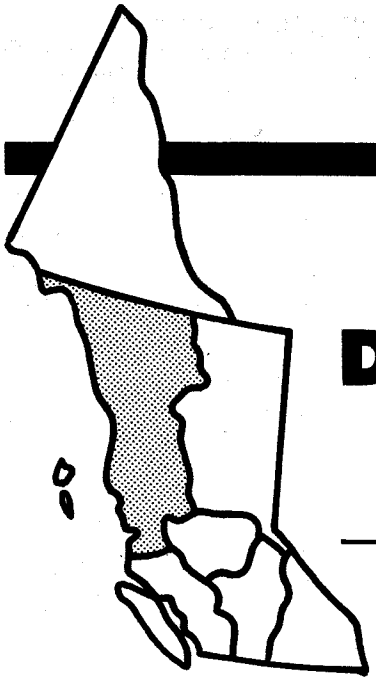
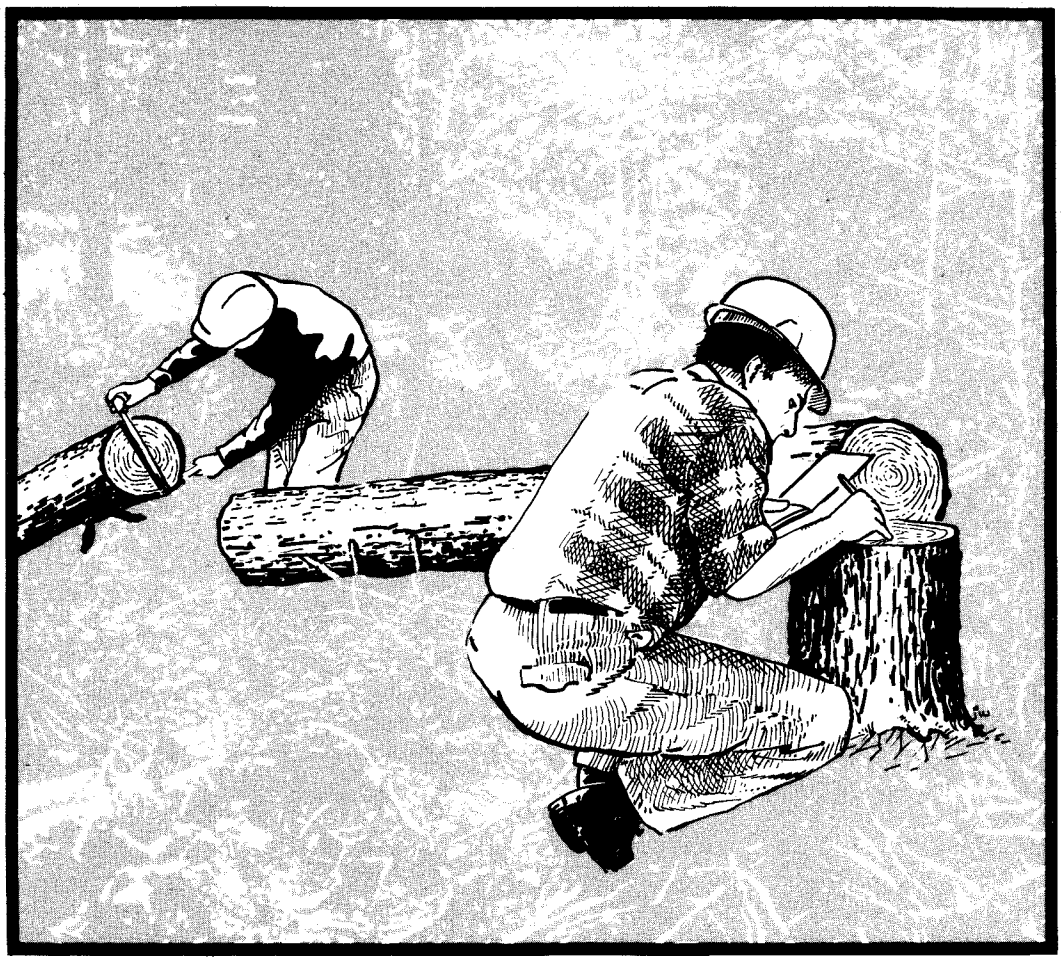


