevil, *Pissodes terminalis*, infestation in a 15-year-old stand being spaced, remained active in 1980, although much reduced from the previous 3 years. The heaviest attacks occurred in 1978, when up to 30% of the terminals were damaged. Although the attacked trees had developed multi-leaders, there were indications a single leader could predominate. In seven other stands (10-25 years old), the most severe damage occurred on the Choelquoit Lake road, with 9% of the leaders infested; at others, 0 to 5% were infested.

The root collar weevil, *Hylobius warreni*, killed scattered groups of two to five young trees in the Prince Rupert Region along the Babine River, in the Perow burn and along the Nilkitkwa Lake road.

In the Kamloops Region, root collar weevils killed about 5% of the trees on a 32 ha plantation near Mann Creek on the North Thompson River.

EUROPEAN PINE SHOOT MOTH

Rhyacionia buoliana

The cooperative detection survey for shoot moth was continued in the Okanagan and Kamloops areas in 1980 by a B.C. Ministry of Forests crew. Infested trees have been found in Kelowna at about the same number of locations (from 39 to 42) each year since 1977. In Kamloops, only one infested tree was located and in Summerland, three compared to 17 in 1979. Fourteen infested trees were found in Vernon, the first since 1976.

The intensive survey and eradication program that began in the Okanagan in 1976 has not eliminated the insect, probably because of the difficulty of locating and inspecting all pines in a city, and the continued introduction of infested pines from the coastal area. No new infestations were detected on plantings at Castlegar, Creston or Cranbrook or in native stands in the Okanagan area. Factors limiting the spread of the shoot moth could include prevention of a population buildup through the control efforts, abundant pitch exudation by ponderosa pine which largely prevents larval survival, and the relatively small amount of lodgepole pine at lower elevations immediately adjacent to the infested areas.

PINE NEEDLE SHEATH MINER

Zelleria haimbacki

This insect occurs commonly on ponderosa and lodgepole pine in the Interior of the Province, usually defoliating trees over small areas of 20 to 40 ha for 1 or 2 years.

In 1979, defoliation occurred over 1 100 ha at four locations near Clearwater. In 1980, defoliated lodgepole pine was mapped over approximately 5 400 ha along the Clearwater River from Clearwater to Batholith Falls and along the south shore of Mahood Lake. Light defoliation occurred throughout stands from Monte Hills west to Merritt and south to Princeton.

Many ponderosa pine between Cache Creek and Cornwall Creek had 50 to 75% of the branch tips infested.

BLACK STAIN ROOT DISEASE

Verticicladiella wagnerii

The presence of black-stain root disease in forest stands in the Province was verified in 1976, when it was found at six locations in the Nelson Region. Since then, it has been found at other Interior locations and on Vancouver Island. In 1980, it was found at four new locations in the Kamloops Region, two along the Aurora Lake road, along East Barriere Lake Road and near Vernon.

Table 2. Percent of pines infected by *A. mellea*.

Location	% pine component	Number of prism plots	Number of pine stems	% of pine dead / dying	% of pine root rot apparent
Vavenby (east)	80	40	245	28	23
Vavenby (north)	50	36	145	24	22
Adams River*	36	25	47	62	53

* At Adams River about one third of the western white pine were also attacked by mountain pine beetles.

In the Nelson Region, an assessment near Nancy Greene Lake, west of Castlegar, indicated blackstain root disease was present in 6% of the lodgepole pine trees, an additional 15% were infected with blackstain or root rot, *Armillaria mellea*, and 12% had died.

SHOE STRING ROOT ROT

Armillaria mellea

Three large areas of scattered pine trees,

recently killed by *A. mellea*, were recorded in the Clearwater area in the Kamloops Forest Region. Root rot infection often follows drought or defoliation induced stress. In two of the areas near Vavenby, a pine sawfly had severely defoliated the lodgepole pine in 1977 and 1978. An assessment of the intensity of infection was made on three cruise strips (Table 2).

Douglas ~ fir Pests

WESTERN SPRUCE BUDWORM

Choristoneura occidentalis

The infestations in Douglas-fir stands in the Vancouver, Kamloops and Cariboo regions continued, with an expansion of the total area defoliated to 81 400 ha from 48 900 ha in 1979, and an increase in defoliation intensity in some areas (see map).

In the Vancouver Region, defoliation was light over 950 ha, moderate over 14 320 and severe over 12 030 ha, with a total of 27 300 ha compared to 19 800 in 1979 (Table 3). The most severe defoliation occurred along the Skagit River, Coquihalla River, Siwash Creek and East Anderson River. West of the Fraser River, areas of defoliation increased at Spuzzum Creek, Nahatlatch Lake and River and along Lillooet River at Glacier Lake and Smith Creek.

In the Kamloops Region, the 43 500 ha of defoliation, most of it light, was an increase of 17 500 ha from 1979. Most of the expansion was in the Ashcroft-Cache Creek-Carquille area and west of the Fraser River along Carpenter Lake and Stein River. Severe defoliation occurred over 1 700 ha in the Cornwall Creek drainage and a total of 3 720 ha of moderate defoliation occurred in smaller patches near the border with the Cariboo District at Scottie Creek, Hat Creek and south of Cornwall Creek (Table 3).

Light defoliation occurred in a localized area west of Rock Creek in the Nelson Region.

In the Cariboo Region, defoliation was mapped on 10 600 ha south of Clinton, with 7 100 ha of light and moderate defoliation at Scottie Creek, Loon Lake, Bonaparte River Valley and on the east side of Hart Ridge. Approximately 3 500 ha of severe defoliation occurred on the north and south ridges of Maiden Creek Valley, on the south slopes of Hart Ridge and adjacent to Highway 97 (Table 3).

