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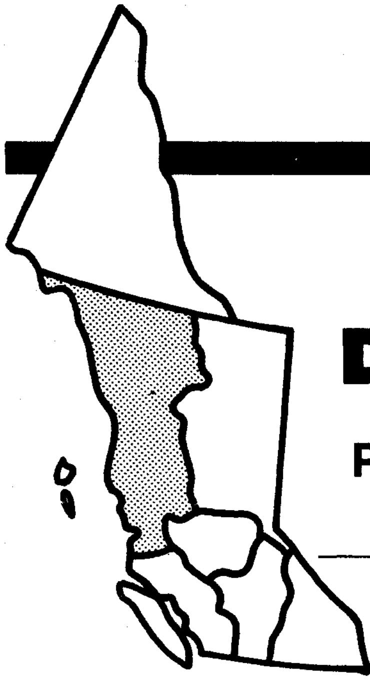

Forest Insect and Disease Conditions

Prince Rupert Forest Region 1985

L. Unger and A. Stewart

Government of Canada
Canadian Forestry Service

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Service canadien des forêts

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SUMMARY AND INTRODUCTION

This report outlines the status of forest pests in the Prince Rupert Forest Region in 1985 and attempts to forecast some of the pest population trends. Pests are listed by host, in order of importance.

The volume of lodgepole pine recently killed by **mountain pine beetle** declined by 40% to 734 000 m^3 over 13 000 ha. Most of the decline was recorded in the interior districts. The amount of current attack was greatly reduced by unfavourable climatic conditions, and in some locations by control programs. **Comandra blister rust** killed 42% of the young lodgepole pine in a plantation near Burns Lake. **Red band needle blight**, although greatly reduced from 1984 levels, continued to severely infect lodgepole pine in chronic areas along the Babine River. **Warren's root collar weevil** consistently caused greater damage in non-burned sites than in burned sites. **Porcupine**-caused pine mortality was mapped over 1 400 ha in the southern part of the Kalum TSA. **Pitch twig moth** populations were considerably higher in high elevation interior lodgepole pine stands than at lower elevations.

Scattered **spruce beetle**-killed spruce was mapped over 15 200 ha with only 104 000 m^3 recently killed. Although the beetle populations have been declining for several years, large adult populations in 1984 blowdown pose a high potential for localized outbreaks in 1986. Increasing **black army cutworm** populations destroyed 120 000 seedlings. The greatest damage occurred on fall 1983 burns that were planted in the spring of 1985. Adult trapping indicates continuing large populations for 1986. **Spruce weevil** killed an average of 26% of the Sitka spruce terminals in the Kalum TSA despite an extensive leader clipping program over the past three years. **Drought** initiated spruce mortality of up to 75% of the mature Sitka spruce occurred in the Kitimat River Valley and in 20 to 30 tree patches near East Ootsa. **Spruce budworm** populations collapsed in the Kitimat area to endemic levels. **Spruce aphid** populations declined but remained persistent in patches on the east coast of the Queen Charlotte Islands (Q.C.I.). Infestations over the past 8 years killed 42% of a semi-mature Sitka spruce stand. **Cone insect** populations were generally low while cone crops increased to moderate levels.

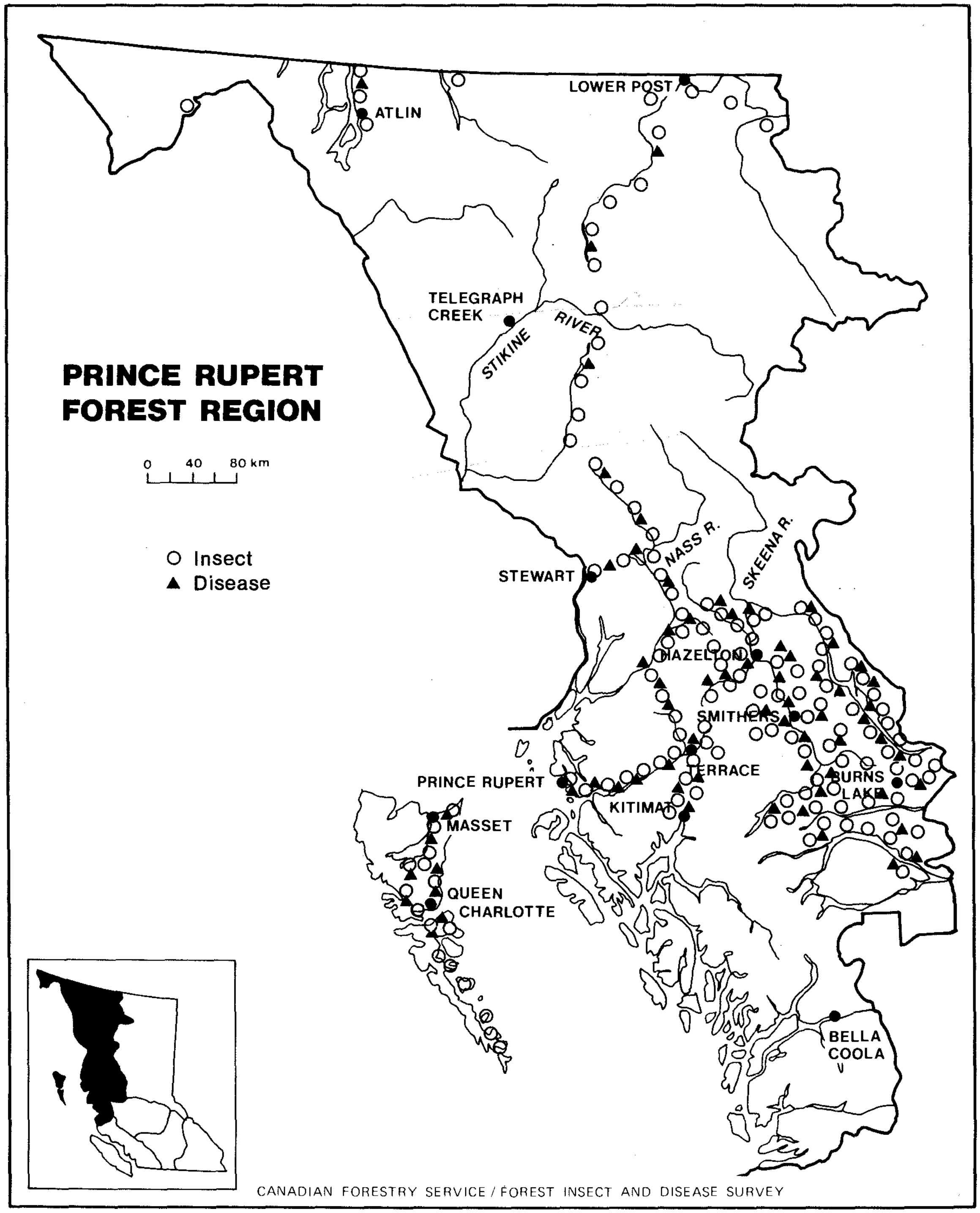
Blackheaded budworm-caused defoliation was mapped over 30 800 ha on the Queen Charlotte Islands and along Douglas Channel. Top-kill and some tree mortality will occur in severely defoliated young stands. High egg counts indicate continuing severe defoliation for 1986.

Alpine fir killed by **western balsam bark beetle** was mapped over 44 400 ha, primarily in the Bulkley TSA. The rate of expansion in newer infestations continues to increase annually.

The area of **poplar shoot blight**-infected trembling aspen increased dramatically in the western portion of the Region, covering 1 200 ha. The intensity of damage caused by the **forest tent caterpillar** decreased in the 900 ha of infested trembling aspen, in chronic infestation areas near Hazelton and Moricetown. The **Pacific willow leaf beetle** severely defoliated willow in the Kitwanga to Smithers area.

Special surveys in search of the **pinewood nematode** continued as 19 symptomatic stands were examined, all of which were negative. Pheromone-baited traps for **gypsy moth**, located at 29 sites, failed to attract any adults. Twelve **exotic conifer plantations** were examined for pest problems and growth performance. A nationally initiated study plot was established near Terrace to monitor the effects of **acid rain**. Pest problems were assessed in 20 accessible **Provincial parks**. In cooperation with research programs at PFC, FPMI and other research institutes, 57 **special collections** were made. The aerial sketch maps of beetle infestations were provided by BCMF personnel from each of the TSAs. In addition, 5 hours of fixed-wing aerial time was provided by the British Columbia Ministry of Forests (BCMF) to survey the Kalum TSA, 3 hours for the Q.C.I. TSA and 1.5 hours of helicopter time by Western Forest Products (W.F.P.), for pest overviews. Three days of helicopter time was provided by W.F.P. and 1½ hours by BCMF for blackheaded budworm egg sampling on the Q.C.I. and near Kitimat.

The 1985 field season extended from mid-May to early October, with additional surveys in mid-November. A total of 303 insect and 98 disease collections were submitted by FIDS field staff for verification to the Pacific Forestry Centre (Map 1). The percentage of beating collections containing potentially damaging insects decreased to 35% from 54% in 1984 and a high of 81% in 1982. A total of 108 contacts and on-site pest examinations with BCMF and industry were made during the field season.



Map 1. Locations where one or more forest insect and disease samples were collected in 1985.

PINE PESTS

Mountain pine beetle, *Dendroctonus ponderosae*

An estimated 896 000 lodgepole pine (734 000 m^3) on 13 000 ha were recently killed by mountain pine beetle in the Region (Map 2). This represents a decrease in area (14 500 ha), number of trees (1 103 000) and volume (1 212 000 m^3) from 1984. Only in the Kalum TSA was a small increase in area recorded.