Forest Insect and Disease Conditions

Prince Rupert Forest Region
1982

L. Unger and N. Humphreys



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SUMMARY

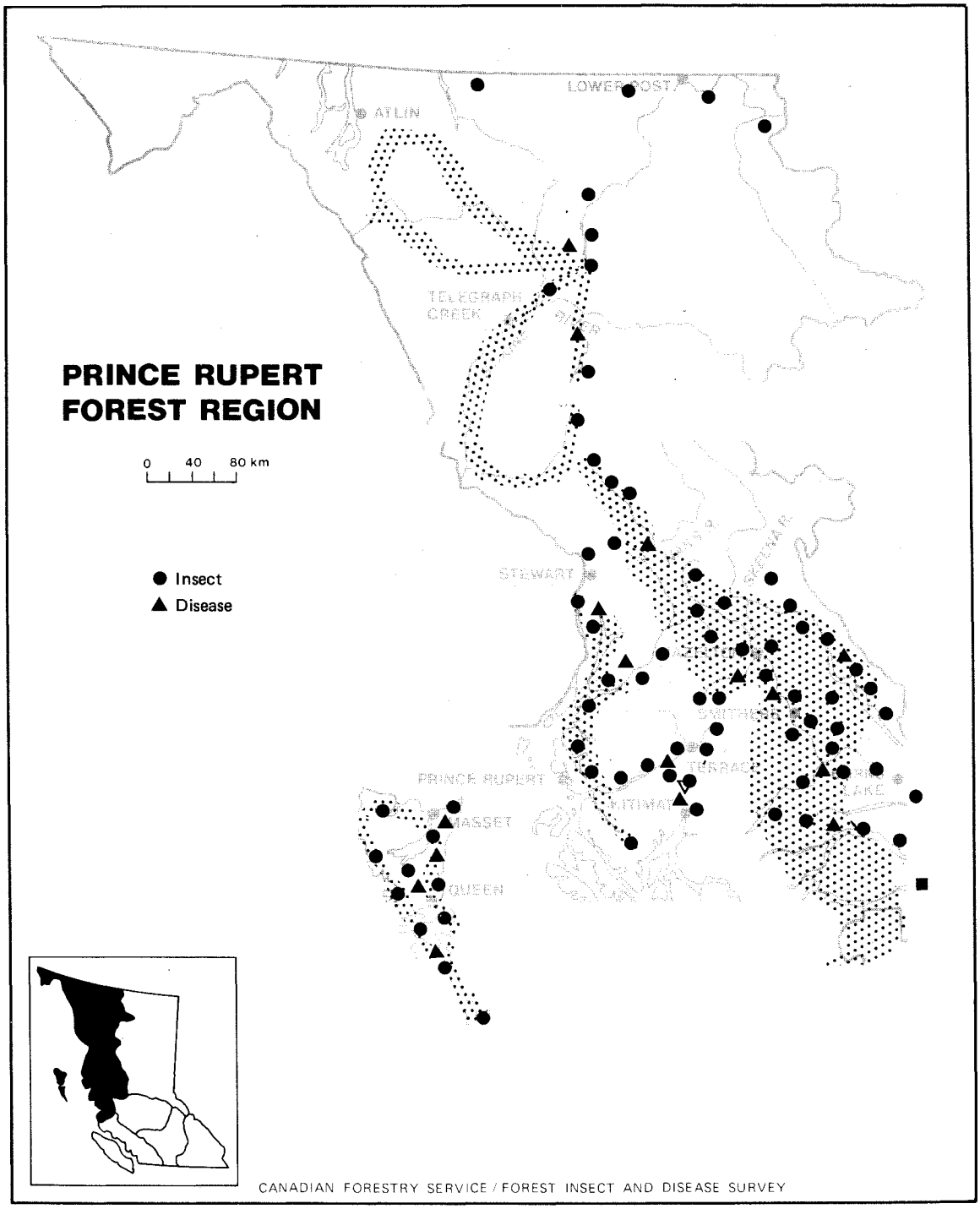
This report outlines the status of forest pests in the Prince Rupert Forest Region in 1982, and attempts to forecast some of the pest population trends. Pests are listed by host in order of importance.

Spruce beetle destroyed an estimated 1 615 000 m^3 of mature white and Sitka spruce on 24 000 ha, the majority of which occurred in the Lakes, Morice and Bulkley T.S.A.'s. Close to 90 000 ha of spruce-balsam stands in the Nass, Kispiox and Babine drainages were lightly to moderately defoliated by spruce budworm. Black army cutworms were responsible for severely damaging spruce seedlings in plantations north of Houston. Cone and seed pests caused severe damage to white spruce cones at Skins, Pinkut and Aldrich lakes. Spruce aphid populations collapsed in the coastal mainland and on the Queen Charlotte Islands. Mountain pine beetle infestations intensified, killing 300,000 lodgepole pine over 6 200 ha. Lodgepole pine needle miner populations decreased, but continued to cause terminal damage near Topley Landing. A hyperparasite, Fusarium eatertium, was found on western gall rust near Prince Rupert, a northern distribution record.

Western balsam bark beetle killed 62 600 m^3 of alpine fir over 17 700 ha, primarily in the Bulkley and Morice T.S.A.'s. Green striped forest looper populations increased in the coastal hemlock-cedar stands in the Queen Charlotte Islands, but no defoliation was recorded.

The pest survey field season extended from late May to late September, during which time a total of 307 insect and 60 disease collections were submitted to the Pacific Forest Research Centre by FIDS survey personnel; Map 1 shows locations where one or more samples were collected. The percentage of collections containing potentially damaging insects was 81% compared with 60% in 1981. Four insect and three disease collections were collected for research programs at PFRC.

Major pest problems in the Region were surveyed and coastal areas sampled by fixed wing aircraft using 45 hours flying time, of which 38 hours were provided by the B.C. Ministry of Forests. Most areas of beetle killed stands were surveyed by CFS-FIDS (Map 1), except for the Lakes TSA, covered by BCMF District personnel.