Egg counts at 29 locations in the Vancouver Region indicate severe defoliation can be expected in 1981 at Cedar and Skaist creeks in Manning Park and Gilt Creek in the Fraser Canyon. Moderate defoliation is predicted for East Anderson River, Urquhart, Hallecks and Smith creeks and Nahatlatch Mountain in the Fraser Canyon, the Upper Skagit River and Shawatum Creek in the lower reaches of the Skagit River. Trees at these locations have lost 70 to 85% of their new foliage and up to 45% of their total foliage complement. Further defoliation in 1981 may cause some top kill and tree mortality. Light defoliation should prevail at the other locations in the Fraser Canyon and, with the extremely low population currently in the Pemberton area, no defoliation is expected.

In the Kamloops Region, egg counts at 21 locations indicate severe defoliation in 1981 will occur at Oregon Jack, and Cornwall creeks near Ashcroft; Scottie, Robinson and Upper Hat creeks and along Pavilion Lake road in the Cache Creek area; Soap Lake and Pimainus Creek near Spences Bridge and Jimmies Creek near Wallachin. Elsewhere within the infestation area defoliation

Table 3. Areas in hectares by location and intensity of defoliation of Douglas-fir in Vancouver, Kamloops and Cariboo Forest regions based on aerial surveys in 1979 and 1980.

Location	Light		Moderate		Severe	
	1979	1980	1979	1980	1979	1980
Vancouver Region						
Lower Skagit R.	2 110	—	2 500	5 440	130	1 720
Upper Skagit R.	320	180	2 680	960	1 730	4 290
Coquihalla R.	—	—	640	1 600	2 560	2 050
Hope to Keefers	250	130	5 120	4 350	770	3 970
Nahatlatch R.	450	—	450	1 200	—	—
Lower Lillooet R.	—	640	130	770	—	—
Sub-Totals	3 130	950	11 520	14 320	5 190	12 030
Kamloops Region						
Cache Cr. - Carquille - Ashcroft	24 450	29 300	1 550	3 720	—	1 700
Spences Br. - Lytton	—	6 230	—	—	—	—
Bridge River	—	2 550	—	—	—	—
Sub-Totals	24 450	38 080	1 550	3 720	—	1 700
Cariboo Region						
Hart Ridge area (Clinton)	2 500	3 800	500	3 300	100	3 500
Totals	30 080	42 830	13 570	21 340	5 290	17 230

will be generally light.

During aerial surveys, areas with extensive top kill and tree mortality were identified and classified by intensity. A total of 5 800 ha were mapped, 1 500 ha light^{1/}, 3 650 ha moderate and 650 ha severe. Ground checks in five accessible areas in the Fraser Canyon showed, on an average, 46% (range 24% to 73%) of the trees dead, about half with Douglas-fir beetle attacks. Of the remainder 20% had top kill. In seven stands in the Pem-

berton area, where the last defoliation occurred in 1977, 53% of the trees were top killed, 4% died from defoliation and 12% from a combination of defoliation and bark beetles. Douglas-fir beetles had attacked weakened trees in the Pemberton and Fraser Canyon areas, but failed to produce large healthy broods, so are not considered a threat to surrounding stands.

In the Kamloops Region, some tree mortality and top kill occurred near Marshall Creek above Carpenter Lake, and elsewhere top kill is widely scattered.

Tree mortality has not occurred to date in

^{1/} Light - up to 10% top kill and tree mortality;
Moderate - 11 to 30%; Severe - 31% +.

the Cariboo Region, but scattered top kill is apparent along Hart Ridge, where egg counts at six locations indicate severe defoliation could occur in 1981.

DOUGLAS-FIR TUSSOCK MOTH

Orgyia pseudotsugata

Larvae were found, generally in small numbers (2 - 20 per three-tree beating sample), on Douglas-fir in the Kamloops-Ashcroft area. However, up to 30 larvae per sample occurred east of Kamloops along the South Thompson River, McClure, Scottie Creek, Oregon Jack Creek, Pavilion and Hedley. Up to 10 larvae per sample were found commonly in the North Okanagan. Defoliation was barely discernible, except around Vernon and Enderby, where some ornamental trees were 50 to 75% defoliated.

The number of male moths caught in pheromone baited traps was generally double that of 1979 in the Okanagan Valley. In addition, near Hedley, enough eggs were found to predict light to moderate defoliation in 1981.

DOUGLAS-FIR BEETLE

Dendroctonus pseudotsugae

Beetle killed Douglas-fir trees were more numerous in areas where severe spruce budworm defoliation occurred in the Fraser Canyon, notably at Spuzzum Mountain, near Tsileuh Creek, above Chapmans and near Stout. Light attacks were recorded at six locations, ranging from 15 to 30 ha in area, in the Fraser Canyon area and on several spots, totalling 80 ha, along the east side of Birkenhead River near Pemberton.

Generally, in the Interior of the Province, tree mortality caused by the beetle remains light, usually in areas where trees have been predisposed by drought or road construction. Small infestations, totalling about 850 trees scattered over 35 ha, occurred near Ashcroft, 80 trees over 5 ha near Bonaparte in the Kamloops Region and scattered incidence in the Cariboo Region.

Spruce Pests

SPRUCE BEETLE

Dendroctonus rufipennis

Spruce forests in the Interior of the Province normally support an endemic population of spruce beetles which maintains itself in windthrown and damaged trees. A combination of circumstances favorable to the beetle, such as unusually warm summers, mild winters and an increased supply of host material in the form of windthrown trees or weather induced susceptible trees, occasionally triggers a rapid increase in the beetle population.

The main problem areas are in white spruce stands in Prince George Region, with 780 infestations on 64 400 ha, and in the Prince Rupert Region, with 133 on 12 700 ha (see map). Some minor local infestations were recorded at four locations in the Kamloops Region. Localized outbreaks occurred at three locations in the Nelson Region.