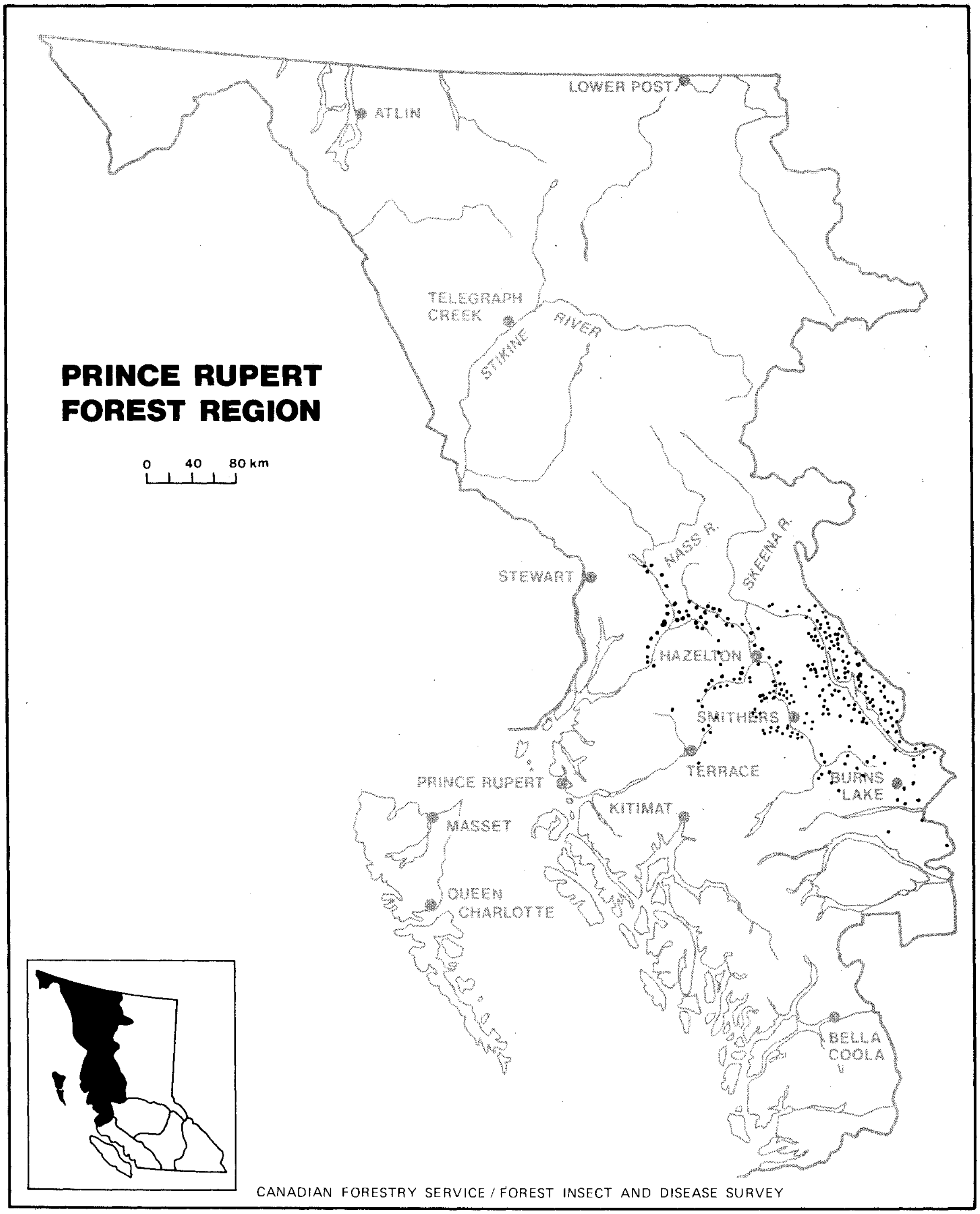
In the Kalum TSA, the volume of pine killed decreased by 34% to 301 000 m^3 over 6 400 ha (5 700 ha in 1984). The infestation in the Cranberry and Nass rivers area has been the primary nucleus of beetle activity where the area of tree mortality has progressively increased over the past 4 years from 700 ha to 6 400 ha. Since many of the more susceptible pine stands have already been devastated by beetle or have been logged, the beetles are moving into smaller diameter (20 cm), younger and more mixed stands. Increasing numbers of scattered small pockets of red trees were recorded downstream along the Nass River towards the Kwinatahl River and Aiyansh. Along the Skeena River, small groups of trees were attacked as far south as the Copper River and light current attack was located near Terrace.

Table 1. Area, volume and number of lodgepole pine recently killed by mountain pine beetle, Prince Rupert Forest Region, 1985.

Location (TSA)	Area (ha)[1]	Volume[2] recently killed (m^3)	Number of trees killed
Lakes	100	7 000	6 000
Morice	2 000	95 000	76 000
Bulkley	3 300	222 000	185 000
Kispiox	1 200	109 000	191 000
Kalum	6 400	301 000	438 000
TOTAL	13 000	734 000	896 000

[1]Areas were computer calculated from maps provided by the BCMF district offices.

[2]Volumes were calculated using CFS-FIDS field data.



Map 2. Areas of lodgepole pine recently killed by mountain pine beetle, determined by aerial and ground surveys, 1985.

In the Kispiox TSA, the volume and area of beetle-killed pine decreased to 109 000 m^3 on 1 200 ha from 117 000 m^3 on 1 850 ha in 1984. The decrease in area was attributed to depleted gray stands in the Skeena River drainage and continual logging in all beetle areas. Both of these activities are reducing the availability of suitable host trees in the two major beetle infested drainages, the Kispiox River (400 ha) and the lower Skeena River (600 ha). Consequently, beetles are moving into the smaller pockets of pine, young stands and mixed stands. Beetle activity continues in the Babine River area (50 ha) and in the Hazelton-Suskwa River area (100 ha).

In the Bulkley TSA, 222 000 m^3 of pine was recently killed by beetle over 3 300 ha. The major areas of concern remain in the Babine and Nilkitkwa rivers area where the 600 ha of beetle-killed pine is largely composed of numerous patches of several trees to occasional 50 ha areas. The potential for expansion remains high, with large tracts of susceptible pine stands remaining. To the south in the Harold Price Creek-Upper Fulton River drainages, the larger infestations have been logged while the number of small infestations continues to increase. Localized areas are almost depleted of suitable host. In the Telkwa River-Walcott area (600 ha) and the Trout Creek-Bulkley River area (450 ha), the beetles continue to find a safe haven from logging on steep terrain from which to re-infest nearby beetle managed stands. However, the pine on these slopes is becoming more limited, and populations should begin to decline.

In the Morice TSA, the 95 000 m^3 of recently killed pine over 2 000 ha was mainly in scattered patches of 1-200 trees between the Chapman-Tanglechain lakes area north into the Babine, Morrison and Tochaha lakes area. One large infestation persists in the Hearne Hill area covering 700 ha. Due to unfavourable climatic conditions for beetle development and aggressive removal of infested trees, the number of small infestations has decreased from 1984. Similarly, only scattered small pockets of recently killed pine were mapped in the Bulkley-Morice rivers area and along Buck Creek. Very occasional 2 and 3 recently killed pine were also present south to Ootsa Lake.

In the Lakes TSA, 100 ha of recent beetle-killed pine was largely in scattered patches along the north side of Babine Lake (80 ha). Small patches of up to 30 trees were widely scattered from south of Babine Lake to Francois Lake and between Day Lake on the west to Shovel Creek on the east. This TSA has a large component of pure lodgepole pine and suitable host availability is not a limiting factor to major increases in mountain pine beetle populations.

Ten pine stands were cruised during September to determine the current attack levels and brood development (Table 2). The current attack ranged from 13 to 65% of the stand volume, averaging 32%, almost identical to 1984 (28%). These percentages represent attack levels in larger infestation areas where the number of beetles remains high despite an overall population reduction. While the percentage remains high, the total area of current attack continues to decrease as beetles concentrate in smaller pockets. Current attack covered less than 10 hectares, in most of the cruise strip areas, even though areas of red and gray were frequently in the hundreds of hectares in adjacent stands.

Table 2. Status of lodgepole pine in stands infested by mountain pine beetle, Prince Rupert Forest Region, 1985.

Location	Percent of volume attacked				
	Current (1985)	pitchout/partial (1985)	Red (1984)	Gray (prior to 1984)	Healthy
Natowite L.	29	3	19	5	44
Nilkitkwa R.	27	1	34	3	35
Harold Price Cr.	13	6	11	2	68
Telkwa	65	4	0	0	31
Walcott	30	3	31	0	36
Kispiox R.	37	5	26	3	29
Kitwanga	28	5	11	0	57
Cedarvale	13	24	18	9	36
Cranberry Jct.	57	3	12	0	28
Nass R.	27	4	6	6	57
Average	32	6	17	3	42

In smaller pockets of beetle-killed pine the ratio of 1985 to 1984 attacked trees was generally 4 or 5 to 1. Several exceptions included areas of low elevation, such as in the Kispiox and Bulkley river areas; or, the trees were of large diameter as in the Natowite and Nilkitkwa lake areas; here, ratios frequently were 1 to 1 of red (1984) to current attack. In the Nass River area very limited current attack was found in the Vandyke Island area, but gradually increased further to the south with extensive attack found only near the Cranberry Junction area (57%).

Brood production has been declining for the past several years for several reasons. Climatic conditions during the summer months have been inconsistent, causing a wide range in beetle development. Development to maturity ranged from 3 months in 1982 to a more normal 1½ to 2 years for much of the interior of the Region. These climatic variations often leave the beetle in a vulnerable stage for overwintering. During the fall of 1984 sudden extreme cold temperatures in late October caused high mortality (98%) among the eggs and early instar larvae of the late attacks. Also, a large number of parent adults (98%) which had not laid eggs or had just started laying eggs were destroyed. These three stages constituted an estimated 70-80% of the beetle population. In addition, larval mortality was estimated at 73% by a BCMF study. Spring brood sampling by FIDS indicated that good survival in the interior portion of the Region was primarily in large diameter trees, at the root collar level and on the south side of trees on a south aspect at lower elevations. Along the Skeena River especially, brood survival was dramatically better on the south side of the trees with 80% of the surviving brood on this side. In June, reproductive ratios which compare entrance holes with surviving broods, indicated that all populations were at a static to declining stage.

The 1985 attack scenario varied greatly between specific areas. In the interior portion large 1984 broods were common at the root collar area, where cool temperatures slowed development and resulted in another late flight in 1985. Areas with larger trees had good brood survival further up the tree and 1985 flights were earlier, with close to normal brood development by fall. On southerly aspects broods had frequently developed to the late instar and pupal stage. In the Kispiox and Nass river infestations, to the west, broods were in the early instar larval stage and were generally developing in a 1-year cycle. In general, flights were a few weeks earlier than in 1984, with brood having developed beyond the egg stage. Hence, survival should improve over the high mortality rates of the 1984/85 winter. However, several consecutive good summers are required to bring populations back to previous levels.

A further factor in the reduction of population levels and amount of spread of current attack has been the extensive and aggressive control program of fall and burn and logging of larger infestations. The program, which has been in place for several years, appears to have reduced population levels where it was thoroughly expedited. Aerial color photos have been a tremendous asset in locating small pockets of red trees for fall and burn. Extensive pheromone baiting has also assisted in restricting the spread of attack. Additionally, due to the extended life cycle of the beetle, many of the broods are retained in the discolored trees and are readily located for brood elimination. However, mature pine stands continue to remain highly susceptible to mountain pine beetle and a continual and thorough vigilance is essential to keep the populations at the current levels created by adverse climatic conditions and control efforts.

The previously mentioned factors indicate the complexity of predicting what the attack levels will be in 1986. In the western portion, beetles should continue to progressively move into the remaining susceptible pine stands with further new small pockets developing in the lower Nass and along the Skeena river valleys toward Terrace. Along the major interior valleys such as the Bulkley, Upper Skeena and Kispiox drainages, the attack should maintain the 1985 levels or increase slightly where suitable host material remains. Most of the remaining interior areas should have increased attack over the very low 1984 levels. However, these predictions will be locally affected by climatic conditions, control programs, and susceptible host availability.

Comandra blister rust, *Cronartium comandrae*

This serious rust of pine caused 42% tree mortality in a study plot near Division Lake. In 1981, in an infected 11-year-old stand, 10 plots were established to observe the effect of *C. comandrae* on young pine. Initially 40% of the trees had stem infections; this increased to 59% in 1983, with no new infections noted in 1985. Tree mortality increased dramatically with 18% dead by 1983 and 42% by 1985. The pattern and severity of infection would suggest that infected nursery stock had been planted.

Red band needle blight, Scirrhia pini

The generally light infection by the fungus recorded between Hazelton and Endako in 1984 was reduced to only several scattered chronic pockets of infection. It continued to cause severe foliage loss to approximately 10 ha of young pine (avg. ht. 8 m) near Kisgegas along the Babine River. Foliage on 35% of the trees was reduced to only the 1985 growth. Lower branch mortality has progressed up the tree leaving crown depths of less than one meter for 80% of the trees. Light infection was also present on 24% of the young pine in a plantation along the Suskwa River. Favourable moist weather conditions during spore production can result in complete defoliation of the host pine in one year.