Map 1

Area covered by aerial surveys and locations
where one or more forest insect and disease samples were collected, 1982

SPRUCE PESTS

Spruce beetle, *Dendroctonus rufipennis*

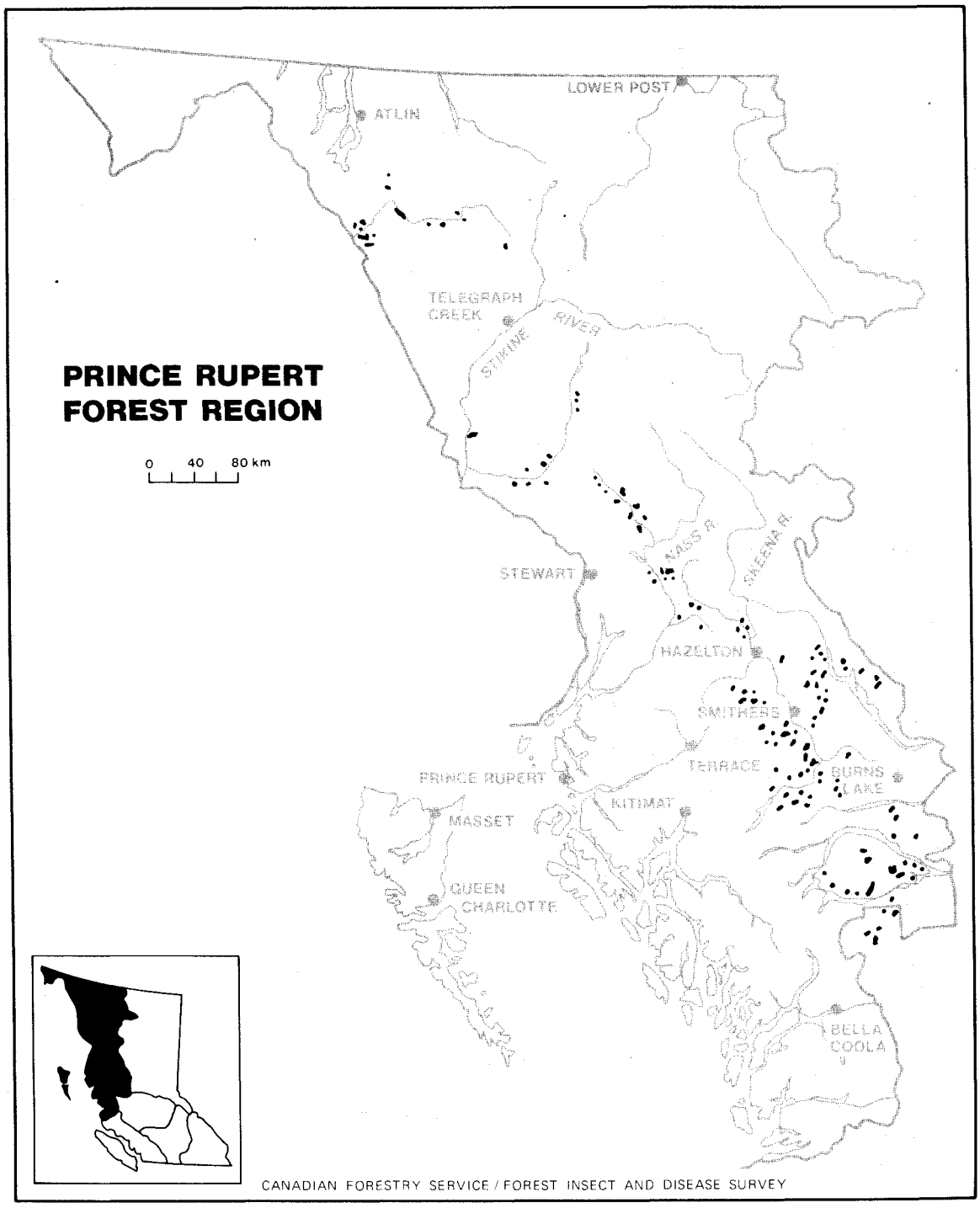
Spruce beetle killed an estimated 670,000 mature spruce on 24 000 ha in the Region in 1980 and 1981 as determined by aerial surveys in 1982, compared to only 81,000 trees on 6 200 ha in 1981. Increased beetle flights in 1981 expanded the main infestation areas, and numerous small scattered areas of 1-2 trees per hectare increased in size tenfold. Infestations in the Cassiar Timber Supply Area are also included in 1982 for the first time in the Prince Rupert report.

The Morice TSA contained 5 800 ha of beetle-killed spruce, more than double the 2 060 ha in 1981. The infestations in the Morice River-Poplar Lake (2 100 ha) and at Walcott (1 000 ha) increased significantly from a total of 1 900 ha in 1981. Further increases resulted from the increased number of 1980 and 1981 attacked trees discolored in the Guess Creek to the Fulton and Chapman lakes area (1 080 ha), where only scattered patches of 2-5 trees were noted in 1981.