In the Prince George Region, mortality of

mature white spruce increased considerably in the upper basin of the Bowron River Valley, Wendle Creek, Upper Willow River, Narrow and Stony lakes, where infestations covered 34 800 ha, of which 9% was light, 33% moderate and 58% severe^{2/}. On nine cruise strips in this area, an average of 36% of the spruce had been attacked in 1980 (including 10% partial attack), up dramatically from 4% in 1979 (Table 4).

In the Parsnip-McGregor River area, of the 8 100 ha on which infestations occurred, 30% were light, 62% moderate and 8% severe. Populations appear to be declining in this area, with fewer trees attacked in 1980 on cruise strips at two locations (Table 4).

^{2/} Light - up to 5% of trees attacked;
Moderate - 6 to 30%; Severe - 31% +.

Table 4. Location of spruce beetle infestations in Prince George Region and status of white spruce on cruise strips, 1980.

Location	Number of infestations	Area in ha	Number cruise strips	Average percent of white spruce stems ^{1/}			
				healthy	current	red	gray
Bowron - Willow rivers	300	34 900	9	49	2/ 36(10)	4	11
Parsnip - McGregor rivers	250	8 700	2	79	7(2)	9	5
McLeod - Carp lakes	51	7 900	2	75	7(5)	9	9
North Ft. St. James	111	12 900	6	74	10(7)	5	11

^{1/} Healthy - No beetle attacks
 Current - Attacked in 1980
 Red - Discolored trees, attacked in 1979
 Gray - Attacked prior to 1979

^{2/} Percentage of trees included in current attack which were partially attacked and which may recover or be re-attacked in 1981 .

The decline in the McLeod-Carp lakes infestations was evidenced by the percentage of trees which were only partially attacked. Scattered recently attacked trees were recorded over 7 700 ha (Table 4), well below the more than 32 000 ha in 1979.

North of Fort St. James, infestations occurred over 12 100 ha. On six cruise strips in the area, 10% of the white spruce were currently attacked, although this includes 7% only partially attacked. The only significant current attack occurred at one location at Tarnazell Creek.

The percentage of trees partially attacked in relation to the total current attack indicates a declining beetle population in the latter three areas. However, in the Bowron-Willow River area, the high proportion of current attack suggests a healthy beetle population, with the potential to cause increased tree mortality.

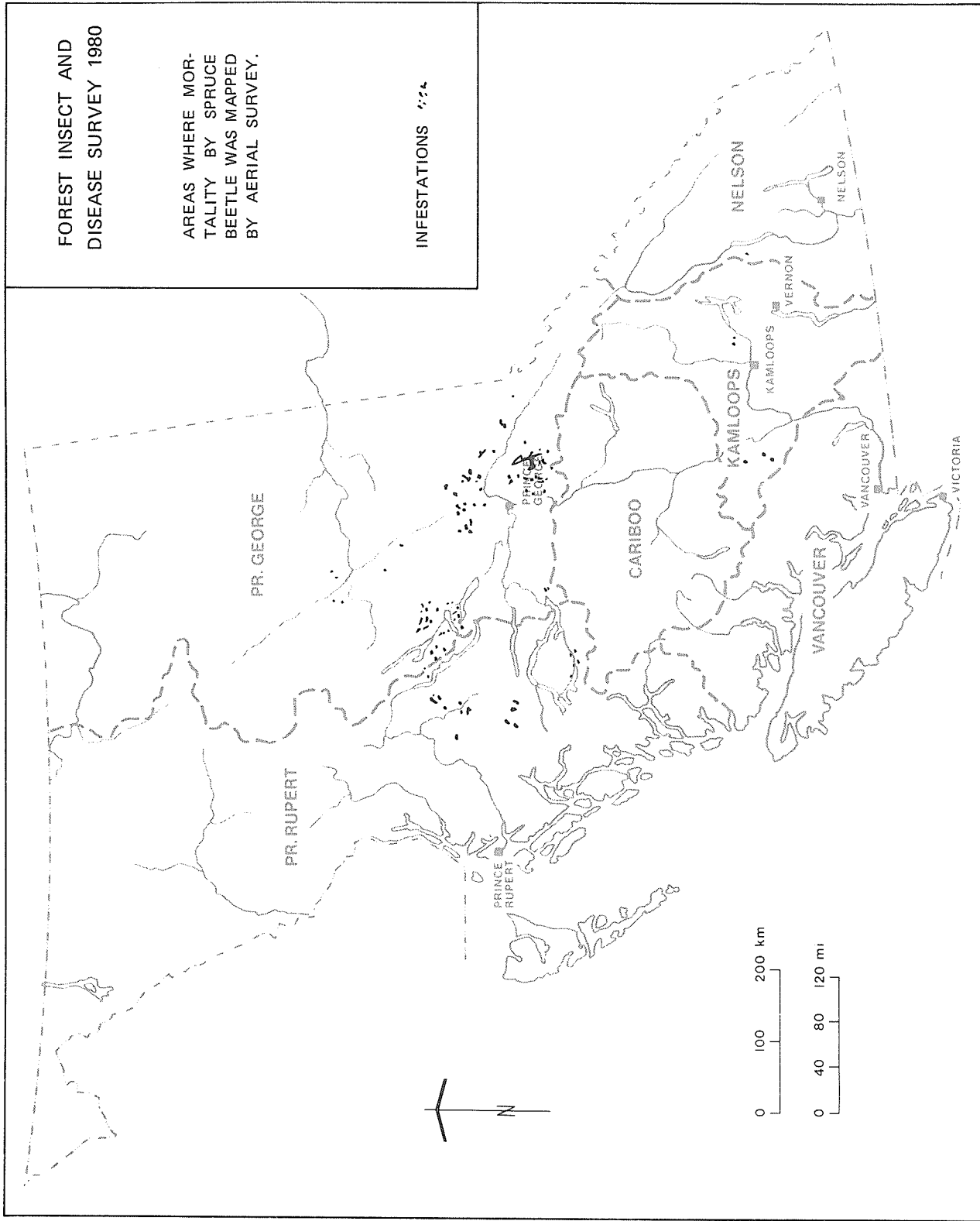
In the Cariboo Region, adjacent to the large infestations in the Bowron River, small groups of white spruce trees were attacked north of Bowron Lake near Kruger Lake, at Big Valley Creek near Sugar Creek, near Par Point on Spectacle Lake in Bowron Provincial Park and in Tokwuh Creek Valley.