Warren's root collar weevil, Hylobius warreni

This root collar weevil caused light to moderate tree mortality in 7 of 14 young lodgepole pine stands examined in 1985. Tree mortality ranged from 1% at Division Lake near Burns Lake up to 31% in a plantation near Nilkitkwa Lake. Overall, an average of 8% of the trees were killed in stands where mortality was present.

A review of surveys in 10 to 20-year-old lodgepole pine stands over the past 5 years was done to compare the incidence of attack in burned and non-burned sites. Strips were placed in the center of the stands as well as within six meters of a mature pine fringe. The results indicate the very positive effect of slash burning in reducing the incidence of tree mortality in the center of a stand. This effect is less obvious along the fringe where weevils move in from the adjacent mature stand. In dense natural stands, weevils are less of a problem than in well spaced plantations. In both situations the damage will create openings in the stand as spread of the non-flying weevil is slow. Emerging weevils will usually attack young pine trees well within five meters of the parent tree. Damage is not restricted to young trees only, but continues in maturing stands, reducing growth and has caused tree mortality at Luno Creek.

Table 3. Incidence of Warren's root collar weevil compared in young lodgepole pine stands on burned and non-burned sites, Prince Rupert Forest Region, 1985.

	Percent tree mortality				
Burned sites			Non-burned sites		
Location	edge[1]	center	Location	edge	center
Tsezkwa Cr.	4	1	McBride L.	8	3
Nilkitkwa L.	6	1	Palling	7	4
McBride L.	8	0	Salmon R.	15	12
Telkwa R.	5	0	Suskwa R.	7	3
Babine L.	6	1	Nilkitkwa L.	28	31
Babine L.	7	0	Nilkitkwa L.	9	6
			Division L.	3	1
			Tatalrose	8	4
Average	6	0.5		10.5	8

[1]The edge strips were run within 6 meters of a mature lodgepole pine stand.

Climatic damage

Although climatic injury to young lodgepole pine is not uncommon, the damage can be greatly increased by spacing older stands. In a spaced 45-year-old lodgepole pine stand along Hannay Road, 20% of the leave trees had been broken below crown level. Spacing had reduced the stocking from 8 000 trees per hectare to 850, leaving tall, small diameter trees widely separated and vulnerable to breakage caused by a combination of heavy wet snow loads and wind.

Porcupine damage

Porcupine feeding caused scattered mortality of lodgepole pine in the Kitimat, Kalum and Skeena river valleys totalling approximately 1 400 ha. In a feeding area covering about one hectare southeast of Lava Lake, 32% of the trees were fed upon, comprising approximately 46% of the stand volume.

Atropellis canker, *Atropellis piniphila*

This perennial canker on lodgepole pine is common in most natural pine stands in the Region. The more densely stocked stands favour rapid growth and spread of the disease. In a well stocked (5 500 trees/ha), 60-year-old stand at Pine Creek, 48% of the trees had at least one major stem canker (avg. 3). An additional 7% of the trees had been killed by Atropellis.

Lodgepole terminal weevil, *Pissodes terminalis*

This weevil recently killed an average 6% of the leaders in 3 of 14 young pine stands examined. Plantations at Tatalrose (12%), Nilkitkwa Lake (4%) and at Suskwa River (3%) were within the height category favoured by the weevil (2-8 m). Accumulated damage occurred on 40% of the stems in several young natural stands on poor growing sites near Nadina Lake.

A twig beetle, *Pityophthorus* sp.

This twig beetle was commonly found in recently-killed terminals of young lodgepole pine from the Kalum River area east to Telkwa. The most severe damage was in a young plantation along the Telkwa River, where 5% of the terminals had been killed. Randomly located small patches of 2-3 trees were common in several of the young stands in the Telkwa to Coffin Lake area. Dead terminals require individual examination in order to separate beetle damage from lodgepole terminal weevil damage.

Pitch twig moths, *Petrova* spp.

Only light damage was present in 5 of 14 young pine stands examined. Incidence in stands at Suskwa River, Telkwa River, Nilkitkwa Lake and Tatalrose averaged only light intensity, on branches of affected trees.

Pheromone-baited sticky traps were placed at 5 locations. Interior, higher elevation traps caught large numbers of moths compared to only a few in the more coastal and lower elevation traps. However, the interior pine stands are considerably more expansive and would be expected to harbour larger populations than the more mixed species coastal stands.

Table 4. Number of pitch twig moths caught in pheromone-baited traps, Prince Rupert Forest Region, 1985.

Location	Elevation (m)	No. of moths	Pitch moth species
Cedarvale	120	1	*P. metallica*
Big Oliver Cr.	120	28	*P. metallica*
Boulder Cr.	460	9	*Petrova* sp.
Dungate Cr.	1 200	114	*Petrova* sp.
Hannay Rd.	1 000	221	*Petrova* sp.

Pine sawfly, *Neodiprion* sp.

Populations were greatly reduced from the 1984 levels, with only light defoliation on approximately 30% of the shore pine near Pure Lake on the Queen Charlotte Islands. Infestations seldom last more than two years and no significant defoliation is expected in 1986.

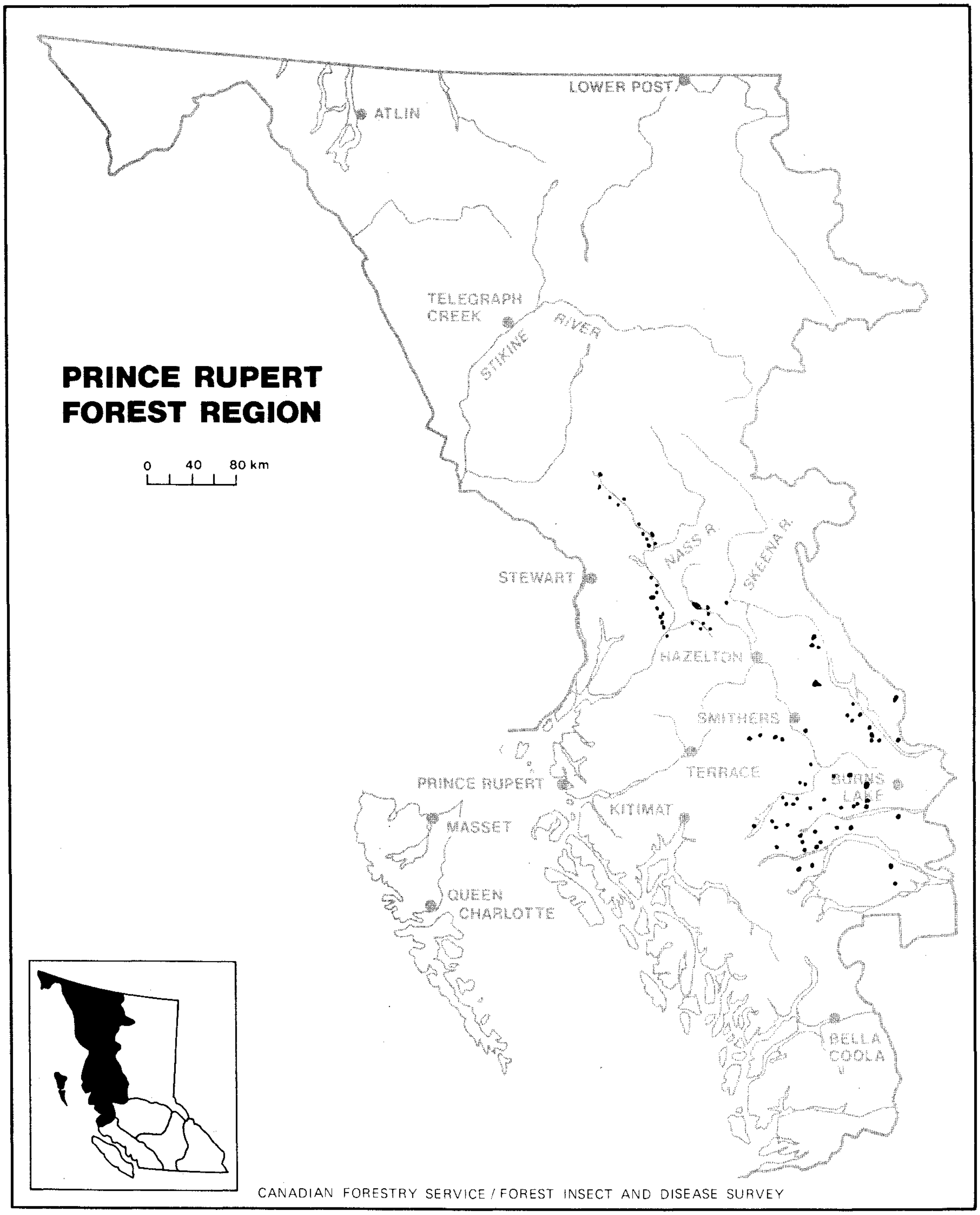
Winter drying

Winter drying caused very light discoloration of lodgepole pine and spruce on approximately 700 ha in the Legate to Oliver creeks area along the Skeena River and close to 400 ha along Buck Creek, near Houston. This type of climatically-caused foliage discoloration has been recorded frequently along portions of the Skeena River between Terrace and Kitwanga. This is a climatic transitional zone during late winter and early spring when foliage desiccation occurs and some degree of discoloration can be expected almost annually.

SPRUCE PESTS

Spruce beetle, *Dendroctonus rufipennis*

An estimated 106 000 m^3 of spruce were recently killed over 15 200 ha in the Region (Map 3). This is a slight increase in area over 1984 (13 620 ha), but a major decrease in volume from 717 000 m^3. The changes are largely due to more extensive mapping of areas with scattered pockets of infested spruce not previously mapped and the inclusion of older grey stands with only scattered fading spruce. Increased areas were recorded only in the Morice and Lakes TSAs. No major new infestations were recorded.



Map 3. Areas of mature spruce recently killed by spruce beetle, determined by aerial and ground surveys, 1985.

In the Lakes TSA, 4 600 ha of very light and scattered tree mortality (35 000 m^3) continued in older infestations in the Chelaslie-Ootsa Lake area (500 ha), Foxy-Ramsey creeks area (1 300 ha), Twain-Pierre creeks area (800 ha) and in the Tildesley Creek area (1 400 ha). Other smaller infestations included Binta Lake, the west end of Francois Lake and near Butterfield Lake.

Table 5. Area and volume of spruce recently killed by spruce beetle, Prince Rupert Forest Region, 1985.

Location (TSA)	Area (ha)[1]	Volume recently killed[2]
Kalum	4 300	21 000
Kispiox	700	13 000
Bulkley	1 000	12 000
Morice	4 600	25 000
Lakes	4 600	35 000
TOTAL	15 200	106 000

[1]Areas were computer calculated from maps provided by the BCMF district offices.

[2]Volumes were determined using CFS-FIDS field data. Recently killed refers to discolored trees, primarily 1984 attack.

In the Morice TSA, most of the 4 600 ha of beetle-killed spruce (25 000 m^3) were mapped in the older infestation areas of the southern portion of the TSA between the Morice River and Ootsa Lake (3 500 ha). Much of this area with patches of scattered and light recent mortality was not mapped in 1984. Scattered fading spruce were also recorded in the old infestations in the Buck Creek area (300 ha), Walcott (400 ha) and in the Topley Landing-Fulton Lake area (400 ha).

In the Bulkley TSA, 1 000 ha of recent beetle-killed spruce (12 000 m^3) were mapped in continuing infestation areas. Only in the Nichyeskwa Creek-Nilkitkwa Lake area was moderate mortality (6-30%) recorded (300 ha moderate and 150 ha light). Light mortality was also noted in the Chapman Lake area (350 ha), Telkwa River (100 ha) and in the Deep Creek area (50 ha).