TABLE 1. Area, number of trees and volume of spruce recently killed by spruce beetle in the Prince Rupert Forest Region in 1982.

Location (TSA)	Area (ha)	Number of trees	Volume (m^3)
Lakes	4 100	142,800	285 700
Morice	5 800	206,800	413 500
Bulkley	2 900	95,700	191 400
Kispiox	200	1,350	5 400
Kalum	4 900	61,250	245 000
Cassiar	3 200	75,850	303 400
Tweedsmuir Park	3 000	86,250	172 500
TOTAL	24 100	670,000	1 616 900

The 142,800 trees killed on 4 100 ha in the lakes TSA was a threefold increase in area, and a sixfold increase in the number of spruce trees killed over 1981. The infestation area increased in the Tetachuck-Chelaslie Lakes region where beetle killed spruce was recorded over 3 300 ha. The major areas of more recent beetle activity were over



Map 2

Spruce Beetle

Areas of recently killed spruce
as determined by aerial surveys, 1982

530 ha north of Francois Lake along the Morice TSA boundary within the Foxy, Allin and Ramsey creek drainages.

The area of spruce beetle killed timber increased threefold in the Kalum TSA where 61,000 mature spruce were killed over 4 900 ha. Major increases occurred along the Nass River near Vandyke (900 ha) and along the lower Bell-Irving River (3 900 ha) where numerous small infestations coalesced.

In the Bulkley TSA, where 96,000 trees were killed on 2 900 ha, small patches of previously killed spruce in the Goathorn (500 ha), Telkwa (250 ha) and McDonell Lake (500 ha) areas expanded eightfold to 1 250 ha.

Additional new infestation areas occurred over 700 ha in the Chapman Lake to Torkelsen Creek areas where only 1 to 3 attacked trees were recorded in 1981. Significant increases also occurred in the Kitsequecla Valley-Trout Creek (225 ha) in 1982 from 65 ha in 1981, Reicster Creek (55 ha) from 35 ha in 1981, and in the Nichyeskwa Creek (115 ha) from 20 ha in 1981.

Only a slight increase in area was recorded in the Kispiox TSA, where 1,347 trees were killed on 180 ha compared with 100 ha in 1981. The number of beetle-killed spruce continues in scattered patches of up to 15 ha along the Kispiox River from Murder Creek north to Swan Lake.

In the Cassiar TSA, 3 200 ha of recently killed spruce were mapped from aerial surveys, primarily in the Taku-Inklin river drainages south of Atlin, where 74,000 recently killed trees were recorded over 3 000 ha. In this drainage an estimated 55,000 trees over 900 ha had been killed prior to 1980. Localized infestations of 10 ha or less were also scattered along the Iskut and Stikine rivers.

Large populations continued within Tweedsmuir Provincial Park where an estimated 86,000 recently killed white spruce were recorded on 3 000 ha. The main infestation areas remain at Eutsuk Lake (2 000 ha) and at Sigutlat Lake (1 000 ha) and several small infestations of 30 ha or less were also noted in the Glatheli Lake area.

Logging of currently infested trees and the use of trap trees were implemented by the BCMF and industry in some locations in the Lakes, Morice and Bulkley TSA's, where access and logging exist and where losses could be reduced by these methods.

Information from nine prism plot cruised stands in September indicated a large 1982 flight occurred in the Region with an average of 33% of the spruce in the plots attacked in 1982. The incidence of 1982 attack was higher than the number of red trees in seven out of nine cruised stands, with an average 12% more currently attacked trees than red. The two stands where current attack was light were at Dunegate Creek (11%) and

Poplar Lake (14%). Both of these stands were located in extensively logged areas; the former in conjunction with a trap tree program.

The 1983 flight should be smaller than the 1982 flight in the lower elevation stands in the Lakes, Morice and Bulkley TSA's because 80% of the 1982 broods and half of the 1981 broods will attack in 1984. However, the 1983 beetle flight will increase above 1 200 m elevation because the 1981 brood developed primarily in a normal two year cycle. In the Kispiox River drainage, 50 to 60% of the 1982 brood are in a one year cycle, which indicates a rapidly increasing population and damage potential in 1983 in this area. Only 15% of the brood in the Bell-Irving River drainage is developing in a one year cycle and a reduced flight can be expected in 1983.

TABLE 2. Status of spruce stands infested by spruce beetle in the Prince Rupert Forest Region in 1982.

Location	Percent stems attacked					
	1982	1982 partial	1982 pitchout	1981	Prior to 1981	Healthy
Pimpernal Cr.	31	2	6	22	10	29
Poplar L.	14	5	2	25	11	43
Walcott	57	0	2	23	7	11
Dunegate Cr.	11	3	0	24	6	56
Guess Cr.	44	8	0	20	2	26
Goathorn Cr.	29	4	10	23	7	27
Chapman L.	37	4	2	32	4	21
Kispiox R.	28	0	3	9	6	53
Spruce Cr.	45	3	7	13	16	16

The current status of spruce beetle in stands along the Haines Road is described in "Special Report - Spruce Beetle, Haines Road, 1982" Appendix IV.