Spruce beetle attacks occurred at 133 separate locations on 12 700 ha in the Prince Rupert Region, up slightly from 11 170 ha in 1979. However, on 8 000 ha, or 63%, the infestations were light, 30% moderate and 7% severe. The only severe infestation occurred at Eutsuk Lake in Tweedsmuir Park. The most extensive infestations were in the Morice River drainage, 4 400 ha; McDonnell Lake - Kitsequecla River 1 380 ha and Babine Lake 1 760 ha. Smaller groups of infested trees occurred at Fulton-Guess lakes, Kispiox River and Cranberry River. Beetle broods in standing trees generally indicated that infestations should decline in most areas. At Walcott, high brood numbers in windthrown

FOREST INSECT AND
DISEASE SURVEY 1980

AREAS WHERE MOR-
TALITY BY SPRUCE
BEETLE WAS MAPPED
BY AERIAL SURVEY.

INFESTATIONS



trees could pose a threat to adjacent stands. Trap trees felled along the Cranberry River also contained healthy broods.

No major areas of beetle kill occurred in Engelmann spruce stands in the Kamloops Region, although scattered infestations occurred in the Lillooet area over 60 ha in McKay Creek, and 260 ha in Blowdown and Cayoosh creeks and on a total

of 200 ha in Raft River, Thunder River and Miledge Creek in the Clearwater area.

In the Nelson Region, about 5% of the Engelmann spruce had been recently attacked south of Revelstoke at Coursier Creek. North of Golden, infestations occurred in seed blocks in Copper Creek and in stands in Quartz Creek. Populations had increased in logging debris and high stumps.

True Fir Pests

TWO-YEAR-CYCLE SPRUCE BUDWORM

Choristoneura biennis

Feeding by this budworm, which is generally heavier in the "even" years, occurred in mature and overmature alpine fir and spruce stands over 365 200 ha (see map), much more extensively than in 1978 and 1979.

In the Cariboo Region, the area of defoliation increased to 235 000 ha, most of which was light to moderate, notably from Hendrix Lake north and west through Bowron Lake Park. Severe defoliation occurred on only 1 500 ha in patches at McKay, Horsefly, Little and Matthew rivers and Ghost and Mitchell lakes.

In the Prince George Region, alpine fir - white spruce stands were defoliated over 115 000 ha, mostly light and moderate, in the Bowron, Willow and Holmes river valleys and in Mt. Robson Park east of Moose Lake.

Larvae were common in the Prince Rupert Region, and light defoliation of current growth occurred along the Skunsnat Creek road and highway 37 from the second crossing of Bell-Irving River south to Meziadin Lake.

In the Kamloops Region, defoliation was again severe in the Lempriere Creek drainage, where the alpine fir and Engelmann spruce have lost up to 75% of their foliage through 6 years of budworm feeding. Light defoliation occurred on both sides of the North Thompson River west to Stormking and Lebher creeks and in patches from Serpentine Creek north along the Albreda River to Clemina. A new

area of defoliation was recorded along Fishtrap Creek west of Barriere.

In the Nelson Region, localized infestations of 100 to 600 ha occurred at East White River, Bugaboo, McMurdo and Vowell creeks. In the latter three areas, the budworms are "off phase", i.e. they complete their larval development in the "odd" years when the heaviest feeding occurs.

Egg counts indicate high populations in 1981 at Holmes River in Prince George Region, and Fishtrap Creek near Barriere in the Kamloops Region and moderate at Horsefly River, Cariboo Region. However, as 1981 is the first stage of the 2-year-cycle, defoliation should not be serious.

A CONIFEROUS SAWFLY

Neodiprion sp. —

BARK BEETLE

Pseudohylesinus spp.