In the Kispiox TSA, 13 000 m^3 of spruce were recently killed on 700 ha. The only two remaining active areas were at Stephens Lake (650 ha) and 50 ha at Cullon Creek.

In the Kalum TSA's, 4 300 ha of spruce beetle-killed trees (21 000 m^3), scattered patches of fading spruce continue within primarily gray stands in the Bell-Irving River (3 000 ha) and the Nass River (1 600 ha including the Kinskuch and Nanageese rivers).

On the Queen Charlotte Islands at Phantom and Riley creeks, occasional stressed, overmature Sitka spruce had light spruce beetle attack. None of the attacks were large enough to kill the tree in a season, and broods present were very small with reproductive (R) values of less than one. Based on history and the beetle's biological requirements, spruce beetle should not pose a major threat on the Q.C.I. Adult spruce beetle require a cold winter in order to produce large healthy progeny. This is usually lacking in the B.C. coastal areas, although occasional cold winters may favour an increase in population. In addition, decomposing fungi rapidly invade and reduce the suitability of the under-the-bark environment for beetle reproduction and development.

The small infestation on the Haines Road between the Yukon and Alaska borders that was initially reported in 1982 appears to have subsided to endemic levels. No new attacks were found in 1985. Removal of infested trees and peeling of less accessible felled trees in 1983 greatly assisted in reducing the beetle population.

Three beetle-infested stands in the Region were cruised during September to determine the current attack levels and brood status (Table 6). The average current attack levels (17%) increased from 1984 (8%); however, current attack was confined to much smaller areas, often less than one hectare. A further 10 stands in the Morice and Kispiox rivers, Ootsa, Babine, and Chapman lakes areas were examined in a 1-2 km walk-through cruise without encountering more than occasional partial attacks. All of the strips were run in areas where there was evidence of beetle activity with some recently killed spruce. The 1985 broods examined were primarily developing in a normal two year cycle.

Table 6. Status of spruce stands infested by spruce beetle in the Prince Rupert Forest Region, 1985.

	Percent of volume attacked				
Location	Current (1985)	partial and pitchout	Red (1984)	Gray (prior to 1984)	Healthy
Dungate Cr.	10	6	24	26	34
Maxan Lk.	9	15	15	10	51
Nilkitkwa Lk. Rd.	32	21	20	4	23
Average	17	24	20	13	36

Of more immediate concern is the brood content in the unsalvaged spring 1984 blowdown. The 1984 established broods are now in the adult stage and pose a significant threat to nearby mature standing spruce. Population levels varied greatly between areas (Table 7) but low numbers of adults per sample should only be considered in conjunction with the incidence and area at blowdown. In areas with low numbers of adults per tree but large numbers of blowdown, the threat of an outbreak remains high.

Table 7. Numbers of spruce beetle adults in 1984 blowdown, Prince Rupert Forest Region, 1985.

Area		No. of adults per 1000 cm^2 of bark Average	Range
Lamprey Creek		125	50-200
Nadina R.	) 1	15	5-40
to	) 2	55	30-80
Shelford Hills	) 3	50	30-80
Walcott		35	20-100
Nilkitkwa Rd.		23	5-35
E. Ootsa		5	0-35
Loon Lk. Rd.		5	0-25

The infested blowdown remaining in the spring of 1986 will provide a new insurgence of beetles into a generally declining population. A continuing high level of pitchouts and partial attacks (14%) in standing trees for the past two years indicated a weakening population, as well as a shortage of highly susceptible spruce remaining in some areas. Spruce beetle populations generally decline when brood production is wholly dependent on healthy standing trees.

Spruce beetle and root rot sites examined during the past 5 years indicate that root rot infected trees on their own are not responsible for bark beetle increases but only contribute to maintaining a local population. Root rot fungi weaken trees at a slow rate and do not promote a rapidly increasing beetle population. Root rots may play a role in the beetle population increases when blowdown occurs. The trees weakened by root rots scattered through a mature stand are very subject to blowdown, at which time they provide an ideal beetle brood production environment. Since detection and removal of these small pockets is difficult, large broods remain undisturbed until they mature. During strong winds, not only do the weakened trees fall, but also some of the new fringe trees. This increases, for example, a five tree root rot center to a 10 to 15 tree blowdown patch. Scattered through a susceptible stand, these may be enough to create the beginning of a beetle outbreak, especially considering that the population from one blowdown tree can kill a further 10 trees.

A survey of 74 mature spruce sites in 1983 indicated that 65% of the plots had advanced root rot affecting 15% of the trees. A resurvey of 25 of these sites in the general path of the spring 1984 storm indicated that blowdown had occurred at all sites. In addition to the obviously diseased trees, approximately an equal number of incipient diseased and healthy trees were blown down. Representative samples at each site indicated that beetle brood were present to some degree at all locations. In those sites which were not near large areas of sheet blowdown, attacks were severe and broods large enough to pose a serious beetle problem.

Predictions are that increased attack will occur in 1986 in areas of blowdown where susceptible host remains, and that little or no attack will occur in areas with very scattered or no blowdown.

Black army cutworm, *Actebia fennica*

Black army cutworm larvae destroyed an estimated 120 000 newly planted white spruce and lodgepole pine seedlings in the spring of 1985. This is the fourth consecutive year of cutworm-caused seedling mortality in the Region. The most severe infestation at Poplar Lake accounted for the majority of the mortality (85 000) with smaller patches of destroyed seedlings in the Swiss Fire, Telkwa River, Harold Price Creek and Walcott plantations. Infestations were classified by severity at 16 locations (Table 8). A combination of area covered and severity of defoliation was used to determine relative severity of infestations. Numerous other areas, especially previous infestation areas where declining populations persisted, had cutworm present as well. However, with the exception of the Swiss Fire only fall 1983 burns were included. The major defoliation period for fall burns is the second spring following the burn. For example, a fall 1985 burn would have its largest population in the spring of 1987. Burns during the summer period may still attract moths flying in late August or early September and defoliation could occur the spring following the burn.

Table 8. Assessments of 1985 black army cutworm areas in decreasing order of severity, Prince Rupert Forest Region, 1985.

Location	Planting period	% Seedling mortality	Herbaceous feeding		Pupal counts
			% of area	% of growth destroyed	
Poplar Lake	spring 1985	30	90	75	45
Andrew Bay	spring 1984	0	85	65	32
Morrison Lake	late spring 1985	–	65	75	–
Nadina Main	spring 1984	0	70	60	30
Harold Price Creek	spring 1985	2	45	80	11
Telkwa River	spring 1985	2	45	65	13
Swiss Fire	spring 1985	5	25	80	19
Chapman Lake	not planted	–	25	70	30
Nanika R.	not planted	–	40	30	6
Smithers Ldg.	summer 1985	–	10	65	11
Walcott	spring 1984	1	8	60	10
Taltapin Lake	not planted	–	40	10	–
Betty lake	spring 1984	0	5	40	14
Pop Fire	not planted	–	40	5	
Goosly Lake	spring 1984	0	10	5	
Cross Cr.	not planted	0	10	5	

The planting time in relation to burn time appears to be an important factor in seedling survival. Seedlings planted the spring after a fall burn when cutworm are not present survive relatively large populations the following spring. The populations at Andrew Bay Rd. and Nadina Main (areas planted in 1984) were judged to be the second and fourth most severe infestations, yet no seedling mortality was found. In contrast, spring 1985 planted areas at Harold Price Creek, Telkwa River and the Swiss Fire, although considerably less severe, had significant seedling mortality due to cutworm feeding.

High pupal counts averaging 20 per 1 000 cm^2 duff sample indicate a high population at this stage. This is the highest average pupal count ever recorded in the Region. Local population collapses during the current infestation period (1982-85) have been initially indicated by low pupal counts, e.g. Bristol Lake, 1983.

Natural biological control factors were present only at low levels in the older Swiss Fire population, where pupae parasitized by Erigorgus sp. were reared from mass collections. Mass collections from Poplar Lake, Taltapin Lake, Morrison Lake and Harold Price Creek yielded no positive samples of disease or parasitism.

Attractant-baited traps indicate continuing large populations for 1986 (Table 9). An average of 10 moths (.1% concentration) were caught per trap, the same as in 1984. However, the number of locations with counts over 20, which indicates epidemic population potential, increased to six from only one in 1984. It is only in the Lakes TSA where populations appeared consistently low. Some experimentation was done using improved attractants and a more versatile trap design with very positive results. Further calibration is required before these become a useful tool in predicting population levels. All traps were on site from early August to the end of September.

Table 9. Average number of black army cutworm moths caught in attractant-baited traps placed in fall 1983 burns and predictions for 1986, Prince Rupert Forest Region, 1985.

Location	.1%[1] concentration	.01%[1] concentration	Unitrap with new attractant[2]	Potential[3] population levels 1986
Kispiox TSA				
Burdick Cr.	24	–	430	H
Nash Y	22	–	–	H
Suskwa R.	4	0	600	L/M
Natlan Cr.	1	0.5	200	L
Morice TSA				
Jinx Rd.	29	–	760	H
Nosebay Rd.	23	–	960	H
Hagan Arm Rd.	13	–	–	M
Hilltout Rd.	6	–	245	L
Francois Lk.	1	–	–	L
Pop Fire		–	1175	M/H

Location	.1%[1] concentration	.01%[1] concentration	Unitrap with new attractant[2]	Potential[3] population levels 1986
Bulkley TSA				
Telkwa R. (500-1)	25	-	-	H
Harold Price Cr. (27/72)	22	4	1300	H
Torkelson Cr. (18-2)	18	1	500	M
Torkelson Cr. (18-1)	17	4	1200	M
Harold Price Cr. (93-1)	16	2	-	M
Harold Price Cr. (23-2)	15	4	1200	M
Telkwa R. (500-5)	11			M
Harold Price Cr. (93-2)	10	-	-	M
Harold Price Cr. (23-1)	10	2.5	1200	M
U. Fulton (10-4)	10	0.5	-	M
Harold Price Cr. (22-1)	7	0.5	870	M
U. Fulton (10-3)	4	0	-	L
Silvern Cr.	1.5	-		L
Lakes TSA				
Babine L. (CP.'B')	8	0.25	-	L
Taltapin L. (1901)	7	0.75	980	M
Babine L. (110)	4	0	-	L
Cross Cr. (146)	4	0	142	L
E. Ootsa (036-1)	4	0.7	-	L
E. Ootsa (047-2)	3	3.5	-	L
Taltapin L. (011-5/6)	2.5	0	-	L
Taltapin L. (038-2)	2	0	91	L
E. Ootsa (080-4)	2	0	-	L
Decker L.	-	-	825	M

[1] basic formulation is cis-7-dodecenyl acetate
[2] a new reformulation of the older cis-7-dodecenyl acetate
[3] Classifications are primarily based on the .1% baits which have been followed up for the past three years, but where high counts were present in the universal traps, predictions were raised. 5-10 moths - light feeding potential; 11-20 moths - moderate feeding potential; 21+ moths - severe feeding potential.

The main areas of infestation in 1986, based on moth and pupal counts, will be in the Telkwa River area (1985 summer planted) and in the Harold Price Creek-Upper Fulton River area which was partially planted in 1985 and further scheduled for spring 1986 planting. Several other potential hazard areas but with less data to base predictions on include Burdick Creek, the east side of Babine Lake opposite Granisle, the Pop Fire, Taltapin Lake and Decker Lake.