Spruce budworm, Choristoneura spp.

Spruce budworm lightly defoliated 89 000 ha of spruce-balsam stands in 1982, compared with 39 000 ha in 1981. The areas of defoliation expanded from where defoliation occurred in 1981. The infestation area in the Meziaden Lake-Bell-Irving River valley drainage doubled in area to 63 300 ha from the 34 570 ha in 1981, most of which occurred in the Bowser and Meziadin lake areas, where 25 000 ha were lightly defoliated compared to 700 ha in 1981. Although there was a slight increase in area (4 000 ha) of defoliation from Van Dyke to Bell-Irving River in TFL 1, the damage intensity decreased to only 2 000 ha of moderate defoliation at White River.

Defoliation in the Kispiox River drainage increased dramatically to 14 000 ha from 350 ha in 1981. Most of the defoliation was light from Elizabeth Lake north to Stephens Lake, with moderate defoliation on 2 500 ha in the Nangeese River and Clifford Creek areas.

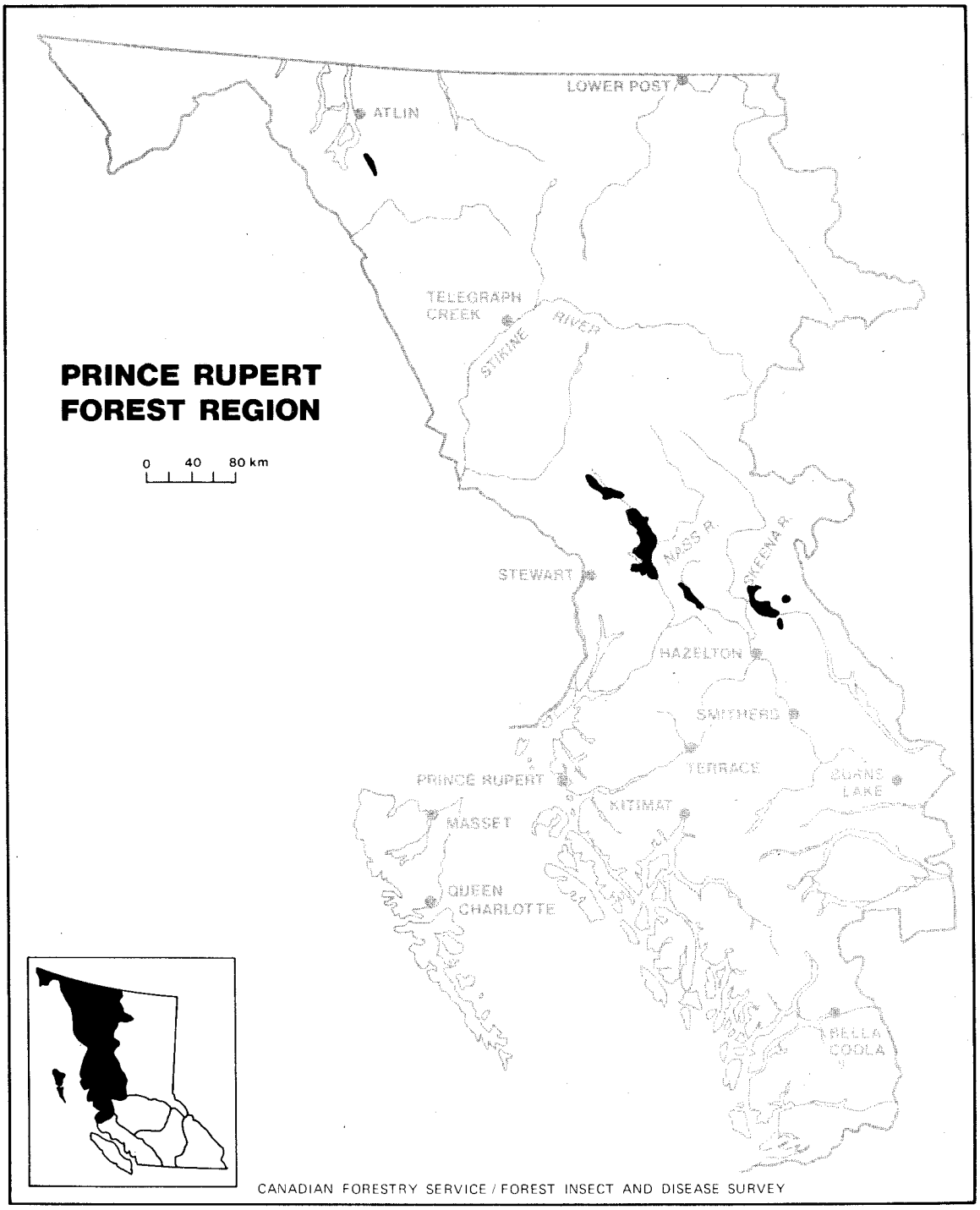
In the Babine River drainage the infestation expanded to 11 000 ha, from 4 060 ha in 1981, the most significant expansion was eastward into Shelagyote River and north up Shedin Creek. Moderate defoliation was confined to a narrow strip of 2 800 ha along the Babine River between Kisgegas and Thomlinson Creek. An isolated 700 ha infestation was also recorded along the Sloko River, 60 km south of Atlin.