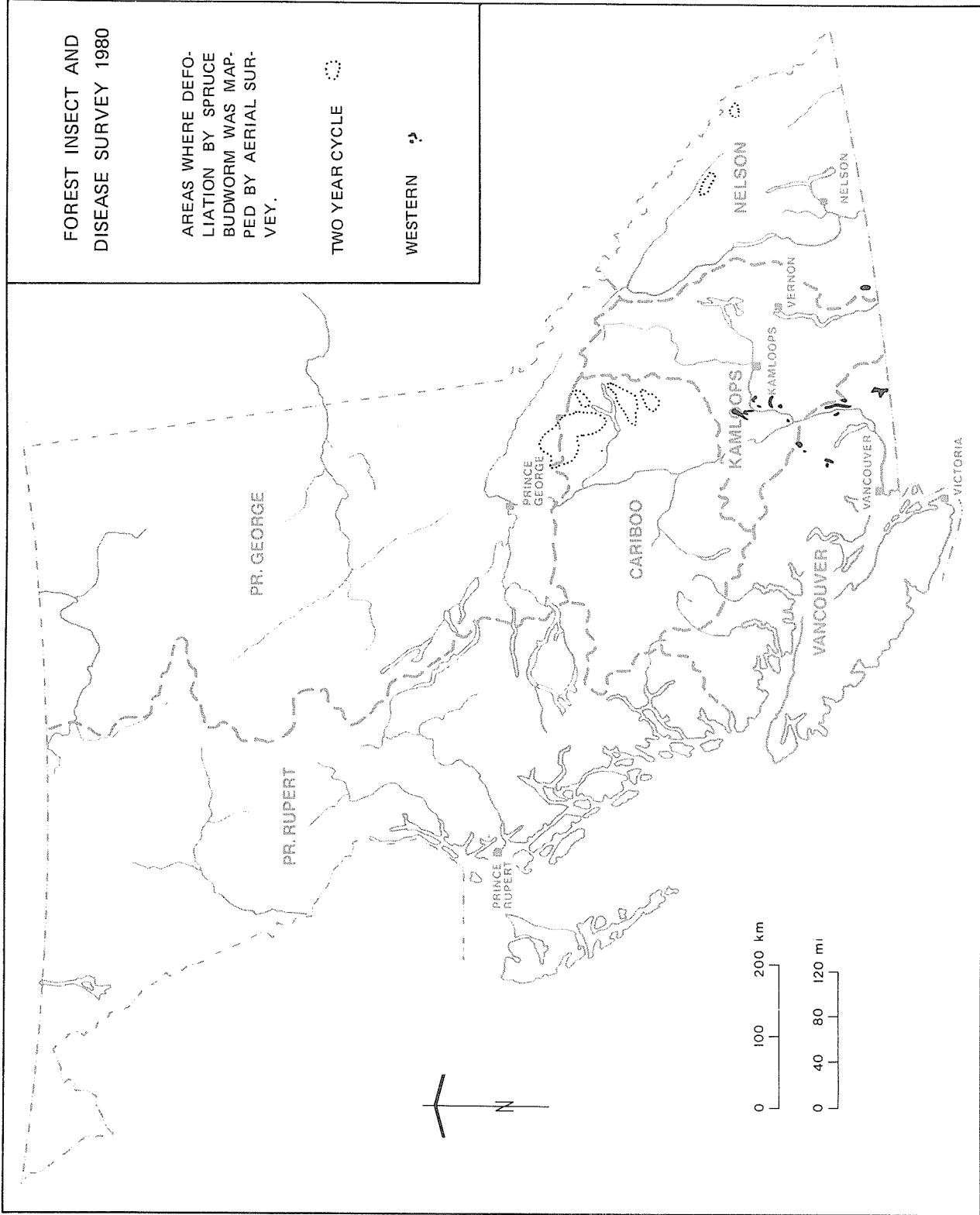
Sawfly populations frequently increase to very high levels in amabilis fir and western hemlock stands along the coast, but only occasionally cause significant defoliation. An infestation occurred in the Keta Lake and Big Tree Creek area near Kelsey Bay on Vancouver Island in 1978 and 1979 but subsided during the summer of 1980. Larvae emerged successfully from the eggs in early summer but disappeared by August, leaving little evidence of current feeding. During the previous 2 years, however, amabilis fir trees over about 700 ha had been severely defoliated, with some trees completely stripped of foliage. Western hemlocks were not severely affected.

FOREST INSECT AND
DISEASE SURVEY 1980

AREAS WHERE DEFOLIATION BY SPRUCE BUDWORM WAS MAPPED BY AERIAL SURVEY.

TWO YEAR CYCLE ○

WESTERN ↗



Three species of bark beetle subsequently attacked the severely weakened amabilis fir; *Pseudohylesinus granulatus* in the lower bole and *P. nobilis* and *P. grandis* in the upper bole. Although bark beetles had attacked 46 and 56% of the amabilis fir examined at Keta Lake and Big Tree Creek, respectively, successful broods were usually present only in trees more than 90% defoliated and this category included about one-third of the trees. Few if any of the weakened, attacked trees will recover, but the populations of this beetle should present little or no threat to amabilis fir recovering from lighter defoliation or to healthy trees in surrounding stands.

In the Prince Rupert Region, light defoliation of understory hemlocks occurred between Burdick and Hazelton creeks for the third year and trees were lightly defoliated at Robinson Lake, where moderate populations of larvae were found.

FIR - FIREWEED RUST

Pucciniastrum epilobii

An unusually severe infection occurred on young amabilis fir on Vancouver Island in the Adams, White and Eve River valleys and on southeast facing slopes near Haihte Lake. Except for the top quarter of the crown, most of the current year's needles were infected on 3- to 15-metre-high trees, resulting in up to 50% defoliation.

In the Prince Rupert Region, all of the new growth of alpine fir was infected for 5 km along Morice Lake road and Rainbow Lake. Moderate and light infection occurred at Nadina Lake and Byman Creek, respectively.

Severe infection and discoloration of current year's foliage occurred throughout much of the Prince George Region, the most severe being in the Bowron River Valley, Stoney Creek - Willow River area and near Aleza Lake. Lighter infections were common and widespread throughout the Cariboo Region.

Hemlock Pests

WESTERN HEMLOCK LOOPER

Lambdina f. lugubrosa

In the Vancouver Region, populations increased significantly along the east side of Coquitlam Lake, just north of a previous outbreak area (1969-1972), where substantial tree mortality occurred on several hundred hectares. Collections averaged 31 larvae, up from 10 in 1979, but no defoliation is apparent. Few eggs were found in moss samples taken from the lower bole of six trees in the area, so it is expected the population will remain at about the same level in 1981.

In the Nelson Region, larvae were found in small numbers throughout the West Kootenay, with higher populations near Nakusp and Revelstoke. An infestation in this wet belt area in 1972-1973 declined rapidly in the second year after severely defoliating trees at several locations.