Planting sites should be examined during early spring, especially where trapping indicates the presence of cutworm populations. Both early instar larvae and initial feeding of herbaceous cover is difficult to detect. However, careful examination of duff samples and emerging plants such as fireweed and false Solomon's seal, provide an indication of cutworm population levels. Based on sites examined during the past three years, the following table (Table 10) is a suggested guideline as to when consideration should be given to alter planting schedules.

Table 10. Early instar larval counts and potential seedling damage, Prince Rupert Forest Region, 1985.

Larval instar	No. of larvae/1000 cm^2	Potential damage to newly planted seedlings
3-4	5	expect mortality, delay planting until better assessment of population size can be made
5+	5	expect patches of mortality on drier knolls and some south slopes
5+	15+	major infestation

Spruce weevil, *Pissodes strobi*

Current damage by the spruce weevil was variable in the Kitimat, Kalum and Cranberry river valleys (Table 11). Populations remained high in several areas despite clipping programs implemented by the BCMF over the last three years. The extensive Sitka spruce plantations have probably facilitated the buildup and maintenance of this pest population.

Table 11. Incidence of current attack by the spruce weevil in untreated Sitka spruce stands, Prince Rupert Forest Region, 1985.

Location	Percent of Sitka spruce currently attacked	Percent of Sitka spruce in the plantation	Stand age
30 km N. Kitimat	51	100	12
Cedar River	50	2	10
Kalum Lk.	31	97	10
20 km N. Kitimat	20	100	12
Lakelse Lk.	2	53	7
Cranberry Jct.	2	59	11
Average	26	69	10

Spruce mortality

Recent dead spruce were examined in the Kitimat River Valley and in the East Ootsa area. In the Kitimat Valley up to 75% of the mature Sitka spruce on 43 ha of flood plain had died, primarily within the past five years. A primary cause appeared to be drought stress which occurred between 1978 and 1983. During this period, an evapotranspiration related stress was placed on the trees for part of each growing season; these were the only consecutive years of such stress dating back to 1955. The driest and hottest summer for the 30 year period was in 1982.

Other factors which enhanced the effect of the drought-induced stress include major flooding during the fall of 1978. Sand and gravel deposits of up to 30 cm in portions of the area destroyed fine root systems and in some areas permanently impaired water absorption capabilities by affecting the oxygen/carbon dioxide levels. The damaged or destroyed root systems became prime infection centers for establishment and rapid spread of root rot fungi. Polyporus tomentosus (Inonotus tomentosus), which was found in a number of samples, was not advanced enough on its own to cause tree mortality, but in some instances, would have destroyed portions of the root system.

In the East Ootsa area, several patches of up to one hectare had 20-30 dead or dying young to semi-mature spruce. Major factors contributing to the mortality include drought, extensive feeding by Hylobius sp., Ips tridens and Monochamus sp., which were found in the dying and adjacent healthy trees. In addition, 8 of the 15 trees examined were lightly infected by Polyporus tomentosus.

Spruce budworms, Choristoneura spp.

All spruce budworm populations were at a low level in 1985. The C. orae infestation in the Kitimat Valley area (2 850 ha in 1984) collapsed with no larvae collected. There was no apparent cause for the population collapse, but egg sampling in 1984 indicated a major decline in larval feeding for 1985. Regular larval sampling indicates a continuing low population in the Kispiox River drainage with an average of 7 larvae per sample, a decrease from 12 in 1984. Slight larval increases to six from one per sample site were noted in the Morice River drainage. In the Harold Price Creek-Upper Fulton River area, collections remained comparable to 1984 at 4 larvae per collection.

Pheromone-baited sticky traps were placed in three areas where infestations have recently occurred. The number of adults attracted to the traps in the Meziadin Lake area doubled from 1984, while catches in the Kispiox area remained at the previous year's level. Several problems remain with the type of trap currently being used, thereby reducing their effectiveness in predicting population changes.

Table 12. Average number of male spruce budworm moths caught in pheromone-baited sticky traps, Prince Rupert Forest Region, 1985.

Location	Species pheromone with which traps were baited C. biennis/fumiferana	C. orae
Kispiox R.	62	31
Wedeene R.	5	18
Meziadin L.	63	13

Spruce aphid, Elatobium abietinum

Spruce aphid activity declined from 1984, with only scattered light to moderate feeding of Sitka spruce on the eastern coastline of the Q.C.I. and only minimal damage on the Coastal Mainland. The aphid populations were greatly reduced by the cold winter of 1984-85.

In an eight-year-old plantation near Miller Creek on Graham Island, moderate to severe defoliation has been continuous since establishment. Sixty-five percent of the trees had no 1984 or older foliage remaining and slight feeding had occurred on 1985 foliage. The total height growth of the severely defoliated trees averaged half that of the lightly defoliated trees (1.5 m compared to 2.9). The recent terminal increment of the severely defoliated trees for the past 3 years was 35% of the lightly infested trees and only 20% of the uninfested trees.

In a mature stand (avg. dbh 60-65 cm) near Miller Creek on Graham Island, 67% of the trees had died since 1982, when a permanent mortality plot was established to determine the severity of defoliation required to cause tree mortality. Individual trees of varying degrees of defoliation were assessed and marked. Aphid damage was recorded by estimating the years of foliage remaining in each third of the tree's crown and the percentage of twigs that did not flush. Although the early years of defoliation were not recorded for specific trees, the information suggests that two years of severe feeding in mature trees causes some branch and twig mortality. Several trees with very limited evidence of feeding in 1982 had portions of the crown dead by 1985. The degree of fall feeding has been suggested as being very important in determining the actual bud formation and eventual branch and tree mortality.[1] When the percent of twigs killed per tree reached 50%, as per the 1982 estimates, 13 out of 14 trees were dead by 1985. Only one tree with less than 50% of the twigs dead died during the three year period.

[1]Carter, C.I. 1977. Impact of green spruce aphid on growth. For. Comm. Res. and Dev. Pop. No. 116, For. Comm. Res. Stn. Farnham, England. 8 p.

There was an average of one year's foliage present on those trees that died by 1985 compared to two year's foliage for those still alive. Some problems were encountered in incorporating twig and branch mortality with the defoliation estimates. The percentage of twig mortality may prove more useful in determining tree condition.

In a prism cruise run in the same general area, 42% of the trees were dead due to aphid damage compared to 22% in 1982 (Table 13). The smaller trees were more vulnerable to aphid damage, with 59% of the dead trees being under 50 cm dbh, while only 21% of the healthy trees were under 50 cm.

Table 13. Percent of Sitka spruce mortality caused by spruce aphid within three diameter classes on Graham Island, Prince Rupert Forest Region, 1985.

Diameter class	% dead in 1985 n = 114	% dead in 1982 n = 180
30 cm	80	48
31-50 cm	62	27
51+ cm	26	7

Based on the sensitivity to cold winter temperatures, the aphid populations in 1986 should have been further reduced by the cold late fall temperatures of 1985.

Cone and seed pests

Cone collections made during mid-August generally indicated low to moderate levels of insect damage. The two most damaging and frequently encountered insects were a spiral spruce-cone borer, Hylemya sp., and a spruce seedworm, Cydia sp. The spruce-cone borer has been present in all the collections at all permanent cone collection sites over the past five years. The percentage of cones infested has been dependent upon the cone crop size, increasing when cone crops decline and declining as the cone crops increase (Figure 1). Several larvae may be present in a cone, destroying 100% of the seeds, but usually only a single larva infests a cone and often destroys up to 50% of the seeds. The spruce seedworm, generally present at lower levels, is less damaging, with each insect destroying 10-20% of the seeds in a cone. This insect has not been found in collections from the Kispiox River area during the past 5 years, although it has been readily found in most collections to the east and west of Hazelton.

Other insects found at low numbers include: spruce cone axis midge, Dasineura rachiphaga, in 3 of 5 collections; spruce cone gall midge, Dasineura canadensis, in 2 of 5 collections; Dioryctria sp., in 1

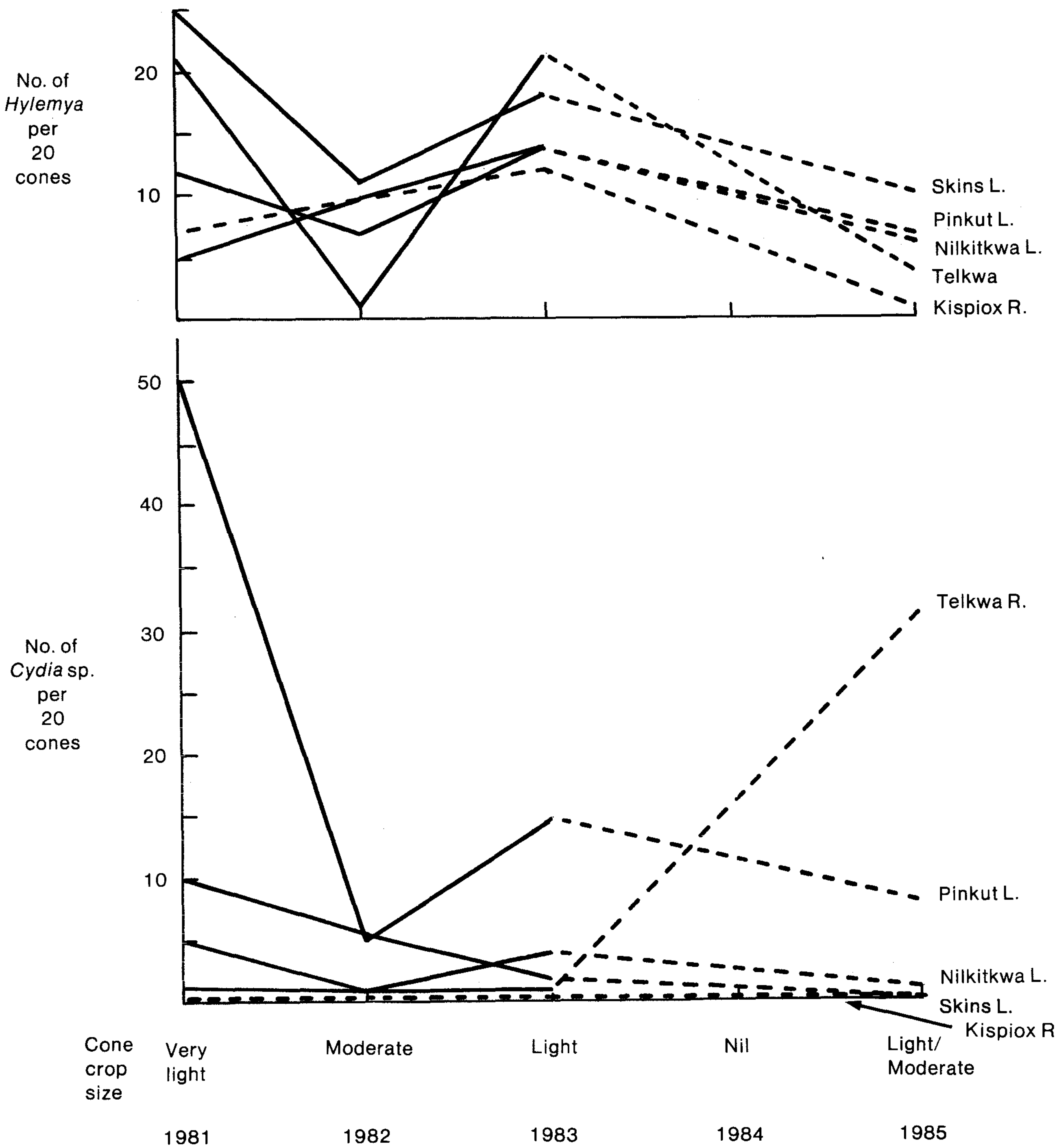


Figure 1. Fluctuations of spruce cone insects *Hylemya* sp. and *Cydia* sp. at permanent sample sites, Prince Rupert Region, 1981-85.

of 5 collections; and *Resseliella* sp, in 1 of 5 collections. The spruce seed midge, *Mayetiola carpophaga*, commonly found during previous years, was not present in any of the 1985 collections.