The identification of the species of budworm remains uncertain due to the uncharacteristic development, which differs from the normal development of the two identified species, C. fumiferana and C. biennis, of the region. Reared larvae indicate that it is a one year cycle spruce budworm, which precludes it being C. biennis which it has been previously identified as.

A binocular assessment of damage to alpine fir (alF) and white spruce (wS) was completed in a strip in the Nass River area, where the population collapsed in 1982, following moderate defoliation of the alF, wS, and western hemlock (wH) in 1981 and 1980. Results indicated that significant bud mortality (range 24-63%) and top kill occurred (range 84-100%) in all the 50 overstory trees examined (Table 3).

TABLE 3. Percent of bud mortality caused by spruce budworm; Nass River infestation, Prince Rupert Region, 1982.

Host	Understory Crown levels			Overstory Crown levels			Percent trees topkilled
	Upper	Mid	Lower	Upper	Mid	Lower	
alpine/amabilis fir	79	67	65	72	60	58	84
Sitka/white spruce	-	-	-	50	40	40	87
western hemlock	36	14	6	55	12	5	100



Map 3

Spruce Budworm

Areas of defoliated spruce-alpine fir stand
as determined by aerial surveys, 1982

The high incidence of bud mortality of the three tree species will greatly affect radial increment in most trees. In addition, top-kill averaged close to 2 m on both spruce and balsam overstory and 3 m on western hemlock, which normally is not a desired host of Choristoneura spp.

Bud mortality was also assessed on 50 cm mid crown branches collected during egg sampling at five locations in active budworm infestations (Table 4). Bud mortality ranged from 54% on balsam at Spruce Creek, with one year of defoliation, to 95% at Mitten Lake with three consecutive years of light to severe defoliation of the current year's foliage, and areas with two years defoliation averaged 68% of the balsam buds killed; however, mortality of spruce buds was less than 50% at all sites.

A parasitic fungus, Beauveria bassiana, was present on larvae on 50 cm branches from trees from which egg samples were taken at four of five locations (Table 4). The highest incidence of infection occurred in the Meziadin Lake-Bell-Irving River infestation where at two locations 90 and 60% of the trees had diseased larvae on collected branch samples; similar infection levels also occurred at Mitten Lake in the Kispiox River infestation. The incidence of this pathogen was more widespread in 1982 compared with 1981, however it does not appear to have reduced the overall budworm population levels as indicated by high egg counts; but small pockets of budworm populations may be greatly reduced by the pathogen as they appear to have been in 1981.

TABLE 4. Percent bud and larval mortality, and defoliation predictions[1/] in spruce budworm infestations, Prince Rupert Forest Region, 1982.

Location	Percent bud mortality		Percent trees with Beauveria infected larvae	Egg masses per $10\ m^2$	Avg. (mm) length	Predicted Defoliation
	balsam	spruce				
Mitten L.	95	49	60	720	2.3	severe
Footsore L.	69	30	0	786	8.5	severe
Kisgegas	74	37	10	743	6.1	severe
Spruce C.	54	0	90	120	7.8	moderate
Hanna C.	62	5	60	240	8.1	severe

[1/] Based on levels used in predicting western budworm defoliation.

light = 1 - 50 egg masses per $10\ m^2$
moderate = 51 - 150 egg masses per $10\ m^2$
severe = 151+ egg masses per $10\ m^2$

Larval sampling indicated an increasing population in the Hazelton to Cedarvale area where 78% of the three tree beatings contained an average of 4 larvae compared to 25% of the collections which averaged 1 larva in 1981.

Pheromone traps, used as a detection tool in areas of low larval populations, attracted relatively low levels of male moths at four of five locations (Table 5). At Nilkitkwa Lake slightly higher catches (10 moths in the .001 concentration) have occurred annually without corresponding larval increases. Comparatively, in the Kispiox River area an average of 56 moths per trap were attracted into the .001 concentration traps just prior to the current infestation.

TABLE 5. Average number of male moths caught in pheromone baited traps. Prince Rupert Forest Region. 1982.

Location	Pheromone concentration by percent		
	.001	.01	.1
Morice R.	0	1	3
Augier L.	0	1	6
Nilkitkwa L.	10	47	52
Telkwa R.	0	2	7
Doris L.	1	7	28

Egg mass surveys utilizing two 50 cm branch samples from each of ten trees were used at five locations within currently defoliated areas (Table 4). The number of egg masses indicate that severe defoliation should occur in 1983 at Hanna Creek, Kisgegas, Footsore Lake, and Mitten Lake; only the sample from Spruce Creek indicated moderated defoliation.

Egg mass lengths have been suggested as an indicator of population vitality; egg masses at Kisgegas (6.1 mm) and at Mitten Lake (7.3 mm) were shorter than the average of 7.6 mm from all areas, with the longest (8.5 mm) recorded at Footsore Lake, which may indicate more vigorous populations at Footsore Lake, Hanna Creek and Spruce Creek, than at Mitten Lake and Kisgegas.