Currently associated with the hemlock looper

in many areas were larvae of the western false hemlock looper, *Nepytia freemani*, and filament bearer looper, *Nematocampa filamentaria*.

GREEN - STRIPED FOREST LOOPER

Melanolophia imitata

There was an increase in the incidence and numbers of larvae in collections from western hemlock, western red cedar and amabilis fir between Terrace and Prince Rupert, along the north coast at Tuck Inlet and at several locations on the Queen Charlotte Islands, particularly Giekie Creek. Frequently associated with *M. imitata* on Queen Charlotte Islands were increased populations of the saddleback looper, *Ectropis crepuscularia*, of which significant numbers occurred at Dolomite Narrows and Eden Lake. Defoliation was not visible but, as with most loopers, populations can increase rapidly and severe defoliation may occur in one season.

Larch Pests

LARCH CASEBEARER

Coleophora laricella

The range of larch casebearer was extended in 1980 in the Nelson Region, with light defoliation of western larch recorded along the valley from Grand Forks to Rendell Creek and severe defoliation from Rendell Creek to Howe Creek. From Rock Creek to McKinney Creek, defoliation intensified to severe from light in 1979. In Fire Valley, a combination of casebearer feeding and larch needle cast caused increased discoloration of larch from Edgewood to Valley Creek. Elsewhere in the West Kootenay, defoliation intensity varied from the previous year, increasing to severe in some areas and decreasing in others. In the East Kootenay, defoliation persisted throughout most of the range of western larch, being generally light at the northern limits and severe on widespread areas in the southwest. An introduced parasite, *Chrysocharis laricinellae*, appears to have become successfully established at a number of locations, probably as a result of releases in the U.S. since 1972, and in B.C. in 1975. About 500 parasites, reared in Victoria from larvae collected in the Nelson Region, were released at Shuttleworth Creek in the Kamloops Region.

In the Kamloops Region, casebearer infestations causing light defoliation, were found for the first time in the Joe Rich-Mission creeks area, east of Kelowna and Terrace Mountain, west of Kelowna. Otherwise, little change occurred in extent and intensity of established infestations.

LARCH SAWFLY

Pristiphora ericksonii

Larch sawfly populations, which have been active in the Fernie-Sparwood area of the Nelson Region since 1975 and affected 4 000 ha in 1979,

subsided in 1980. Larvae were observed at several locations early in July and appeared to be developing normally. However, by late July, the degree of defoliation expected, based on overwintering cocoons, had not occurred. In many locations, much of the egg hatch was apparently delayed or did not occur.

The parasite, *Olesicampe benefactor*, was released at three locations where larvae were active in early July.

LARCH NEEDLE CAST

Hypodermella laricis

Larch needle cast was widespread throughout the range of western larch in the Nelson Forest Region, often occurring in stands infested by the larch casebearer and extending into higher elevation stands. Damage was particularly noticeable along the west side of the Salmo-Creston Highway from Eholt to Christina Lake, on the west side of the Slocan River from Vallican to Lemon Creek, New Denver to Kaslo and from Nelson to Balfour. In the East Kootenay, infection occurred in all age classes of western larch. In small patches along Toby Creek, 60% of the crowns of individual trees were infected, while in the Gold Creek - Cranbrook area, similar damage occurred in stands up to 2 500 ha in size. Some increment loss is expected and infection for several years has resulted in mortality of 5% of the branches and 25% of the buds in the lower crowns of understory regeneration trees in the Roam-Ram-Kootenay-White River areas.

In the Monashee - Mabel Lake area of the Kamloops Region, foliage discoloration was generally light with patches of up to 200 ha of moderate to severe infection.

Deciduous Tree Pests

LARGE ASPEN TORTRIX

Choristoneura conflictana

In the Prince George Region, trembling aspen stands were defoliated along Fraser, Stuart, Tezzeron lakes and south of Takla Lake. Defoliation in the Vanderhoof area and near Prince George is lighter than in 1979.

Infestations in the Yukon continued to cause moderate and severe defoliation of trembling aspen on large patches along the Yukon River at Carmacks, from Stewart Crossing to McQuesten, near Pelly Crossing and north of Mayo. Very little tree mortality has occurred despite four successive years of defoliation.

BIRCH LEAF MINERS

Lyonetia sp. and *Bucculatrix canadensis*

The foliage of white and water birch was discolored by feeding and mining of *B. canadensis* throughout the northern Columbia River Valley from Invermere to north of Golden in the Nelson Region. Most of the leaves were infested for the seventh consecutive year, notably in McMurdo, Spillimacheen,

Horsethief and Toby creeks areas. In West Kootenay, moderate discoloration of white birch foliage occurred along Cariboo Creek.

In the Prince George Region, feeding by *Lyonetia* sp. caused severe discoloration of white birch from McBride east to the Alberta border and from Tete Jaune Cache south to Hugh Allan Creek.

WINTER MOTH

Operophtera brumata

Defoliation by the winter moth was again widespread on Garry oak, broadleaf maple, willow and miscellaneous fruit trees throughout Greater Victoria and surrounding municipalities and north on the Saanich Peninsula to Sidney and Brentwood.

In 1980, parasites were released at an additional 27 sites from Victoria to Sidney to supplement those released in 1979.

In mid to late November, large moth flights were apparent in the infestation area, an indication the infestation will continue unabated in 1981.

Multiple Host Pests

PESTS OF YOUNG STANDS

Recently treated and young natural stands were examined in all regions for pest problems that may occur naturally or be influenced by management practices. A total of 145 stands were examined (Table 5), including plantations, young natural stands, regeneration, spaced stands and seed orchards. Of these, 22 were relatively free from pests, 37 had only minor pest conditions, but 86, or 59%, had pest problems judged to be of significance. In several cases, prior recognition of the condition could minimize inappropriate stand treatment expenses or reduce pest levels.