Spruce cone rust, *Chrysomyxa pirolata*, continues to be only a minor problem with infected cones found only at Pinkut Lake (7%) and at Nilkitkwa Lake (1%). Only the Pinkut Lake site has had a continuous record of rust-infected cones over the past five years, averaging 11%. The last major infection year was in 1979, when an average of 30% of the cone crop was destroyed by rust in the interior of the Region.

A spruce budmoth, *Zeiraphera* sp.

Light feeding of the current year's Sitka spruce shoots was noticed at several locations on the Queen Charlotte Islands. At Lawn Point, 50% of the 1985 foliage on trees along stand fringes and open growing spruce were fed upon. Lower levels of defoliation were also noted at Gray Point and near Masset. This is the third year of a gradual larval population increase on the Q.C.I. The most recent population increase resulted in branch tip and terminal mortality in several spaced young stands.

Herbicide damage

Herbicides caused deformities to 7% of the Sitka spruce in a 14-year-old plantation in the Rennell Sound area. The non-target Sitka spruce saplings had clumped, shortened and discolored 1983 to 1985 foliage, along with branch and some terminal dieback. The damage was attributed to the application of 2-4-D to the stumps of deciduous brush being removed in the stand during August of 1984.

Spruce gall aphid, *Adelges cooleyi*

This pest moderately infested white and Sitka spruce. An average of 60% of the new shoots were infested on white spruce immediately adjacent to Douglas-fir plantations at Burns Lake and Houston, in the interior of the Region. Spruce at ¼ km and ½ km from the plantation had 20% and 2%, respectively, of the new shoots infested. Tree height was 32% less and the dbh was 18% smaller than uninfested young spruce, based on a FIDS study in 1982. Only rarely were infested terminals encountered. In a 5-year-old Sitka spruce plantation near Lakelse Lake, 24% of the trees had less than 20% of the new shoots infested.

Frost damage

Late spring frost damaged or killed an average of 56% of the flushed lateral Sitka spruce buds and leaders in the Kalum, Cranberry and Kitimat valleys (Table 14). Death of terminals resulted in multiple leaders and bushy trees in frost pockets. Frost damage was generally less severe in crowded stands with competing vegetation.

Table 14. Impact of frost damage on the Sitka spruce component of young stands surveyed, Prince Rupert Forest Region, 1985.

Location	Percent of Sitka spruce saplings affected	Percent of Sitka spruce in the plantation	Remarks
Br. 77 Rd. Kitimat	100	1	exposed location
Cranberry Junction	56	59	some protection from competing vegetation
Cedar River	50	2	
2 km S. Lakelse	17	43	fairly dense stocking
Average	56	26	

Sawflies, Pikonema spp. and Neodiprion spp.

Low numbers (1-25 per beating) of Pikonema dimmockii, P. alaskensis, and Neodiprion spp. were collected from mature Sitka spruce at several locations in the Queen Charlotte Islands; however, no significant defoliation was observed. On the Mainland, P. alaskensis was collected from immature Sitka spruce in the Kalum Valley and Neodiprion spp. from semi-mature white spruce in the Cedarvale and Andimaul Cr. areas; although the populations increased slightly, no significant defoliation was observed.

Snowshoe hare damage

Angular clipping of last year's leaders and lateral branches was observed in parts of young stands in the Kitimat and Kalum valleys. This was attributed to feeding by the snowshoe hare during the winter when parts of the saplings were above the snow. In a portion of a 1980 Sitka spruce plantation about 20 km north of Kitimat, 60% of the saplings were damaged; on 28% of the saplings, both the laterals and terminal shoots were clipped, 39% had only the laterals clipped, and 3% had only the terminals clipped.

HEMLOCK PESTS

Western blackheaded budworm, *Acleris gloverana*

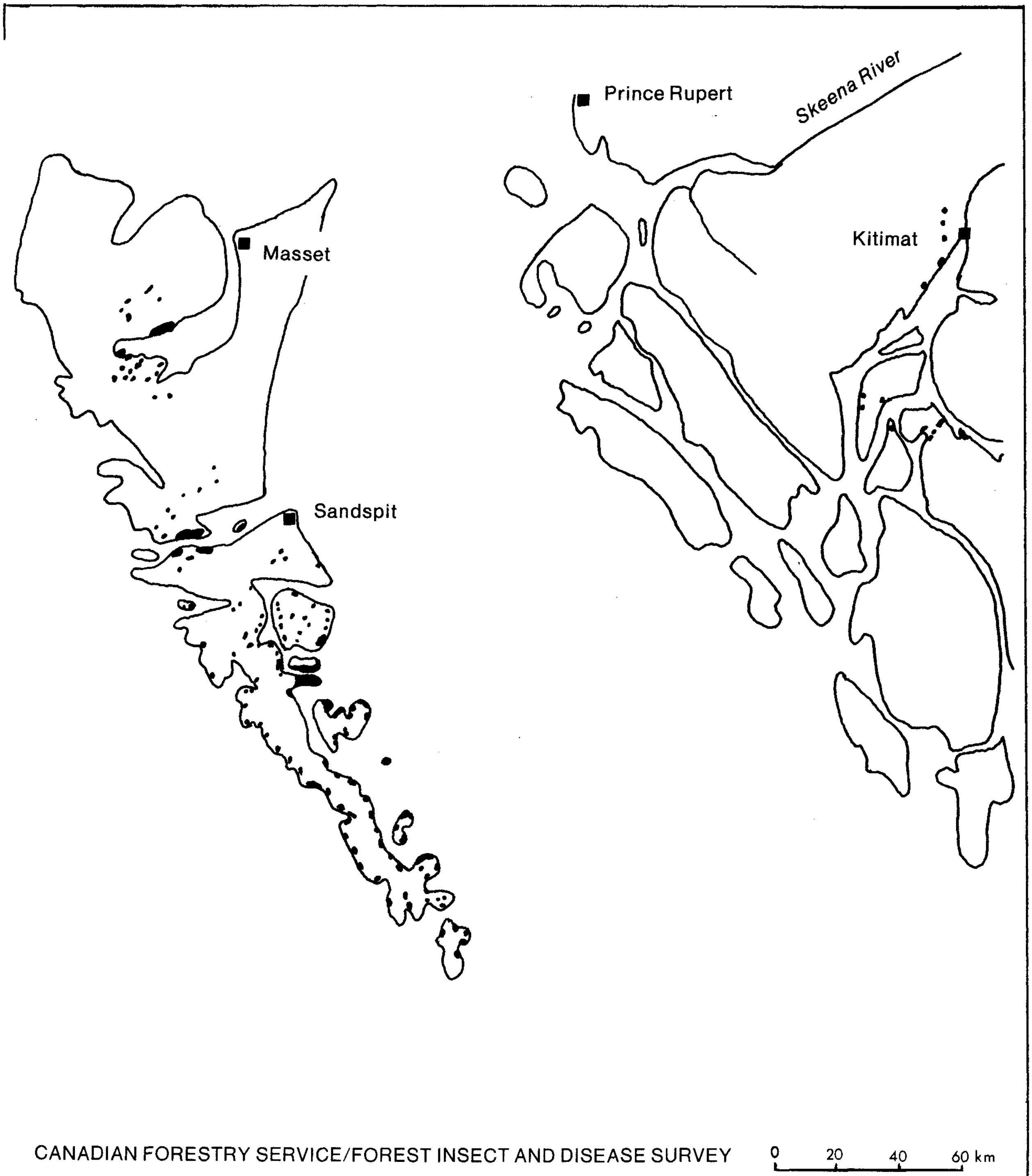
Blackheaded budworm defoliated western hemlock on an estimated 28 600 ha and 2 200 ha on the Queen Charlotte Islands and in the Douglas Channel area, respectively (Map 4), for the first time since 1975. The 3 800 ha of severe defoliation was almost exclusively recorded on mature and immature hemlock between Talunkwan Island and the southern tip of Moresby Island. Moderate defoliation (19 100 ha) in addition to the above area was also extensively mapped in the Masset Inlet area, particularly in the Dinan and McClinton bays and Awun Lake areas. Light defoliation totalling 5 700 ha was present in patches throughout most of the hemlock stands on the southern Queen Charlotte Islands.

On the mainland coastal areas, limited aerial surveys in September indicated light defoliation over 2 200 ha. Defoliated areas of 25 - 400 ha were recorded from Bowbyes Creek near Kitimat south to Hawkesbury and Gribbell islands and into Alan Reach along the Gardner Canal.

The impact upon the trees in defoliated stands depends upon the degree of defoliation, stand density, stand age and site. Increment reduction following only one year of severe defoliation can reach 50% based on information collected during previous infestations. Plots established at 10 egg sampling locations will further assist in assessing impact on individual trees following varying degrees of defoliation. As defoliation increases, top-kill becomes more prominent and damaging. While limited top-kill is quickly replaced by upper branches taking over as terminals, more extensive top-kill leads to severely deformed stems and provides entrance courts for decay fungi. In the plots established, tops were stripped of foliage for at least 2 meters in 8 of 10 plots. In the severely defoliated areas, 93% of trees in young stands were top-stripped as compared to 17% in the mature stands. In the current infestation, average top-kill in mature stands following one year of moderate to severe defoliation is estimated to occur on 20% of the trees. In second growth stands, an average of 90% top-kill can be expected in severely defoliated stands and only 10% in moderately defoliated areas. The apparently low figure for the moderate category is largely due to overestimation of defoliation in young stands due to the brilliant discoloration of foliage compared to more dull discoloration of mature stands.

Tree mortality in the most severely defoliated second growth stands should average no more than 10-20%. In one stand examined on the ground at Talunkwan Island, mortality could reach as high as 70%; however, feeding on the older foliage by hemlock sawflies, *Neodiprion* spp., greatly contributed to the severity of the defoliation. Several young stands on Lyell Island observed from the air appeared to have the same feeding pattern. A plot established in the most severely defoliated (avg. 98%) second growth stand on Kwaikans Island during the 1973-74 infestation resulted in 67% tree mortality following one year of defoliation.

Severe defoliation is predicted for most of the areas currently infested. Hemlock stands lightly defoliated or apparently undefoliated in 1985, especially near currently defoliated stands, are highly vulnerable to



Map 4. Areas of western hemlock defoliated by western blackheaded budworm, determined by aerial surveys, Prince Rupert Region, 1985.

invasion during flight period and subsequent defoliation in 1986. Of the 11 egg sampling sites on the Q.C.I., 9 had large numbers of eggs, up to an unprecedented 343 per 45 cm branch (Table 15). In the Masset Inlet area the one egg sample site may not be totally indicative of the population trend for the whole area and increased defoliation should be expected in 1986. Previous infestations have initially been more severe in the south before intensifying in the north Graham Island area.

The high egg counts at Bowbyes Creek indicate a major increase in defoliation can be expected in the Kitimat-Douglas Channel area. Light defoliation, as was recorded in the Douglas Channel area in 1985, often precedes a major expansion of defoliation the following year. Although high larval counts were not recorded, increased larval populations were noted in the Kitimat, Terrace and Portland Canal areas and in most previous infestations, defoliation has spread into these areas.