Black army cutworm, Actebia fennica

Black army cutworm severely defoliated white spruce seedlings and herbaceous ground cover in three areas in the Region. At Guess Creek in the Fulton River drainage up to 90% of the spruce seedlings were completely defoliated in a 10 ha plantation with some additional feeding of stems and buds; all of the herbaceous growth was destroyed. In two 5-10 ha areas at Cross Creek and in the Natlin River valley, feeding was confined to herbaceous growth. All three areas had been slash burned in the fall of 1980 with adults attracted to the area in the spring of 1981.

Pupal counts from 1 000 cm^2 duff samples indicate a continuing problem for 1983. The number of pupae ranged from 5 pupae at Natlin Creek, 8 at Guess Creek and 25 at Cross Creek; only 10-20% of parasitism or disease was evident. Further indication of population persistance was evident by the number of moths caught in attractant baited sticky traps (Table 6).

TABLE 6. Number of black army cutworm adults caught in attractant baited traps.[1/] Prince Rupert Forest Region, 1982.

Location	Number of moths Average	Range	Number of traps
Guess Creek	26	22-34	4
Bristol Lake (CP 081)	30	5-52*	3
North of Chapman Lake (CP 4)	34	-	1

*The trap with only 5 moths was placed near the base of a burned slope.

[1/] The attractant used was 100 ul of CIS-7-dodecenyl acetate per poly cap.

Successful trapping of black army cutworm has proven difficult in previous attempts and consistent catches of this size are uncommon. Baited traps were placed on ridges in areas which were burned during the fall of 1981, and where planting is expected to commence in the spring of 1983. Portions of these burns planted in 1982 are still susceptible to damage in 1983 and should be surveyed in 1983.

This is the third record of seedling mortality caused by black army cutworm in the Prince Rupert Region. The first infestation recorded was in 1964 in the Houston and Southbank areas, and the second in 1973 when 30-100% of the seedlings were killed on 80-150 ha cutblocks in the Morice and Bulkley TSA's.

Cone and seed pests

Cone and seed pests destroyed a smaller percentage of white spruce cones in seven areas examined in 1982, than in 1981 (Table 7). The two

major seed destroying insects in 100 cone samples were a seedworm, Hylema anthracina, and a cone moth, Cydia youngana, which declined by 50% and 75% respectively compared with 1981. In six of the seven locations, 50% or less of the cones were infested.

The inland spruce cone rust, Chrysomyxa pirolata, was present at a significant level only at Pinkut Lake where 26% of the cones were infected. No infection was found at five of the seven areas, a decline compared to an average of seven percent of the cones infected at all areas in 1981. During the spring, 50% of the alternate host Pyrola sp. were infected in portions of the Kispiox River area, however, the cone production was negligible.

Low percentages of pest damage combined with an increased white spruce cone crop at elevations above 700 metres provided collectable cone crops in a number of areas in the interior of the region. Very few Sitka spruce cones were present in the coastal portions.

TABLE 7. Percent of white spruce cones infested by major pests. Prince Rupert Forest Region, 1982.

Location	Elevation	Hylema sp.	Cydia sp.	Rust	Crop Size
Smithers Ldg.	870	35 (45)[1/]	5 (90)	0 (2)	M
Skins L.	870	55 (85)	15 (25)	0 (2)	M
Pinkut L.	870	50 (100)	25 (25)	26 (3)	M
Erickson L.	900	20 (100)	10 (0)	0 (1)	M
Morice R.	630	10 (55)	10 (30)	0 (12)	L
Telkwa R.	660	5 (30)	5 (70)	0 (13)	M
Aldrich L.	900	45 (15)	5 (65)	5 (15)	M
AVERAGE		31 (61)	11 (44)	4 (7)	

[1/] 1981 percentages in brackets.

Spruce weevil, Pissodes strobi

An average of 16% of the Sitka spruce leaders examined in seven plantations in the Prince Rupert-Terrace-Kitimat area were killed by spruce weevil in 1982 (Table 8). Current attack was over 12% on six of the seven sites with the severest (24%) at Sterling Creek north of Terrace. The Andesite Creek plantation, previously examined in 1981, indicated a reduced level of current attack, of 18% from 27% in 1981. In the Nusatsum

River Valley near Bella Coola, 40% of the roadside Sitka spruce had currently attacked leaders. A major terminal clipping was planned for the Terrace-Kitimat area by B.C. Timber to reduce losses.

In the interior transitional zone of the region, at Natlin Creek, current attack doubled from 2% in 1981 to 4% in 1982, following a 1981 brush control project.

TABLE 8. Incidence of current spruce weevil attack in Sitka spruce plantations. Prince Rupert Forest Region, 1982.

Location	Stand Age	Number of trees Examined	Percent of 1982 attack
Mt. Layton	7	100	3
Zymagahty R.	15	100	12
Sockeye Cr.	12	100	12
Chindemash Cr.	25	100	18
Andesite Cr.	15	100	18
Nalbeelah Cr.	15	100	22
Sterling Cr.	10	100	24
		AVERAGE	16

Spruce aphid, Elatobium abietinum

Spruce aphid feeding of Sitka spruce along coastal portions of the Region subsided to trace levels, following five successive years of defoliation. The aphid populations appear to have been affected by the severe 1981-82 winter climatic conditions.