One of the major problems in coastal Douglas-fir stands and in two small seed orchards was root rot, *Phellinus weirii*, which was recorded in 11 of 16 stands, with up to 10% of the trees infected. Several young, untreated Douglas-fir stands in the Fraser Canyon and Pemberton area have been severely defoliated by spruce budworm, causing top kill ranging from 3% at Owl Creek near Pemberton to 60% at East Anderson River.

Approximately 10 trees per hectare were windthrown in spaced Douglas-fir and western hemlock stands at Rolley Lake and along the Chilliwack River road, but there was no sign of root rot

Table 5. Pest conditions in young forest stands, 1980.

Tree ^{1/} species	Stand type	Stands examined	Pest problems	
			Minor	Major
D	natural	10	aphids blowdown needle cast	<i>Phellinus & Armillaria</i> spruce budworm
	managed	25	cutworm	<i>Phellinus & Armillaria</i>
IP	natural	17	pitch moth needle cast	Atropellis canker, terminal weevil, gall and blister rusts
	managed	40	root weevil needle cast needle miner rodent damage	Atropellis canker, terminal weevil, gall and blister rusts, unknown leader dieback, dwarf mistletoe, Ips beetles
pP	managed	2	midges	Ips and turpentine beetles
wS	managed	12	snow blight	<i>Pineus</i> sp., bud necrosis, spruce weevil
sS	managed	5		<i>Pineus</i> sp., bud miner, spruce weevil
wH	natural	1		dwarf mistletoe
Coastal wet belt mixed wH, aIF, wC, sS, IP	natural	8		gall rust on pine
	managed	10	needle cast on IP	mistletoe on wH, <i>Pineus</i> sp. on sS
Interior mixed D, IP, pP, eS, wL	managed	10		mistletoe on IP, turpentine beetles
eS, aIF	managed	5		<i>Armillaria & Phellinus</i> , beetles in felled trees

^{1/} D - Douglas-fir, IP - lodgepole pine, pP - ponderosa pine, wS - white spruce, sS - Sitka spruce,
wH - western hemlock, aIF - alpine fir, wC - western red cedar, wL - western larch, eS - Engelmann spruce

in the windthrown trees.

In the Prince Rupert and Prince George regions, western gall rust, stalactiform blister rust and *Atropellis* cankers are often the major disease problems in spaced and unspaced lodgepole pine stands. Without some recognition and attention to such diseases, spaced stands could become understocked as designated crop trees die or are devalued. In an 18-year-old stand at Opatcho Lake, the frequency of gall and stem rust infections was 5 to 20% higher in various spacing treatments than in the untreated area. The highest infection frequency was in machine and hand spaced stands. With instruction and supervision, hand spacing should be more effective in eliminating infected stems.

In a number of areas, the needle cast, *Lophodermella concolor*, was prevalent on pines, causing premature loss of foliage. A pitch moth had attacked stem nodes and branch terminals of 75% of the lodgepole pine in a provenance trial area near the Red Rock nursery. The damage often results in branches breaking under the weight of snow. A severe infection of gall rust was reduced by branch clipping.

In white and Sitka spruce stands, weevils had attacked the leaders of 4% of the trees (range 2-12%). Aphids, *Pineus* sp., while not as damaging as the spruce aphid, caused numerous galls on 60% of the white spruce at several locations.

In the Cariboo Region, western gall rust and stalactiform blister rust infections occurred on 30% of the trees (range 6-68%) in four of 16 young, untreated lodgepole pine stands. Dwarf mistletoe on lodgepole pine is widespread in the Chilcoltin, but was present in only one of these young fire-origin stands.

Lodgepole terminal weevils killed 2-9% of the terminals of pines at five locations in the Cariboo, and over a period of 3 years at Alex Graham Mountain have affected 30% of the leaders. Needle miners defoliated leaders and lateral terminals of branches on the top third of 60% of the lodgepole pine along Palmer Lake road near Alex Graham Mountain. Black army cutworms completely defoliated Douglas-fir seedlings on 0.5 ha in a plantation near Cottonwood River.

Heavy gall rust infection occurred in spaced and unspaced lodgepole pine stands in the Nelson

Region, averaging 50% at several locations (range 10-80%). *Atropellis* cankers occurred on 10% of the trees in a 50-year-old stand at Fiva Creek. Pine engraver and turpentine beetles killed more than 5000 immature ponderosa and lodgepole pines in ground-fire damaged stands east of Kimberley and 10% of the trees in a space stand near Skookumchuck. Near Radium, 2500 Douglas-fir Christmas trees were killed as a result of pruning damage during the early growing season. Attacks by an engraver beetle, *Scolytus unispinosus*, contributed to the tree mortality.

In the Kamloops Region, scattered *Armillaria* and *Phellinus* root rot infections occurred in space Douglas-fir stands. In the mixed stands, dwarf mistletoe and rusts were prevalent on lodgepole pine. Secondary beetles had attacked felled Douglas-fir, white spruce and pines and occasionally the odd standing tree in spaced stands at several locations.

CONE AND SEED INSECTS

Except for the Prince George Region, where cone crops were very light, cones of the major coniferous tree species were examined. Damage to Douglas-fir cones, primarily by the Douglas-fir cone moth, *Barbara colfaxiana*, the coneworm, *Dioryctria abietivorella*, and the Douglas-fir cone gall midge, *Contarinia oregonensis*, rendered cones unsuitable for collecting at 90% of the locations in the Cariboo Forest Region, 34% in Kamloops, 54% in Vancouver and 83% in the Nelson Region.