Blackheaded budworm populations can increase extremely rapidly when conditions are favourable; however, they can and often do collapse even more quickly. The stage at which mortality frequently occurs is the early instar larval stage when cold wet conditions or hot temperatures adversely affect development. Populations will also frequently collapse following one or two years of severe defoliation, due to lack of adequate bud formation and consequently, starvation of early instar larvae which require tender foliage for food. The ability to form buds is greatly reduced by the mid-summer feeding budworm, especially considering the limited ability of hemlock to form adventitious buds.

Populations have not been greatly influenced by biological control agents in the past. For the first time, Beauveria sp. was collected on blackheaded budworm in B.C. Although it is not expected to significantly affect population levels, it is suspected of playing a major role in the rapid decline of spruce budworm populations in the Nass River Valley in 1983.

Table 15. Stand condition and predicted defoliation of blackheaded budworm defoliated western hemlock, Prince Rupert Forest Region, 1985.

Location	Average tree defoliation Upper	Mid	Lower	% of trees with 2 m + top-stripping	Egg counts per 45 cm branch	Defoliation estimates[1] for 1986
Moresby Area						
Atli Inlet	90	70	50	100	21	light
Powrivco Inlet	90	70	55	80	71	severe
Tanu Is.	75	50	30	0	101	severe
Talunkwan Is.	90	85	80	92	111	severe
Burnaby Is.	75	50	20	30	117	severe
Sewell Inlet	40	20	10	0	123	severe
Forsyth Pt.	75	65	45	18	135	severe
Ramsey Is.	80	70	60	24	170	severe
Jedway	75	65	60	36	186	severe
Thurston Harbour	95	65	30	100	219	severe
Masset Inlet						
Wathus Is.	40	20	5	0	35	moderate
Kitimat						
Bowbyes Cr.	35	20	10	0	129	severe

[1] 1-26 eggs - light defoliation
27-59 eggs - moderate defoliation
60+ eggs - severe defoliation

Hemlock sawflies, Neodiprion spp.

Hemlock sawfly populations increased in localized areas on the Queen Charlotte Islands. Extensive feeding was present on western hemlock in conjunction with blackheaded budworm at Talunkwan Island, where Neodiprion spp. pupal cases and eggs were abundant during fall egg sampling. Elsewhere, lower population levels were readily noticed at most of the budworm egg sample sites. Sawfly larvae prefer to feed on the older foliage and only feed on current year's foliage after the older foliage has been consumed. As a result, very large populations are required before trees are seriously affected. However, when they feed in conjunction with another defoliator such as blackheaded budworm which prefers the current year's foliage, tree mortality can occur after only one year of defoliation.

Frost damage

Late frost damaged or killed some flushed new growth from Kitimat to Cranberry Jct. Damage was variable between and within stands, affecting from 0 to 77% of the western hemlock component in the young stands assessed (Table 16).

Table 16. Impact of frost damage on the western hemlock component of young stands surveyed, Prince Rupert Forest Region, 1985.

Location	Percent western hemlock component affected	Percent western hemlock in stand	Approximate stand age
2 km S. Lakelse	77	34	7
3 km S. Lakelse	70	33	6
9 km S. Lakelse	34	64	4
Cranberry Junction	25	5	17
Br. 77 Rd., Kitimat	9	69	15
Br. 77 Rd., Kitimat	9	72	15
Cedar River	0	11	14
4 km S. Lakelse	0	30	8
13 km S. Lakelse	0	54	6
Average	25	41	10.2

Herbicide damage

Aerial application of a brush control chemical, glyphosate, on a mixed plantation (69% western hemlock) at Km 4 of the Branch 77 road in the Kitimat Valley resulted in dieback affecting 99% of the western hemlock component. Of the affected trees, 91% had top and lateral dieback and 9% had top dieback only. The spray was applied in August, near the end of a dry summer and when the trees were still actively transpiring. Another glyphosate spray block near Cranberry Junction at Km 84, Nass R. Road, had dieback of the top 10 to 20 cm of 85% of the western hemlock component.

Porcupine damage

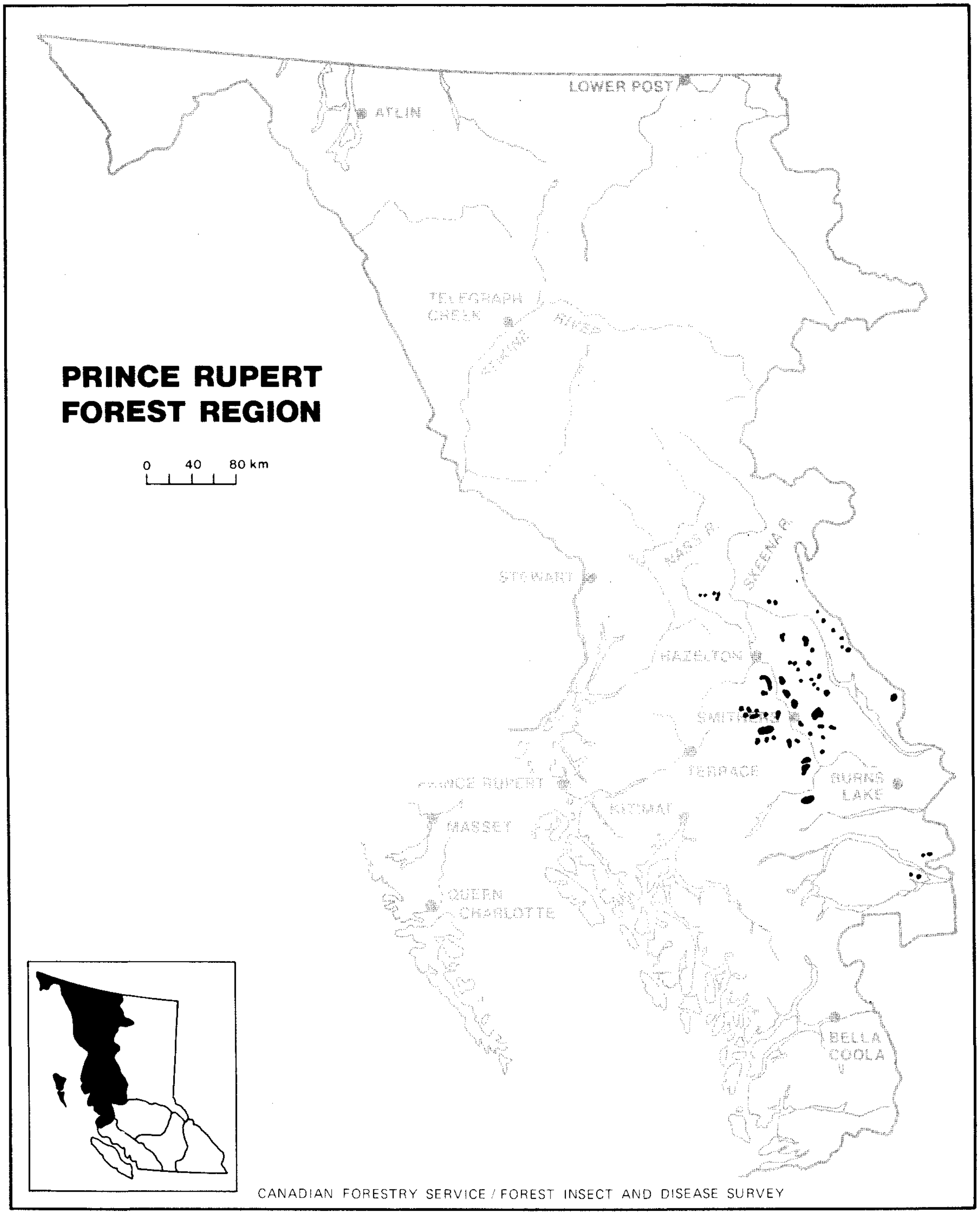
Porcupine feeding in a sapling western hemlock stand at Bitter Creek, near Stewart, had left approximately 10% of the stand dead or currently attacked. Reports continue of current porcupine damage along coastal inlets. Release of natural predators, fishers, by provincial agencies will continue.

TRUE FIR PESTS

Western balsam bark beetle, *Dryocoetes confusus*

Over 44 000 ha of beetle-killed alpine fir were mapped in the Region in 1985 (map 5) (Table 17). Due to the scattered pattern of attack, volume losses of 175 000 m^3 from 1984 attacked trees are only a rough estimate. Accumulated mortality is much higher in the chronic beetle areas. Infestations have been recorded by FIDS since 1949. Also, mapping of alpine fir mortality is incomplete for some TSAs. A more refined mapping procedure and increased ground examination is necessary in order to obtain more accurate loss figures.

The 34 300 ha of mapped alpine fir mortality in the Bulkley TSA is a reflection of the high alpine fir component in the district as well as



Map 5. Areas of mature alpine fir recently killed by western balsam bark beetle, determined by aerial and ground surveys, 1985.

more extensive mapping. Large areas with scattered pockets of mortality included McKendrick Pass (6 500 ha), Gramophone Creek (4 500 ha), Moricetown(4 500 ha), Telkwa River (9 000 ha) and the Nichyeskwa Creek-Nilkitkwa Lake area (2 500 ha). Numerous smaller areas were recorded near McDonell Lake, Harold Price Creek area and along the Bulkley River.

Table 17. Area and volume of alpine fir killed by western balsam bark beetle, Prince George Forest Region, 1985.

Location (TSA)	Area (ha)[1]	Volume recently killed (m^3)[2]
Bulkley	34 300	150 000
Morice	9 000	22 500
Lakes	1 000	2 500
Kispiox	100	400
Total	44 400	175 400

[1]Areas were computer calculated from maps provided by BCMF districts.

[2]Volumes were calculated from CFS-FIDS field data.

The 9 000 ha of recently killed alpine fir mapped in the Morice TSA were primarily recorded in two large areas in the Emerson Creek area (7 000 ha) and near Pimpernel Mountain (1 500 ha). However, scattered, smaller, unmapped patches are readily observed from observation points southward toward Ootsa Lake.

In the Lakes TSA, only two areas with alpine fir mortality were mapped. The most extensive mortality was in the Tildesley Creek area (850 ha) where it was in conjunction with a spruce beetle infestation. Scattered small patches were mapped in the Intata Reach area.

In the Kispiox TSA, small scattered pockets of alpine fir mortality were mapped over 100 ha near the Kitwancool, Suskwa, Babine and Sweetin rivers and Canoe Creek.

Although no alpine fir mortality was mapped in the Kalum TSA, several large areas of mortality have been mapped in recent years, especially along the Bell-Irving River.

The limited number of stands examined indicated an increase in attack levels over the past two years. Currently attacked trees outnumbered the fading trees (trees turning green to red) by roughly 1.2-1 in 160-year-old stands examined in the Shelford Hills and Telkwa River. In turn, the number of fading trees averaged 1-2.5 old dead beetle-killed trees, which still had discolored foliage which is retained for up to 5 years. These stands had only recently been attacked, since only a few scattered gray trees were present.

Frost damage

Late frost damaged or killed some flushed amabilis fir buds in scattered patches throughout the Kitimat Valley. The incidence of damage was less severe in crowded plantations with competing vegetation.

Table 18. Impact of frost damage on the amabilis fir component of young stands surveyed, Prince Rupert Forest Region, 1985.

Location	Percent alpine fir affected in stand		Approximate stand age
9 km S. Lakelse	55	17	4
Br. 77 Rd., Kitimat	19	30	15
Br. 77 Rd., Kitimat	9	28	15
4 km S. Lakelse	0	2	8
Average	21	19	10

Herbicide damage

Aerial application of a brush control chemical, glyphosate, to a mixed plantation (30% amabilis fir) on the Branch 77 Rd. north of Kitimat, resulted in leader mortality affecting 42% of the fir component. The spray was applied in August near the end of a dry summer and when the trees were still actively transpiring.

Giant conifer aphids, *Cinara* spp.

Cinara sp. were collected from three locations on sapling amabilis fir. No damage was apparent at the sites sampled, but larger populations can cause foliar yellowing and reduced growth, especially on young trees.

At one location near Kitimat, a group of approximately 100 aphids was observed on the stem of a sapling tended by large ants. Small foliar collections were made from the Shames River and Gainor Lake areas.

CEDAR PESTS

Yellow cedar mortality

As yellow cedar mortality continues on the Queen Charlotte Islands, the cause eludes identification. Studies by the USDA in southeastern Alaska have also been inconclusive. Root rot sampling at Riley and Phantom creeks on the Q.C.I. created further questions with only an unknown root rot consistently recorded. Although samples from both areas contained root rot, the extensive areas of past tree mortality can hardly be attributed to root rot. However, current discoloration of declining cedar, most often in small groups of 2-10 trees, is typical of root rot damage.

The opportunistic cedar bark beetle, *Phloeosinus sequoiae*, was present in occasional discolored trees and contributed to the mortality, only in the most severely stressed trees.

Stress created by a poor growing site was responsible for some cedar mortality but did not contribute to tree mortality in the good cedar growing sites, where cedar of all ages were dying.

DECIDUOUS TREE PESTS

Poplar shoot blights, *Venturia* spp.

The severity and extent (12 000 ha) of damage caused by the shoot blight, *Venturia macularis*, to trembling aspen increased dramatically in the western portion of the Region, while a major decrease was recorded in the Interior. Defoliation was severe in stands with southerly exposure between the Kitwanga area and Cedarvale over approximately 9 800 ha. Less than 5% of the leaves were healthy with 9% dead, 82% moderately necrotic and curled and 4% only lightly infected. Aspen east of Kitwanga was moderately infected over 2 200 ha. Black cottonwood trees in these areas were also lightly infected by shoot blight, probably *V. populina*. Light infections by *Venturia* spp. were also collected from cottonwood and aspen down the Skeena River to the Terrace area and throughout the Kitimat Valley.

In the Interior, moderate damage with occasional severe patches were noted only in the Wisteria area.

Forest tent caterpillar, *Malacosoma disstria*

Light defoliation on 900 ha of trembling aspen continued for the third consecutive year in the Hazelton and Moricetown areas. In the Hazelton area an estimated 450 ha of aspen were defoliated in the Mount Glen and Four Mile Mountain area, with an additional 300 ha of aspen defoliated on the north side of the Skeena River opposite Hazelton. At Causqua Creek area near Moricetown defoliated aspen was recorded over 150 ha.

Egg mass counts from 5 trees at Hazelton (27) and Moricetown (20) indicate continuing defoliation but at a reduced level for 1986. These numbers are lower than in the past two years, especially in the Moricetown area. In addition, egg masses were generally smaller indicating a less vigorous population.

Pacific willow leaf beetle, Pyrrhalta decora carbo

This leaf beetle caused severe defoliation of willow from 40 km southwest of Kitwanga to 30 km north of Cranberry Junction. Moderate with some severe defoliation extended from Kitwanga to Hazelton and to the east where damage gradually decreased to only occasional clumps of lightly defoliated willow near Smithers. Total defoliation of open growing and roadside willow was common in severely defoliated areas. A predatory insect, Podabrus sp. was often associated with the insect damaged willow.

Poplar and willow borer, Cryptorhynchus lapathi

Infestations of this borer were chronic in the southern half of the Region, killing individual willow stems within the multi-stemmed clumps caused by attacks in previous years. Current attacks were observed along the Skeena, Kalum, and Kitimat valleys.

Alder foliar insects

Alder was lightly to severely damaged in localized areas by a variety of foliar insects. Red alder was severely defoliated by the alder sawfly, Hemichroa crocea, in patches up to one hectare in the Lakelse Lake and Terrace areas. The alder leaf beetle, Pyrrhalta punctipennis, severely defoliated red alder in patches up to 5 ha in localized outbreaks in the Skeena, Kalum and Kitimat valleys. The alder leaf miner, Lithocolletis sp., mined an average of 30% of the foliage on 70% of the leaves on roadside and open growing red alder in the Suskwa River-Natlan Creek junction area. The European alder leafminer, Fenusa dohrnii, was active at light intensity in the Skeena, Kalum and Kitimat river valleys. The alder woolly sawfly, Eriocampa ovata, severely defoliated alder in the vicinity of the Prince Rupert municipal campground. The elm sawfly, Cimbex americana, and a tenthredinid sawfly, Nematus sp., were also collected from alder at this location. The spotted tussock moth, Lophocampa maculata angulifera, was a light defoliator of alder near the Lakelse Lake campground. It was moderately parasitized by a tachinid fly.

Alder brown stripe

An interveinal discoloration was sporadic in occurrence in the Terrace-Kitimat area, Cranberry Junction and Skeena River Valley. The cause of this damage is still undetermined. Previous speculations have included the effects of fluoride emissions and nutrient deficiencies.

Conifer-cottonwood rust, Melampsora occidentalis

This rust caused premature yellowing and leaf drop of seedling and sapling black cottonwood in the Skeena Valley from 20 km west of Hazelton to 53 km west of Terrace, through the Kalum Valley, and from Kitwanga north to the Cranberry Junction area.

Cottonwood foliar insects

The poplar leaf folding sawfly, Phyllocolpa bozemani, and damage from a leafminer, Phyllonorycter sp., were present at light intensity on black cottonwood saplings north of Kalum Lake. Unidentified noctuid larvae were collected from curled leaves in Hirsch Creek Park, also at light intensity.

Birch foliar insects

Light damage on some leaves in the upper crowns of birch in the Skeena River Valley was attributed to a birch leafminer, Lyonetia saliciella, and an undetermined Lepidopteran, possibly Coleophora sp.

Willow foliar diseases

A foliar rust, Melampsora epitea, caused early yellowing and leaf drop on scattered willows throughout the southern portion of the Region. Tar spot, Rhytisma salicinum, was occasionally found at light intensity on willow foliage in the Kalum and Kitimat valleys. Glomerella blight of willow, Colletotrichum gloeosporioides, was collected for the first time on willow near Collins Lake where roadside willows had lost all of their foliage.

SPECIAL SURVEYS

Pinewood nematode, Bursaphelenchus xylophilus

Trees at 19 areas were sampled to determine the possibility of nematode-caused tree wilt. No nematodes that could be confused with B. xylophilus were collected from lodgepole pine, white spruce or alpine fir. Small numbers of native plant pathogens and saprophytic nematodes were found in several of the samples collected.

This nematode, recently discovered in the United States, has been responsible for extensive pine mortality in Japan during the past three decades. More recently, several European countries have not accepted wood product shipments from areas not certified as nematode free zones.

Gypsy moth, Lymantria dispar

Single pheromone-baited gypsy moth traps were placed at 29 sites in the Region. Although all of the traps were located in areas heavily frequented by tourists, no moths were caught. Populations have not yet become firmly established in the province; however, each year moths have been trapped at several locations in southern B.C.

Gypsy moth is a major pest of deciduous trees and some conifers in eastern Canada and part of the U.S.A., including Washington State, Montana and Oregon. Traffic from infested areas in eastern North America is the primary vector responsible for the westward migration of the insect.

Exotic plantations

Twelve Interior exotic conifer plantations were examined for tree performance and pest conditions. In most cases native species performance exceeded that of the exotic species. Scots pine survival and growth was only slightly less than the natural growing lodgepole pine, but it was more subject to breakage. However, Scots pine appears less susceptible to several of the diseases commonly found on lodgepole pine, such as some stem cankers and mistletoe. Western larch at most lodgepole pine sites survived poorly but grew well on one alpine fir site at Lamprey Lake. Top-kill, especially from Phomopsis sp., was a recurring problem causing bushy growth.

Douglas-fir plantations generally displayed poor survival and growth; however, several locations had specimens that were growing as well as the native lodgepole pine. Aphid (Adelges sp.) damage, although common at light intensities at all sites, was not a major inhibiting factor in the younger plantations. Severe infestations caused chlorotic foliage and appeared to affect the growth in an older plantation at Co-op Lake. However, Douglas-fir growth equalled that of lodgepole pine at the North Road site north of Houston. Both western larch and Douglas-fir initially grew slowly and had a bushy form. The trees overcame this stage, generally at 4 to 5 years, and grew well. The growth, however, was generally slower than naturally growing lodgepole pine, but was equal to or better than that of white spruce.

Table 19. Status of exotic conifer species in Interior plantations, Prince Rupert Forest Region, 1985.

Location	Year planted	Stocking or percent mortality	Percent of trees growing well	Average height (m)	Remarks
Scots pine					
Andrew Main (Ps6)[1]	1976	1000/ha	95		1P avg. height 2.3 m Cronartium coleosporioides second collection in B.C.
Meadow Main (Ps 8)	1978	750/ha	70	1	branch breakage, 10%
W20 Rd (Ps 7)	1978	650/ha	90	1.3	branch breakage, 10% 1P avg. height 1.7 m
M5 Rd (Ps 11)	1981	25%	65	0.7	planting failure

Location	Year planted	Stocking or percent mortality	Percent of trees growing well	Average height (m)	Remarks
Western larch					
Francois Lk. (Lw6)	1981	40%	10	0.5	top-kill, bushy
E. Ootsa blk.14 (Lw10)	1980	57%	30	0.3	planting failure
E. Ootsa blk. 11 (Lw 10)	1980	63%	21	0.5	overgrown with lP 1–2 m
E. Ootsa blk. 8 (Lw9)	1980	33%	53	0.5 (1–2)	planting failure
Lamprey Lk. (Lw7)	1981	10%	78	0.7 (.3–2)	*Phomopsis* sp. 20% infection lP avg. height 1 m
Douglas-fir					
Wisteria (Fi27)	1980	15%	20	0.5	*Rhabdocline* sp. light infection
Shelford Hills (Fi 29)	1980	66%	25	0.5	planting failure
E. Ootsa blk. 14 (Fi 31)	1980	27%	20	0.3	frost-killed buds 32% *Adelges* sp. damage light
E. Ootsa blk. 11 (Fi 31)	1980	81%	0	0.3	lP avg. height 1.5 m
E. Ootsa blk. 8 (Fi 30)	1980	58%	71	0.5	height up to 1.5 m
Co-op Lk. (Fi 10?)	1962	800/ha	56	3.0 (1–7)	lP avg. height 10.5 m *Adelges* sp. moderate to severe; *Rhabdocline* sp. – moderate infection on 20%
North Rd. (FI 24)	1966	600/ha	90	3.3 (1–5)	*Rhabdocline* sp. light infection

[1]Exotic plantation numbers as designated by BCMF, Regional Research personnel.

Acid Rain National Early Warning System (ARNEWS)

As part of a national network, a 10x40 m plot was established in the Terrace Watershed to monitor any injury due to acid rain on trees and indicator plants over the next 25 years. Layout of the plot, preliminary growth measurements, soil and foliar analyses, and pest assessments, were completed during the 1985 field season.

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