Engelmann and white spruce cones were infested with the spruce seedworm, *Laspeyresia youngana*, and the spiral spruce-cone borer, *Hylemia anthracina*, and were unsuitable for collecting in 87% of the locations in the Kamloops Region and at almost all sites in the Cariboo and Prince Rupert Regions.

Other conifers were relatively free of cone insects.

AMBROSIA BEETLES

Trypodendron lineatum and *Gnathotrichus sulcatus*

North of Prince Rupert in the Kitsault River Valley, ambrosia beetles infected large diameter western hemlock, amabilis fir and Sitka spruce over

1 200 ha which were blown down in 1978. The intensity of attack was moderate to severe, ranging from 15 to 50 entrance holes per 0.1 m². The ambrosia beetle boring degrades lumber and plywood and may affect log export.

WEATHER DAMAGE

The foliage of Douglas-fir, Sitka spruce, amabilis fir, bigleaf maple and numerous other deciduous trees and shrubs was damaged and discolored along a narrow coastal strip close to Campbell River during early June. Extensive shoot mortality occurred on conifers that had just flushed. The damage, most severe in locations with a southeast exposure, was due to strong, cold drying winds shortly after new growth began. Similar damage occurred in a Douglas-fir seed orchard at Deadwood Creek west of Ladysmith and at Gordon River.

In the Prince Rupert Region, most of the buds and young shoots of western hemlock and white spruce were killed over several hectares along the Hoodoo Lake road.

Trees usually recover from such physiological damage.

Drought conditions for several years resulted in dieback of Douglas-fir and premature needle loss on Ponderosa pine in 1978, in the drybelt of the East Kootenay. Affected trees were prevalent along roadsides from Moyie to Canal Flats. Trees appeared to partially recover in 1979 but, in 1980, the majority died, resulting in a proliferation of discolored trees throughout the area. The overall impact, although conspicuous, is not serious.

DWARF MISTLETOES

Arceuthobium spp.

Under intensive forestry programs, increased attention is being directed toward minimizing the occurrence and effect of dwarf mistletoes through sanitation programs during juvenile spacing and stand regeneration. It is not necessary to survey this perennial disease annually, but infections continue at moderate and severe levels in about 30% of the Province's mature lodgepole pine stands. Infection in coastal hemlock is patchy, but common, and in the Interior, severe localized infections occur in many larch and Douglas-fir stands. A few current observations follow.

A high level of mistletoe infection occurred at Ralph River campsite on Central Vancouver Island, where all of the understory western hemlock trees were infected. At Storey Creek on Nimpkish Lake, 50% of the understory hemlock were infected.

In the Prince Rupert Region, heavy brooming and some stem swellings occurred in stands along Hoodoo Lake road and sections of the Kinskuch Road in the Nass Valley, but it did not appear to be a problem in some recently regenerated areas. South of Greenville, some heavily infected residuals were left after logging and perimeter trees were heavily infected. These could be a source of infection for the regeneration.

South of Beaverdell in the Nelson Forest Region, mistletoe-caused swellings on lodgepole pine branches were chewed by squirrels, causing up to 20 "flagged" branches per tree.

Other Noteworthy Insects and Diseases.

Insect / Disease	Host(s)	Forest Region	Locality	Remarks
<i>Acleris gloverana</i> Black headed budworm	Fir, alpine Spruce, white	Prince Rupert	Byman Cr., Chapman- Morice lakes, Fulton R.	Light defoliation of new growth.
<i>Contarinia</i> spp. Douglas-fir needle-midges	Douglas-fir	Nelson	Columbia & Kootenay valleys	Up to 100% of needles infected in localized patches.
<i>Dichomera gemmicola</i> Bud blight	Douglas-fir	Nelson	Kaslo, Davis Cr., Argenta, Meadow Cr.	Up to 30% of buds killed causing bushy trees, multiple tops.
<i>Elatobium abietinum</i> Spruce aphid	Spruce, Sitka	Prince Rupert	Q.C.I. Tlell to Q.C. City, Alliford Bay to Sandspit	Defoliation of shoreline trees since 1976 resulting in a few dead tops and trees.
<i>Eucosma sonomana</i> Western pineshoot borer	Pine, ponderosa	Nelson	Johnstone Cr.	Light damage to new shoots.
Maple leaf decline, unknown cause	Maple, broadleaf	Vancouver	Vancouver Island and Mainland	Wilting, discolored foliage widespread.
<i>Melampsora epitea</i> Hemlock-willow rust	Willow	Prince Rupert	Morice L., Knockholt, Buck Flats	Up to 100% of foliage infected.
<i>Nepytia freemani</i> Western false hemlock looper	Douglas-fir	Kamloops	Okanagan Valley, Kamloops	Larvae common in collections.
<i>Phenacaspis pinifoliae</i> pine needle scale	Pine, lodgepole	Nelson	Moyie L.	Up to 20% needles infected in localized areas.

Cont'd. . .

Other Noteworthy Insects and Diseases (Continued)

Insect / Disease	Host(s)	Forest Region	Locality	Remarks
<i>Pseudohylesinus nebulosis</i> Douglas-fir pole beetle	Douglas-fir	Kamloops	Nicola R., Silverstar Rd., Winfield	Caused light tree mortality.
<i>Scythropus californicus</i> Weevil	Pine, ponderosa	Nelson	Cranbrook, Elko, Wasa, Canal Flats	Up to 100% of 1979 needles on scattered trees damaged.
<i>Zeiraphera pacifica</i> spruce bud moth	Spruce, Sitka	Prince Rupert	Q.C.I. at Deena Cr.	Damage reduced, less than 15% of buds infested.
<i>Zeiraphera</i> sp. Budmoth	Hemlock, western Spruce, white Fir, alpine	Prince Rupert	Natlan Cr.	Up to 30% defoliation of new growth.

Environment Canada
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