A cruise strip in a severely defoliated stand near Miller Creek indicated that 22% tree mortality had resulted due to five successive years of aphid feeding. The mortality ranged from 48% of the trees less than 30 cm dbh to 7% of the trees over 51 cm dbh (Table 9).

TABLE 9. Mortality of Sitka spruce caused by spruce aphid. Queen Charlotte Islands, Prince Rupert Forest Region. 1982.

Tree diameter breast height	Total number of trees	Percent dead	Percent severely defoliated [1/]
< 30 cm	27	48	0
31-50 cm	81	27	17
51 + cm	72	7	67

[1/] Three or more years of twig dieback over entire tree.

The survey showed that although the larger trees were the most severely defoliated, the severest mortality occurred in the smaller trees, which suggests that the larger trees are more able to withstand continuous defoliation for a longer time period, and also have a prolonged dying process due to more reserve tissue to draw upon than smaller trees. It is estimated that at least 25% of the severely defoliated trees will die during the next few years, regardless of whether there is further aphid feeding or not.

Root and butt rots

Root and butt rots, such as Polyporus tomentosus and P. sulphureus, are a compounding and often unnoticed problem causing tree mortality, reduced growth, log quality, and stand value in spruce stands in the Region. In the Kispiox River Valley, P. tomentosus infected 12% of the mature trees in a 1 000 m long strip, with infection centers, containing infected blowdown, ranging from 2 trees to 2 ha openings. At Dunegate Creek, near Houston, groups of 3 to 10 infected trees occurred at an average of 100 metre intervals along a 500 m strip. The brown cubical rot, P. sulphureus, was evidenced in scattered windthrown trees broken at the butt throughout the Kispiox River Valley.

There is strong evidence that root and butt diseases in mature and overmature stands predispose trees to attack by spruce beetle and contribute to the initial rapid expansion of beetle populations. Further problems are encountered when severely infected old stands are logged and replanted to the same or other susceptible species, thereby encouraging ever enlarging root rot centres.

Snow damage

Near record snowfall and snowslides combined with ice storms during the 1981-82 winter resulted in extensive breakage of tree tops and branches of both coniferous and deciduous trees for 100 km along the

Terrace-Prince Rupert Highway. The severest damage was to young regeneration, with up to 100% of the Sitka spruce, under two metres, having broken tops at a Andesite Creek plantation. Young plantations at Zymagotitz and Exchamsiks rivers had broken tops on 16 and 11% of the trees, respectively; of the three species, Sitka spruce, Amabilis fir and western hemlock, the latter had the least damage. In natural multi-aged stands, top breakage was most numerous on western red cedar and cottonwood. In addition to direct stem breakage, damaged trees are predisposed to invasion by pathogens through scars and wounds.

Salt Damage

Salt spray, which resulted from high winds during the 1981-82 winter, severely discolored shoreline Sitka spruce and alder between Skidegate and Tlell on the Queen Charlotte Islands.

Repeated exposure to spray has led to excessive salt absorption, resulting in up to 20% twig mortality of young spruce within 100 metres of the beach; less damage was evident up to 400 metres inland.

Red Belt

Light foliage discoloration caused by winter drying (red belt) was scattered along the eastern slopes of the coastal range in the Nass and Skeena river areas. The most notable discoloration was confined largely to the 1981 foliage of Sitka spruce and lodgepole pine between 400 and 800 metre elevation from Mt. Hoeft to Dragon Lake along the Nass River Valley. No bud damage was found and the discoloration faded with the growth of new foliage.

A spruce budmoth, Zeiraphera sp.

The spruce bud moths were the most common larvae collected in three tree beatings from spruce in the interior portion of the Region, however no defoliation was present. Of 23 collections during the larval period 14 (61%) contained an average of 4 larvae (range 1-14) which indicates a rising population from only one positive collection in 1981. This pest is less damaging to white spruce than to Sitka spruce, on which only occasional single larva were collected in 1982.

A seedling weevil, Steremnius carinatus

Damage by this pest in 1982 was confined to partial girdling of 4% of the Sitka spruce seedlings in two northern Moresby Island plantations where 20-50% mortality occurred in 1981. The weevil infestations recorded to date on the Queen Charlotte Islands indicate that epidemic levels have lasted for one to two years at approximately ten year intervals. Root

weevils are suspected vectors of a blackstain root disease Verticicladiella sp., however no evidence of the disease was found on the seedlings examined.

A spruce sawfly, Pikonema sp.

Spruce sawfly, a frequently collected defoliator of spruce, defoliated 5-20% of the 1982 foliage in a seven year old plantation near Skeena Crossing. Damage to open growing young spruce has occasionally become severe enough to cause tree mortality. However, 50% of the larvae in this population were diseased which should prevent a population buildup in 1983.

PINE PESTS

Mountain pine beetle, Dendroctonus ponderosae

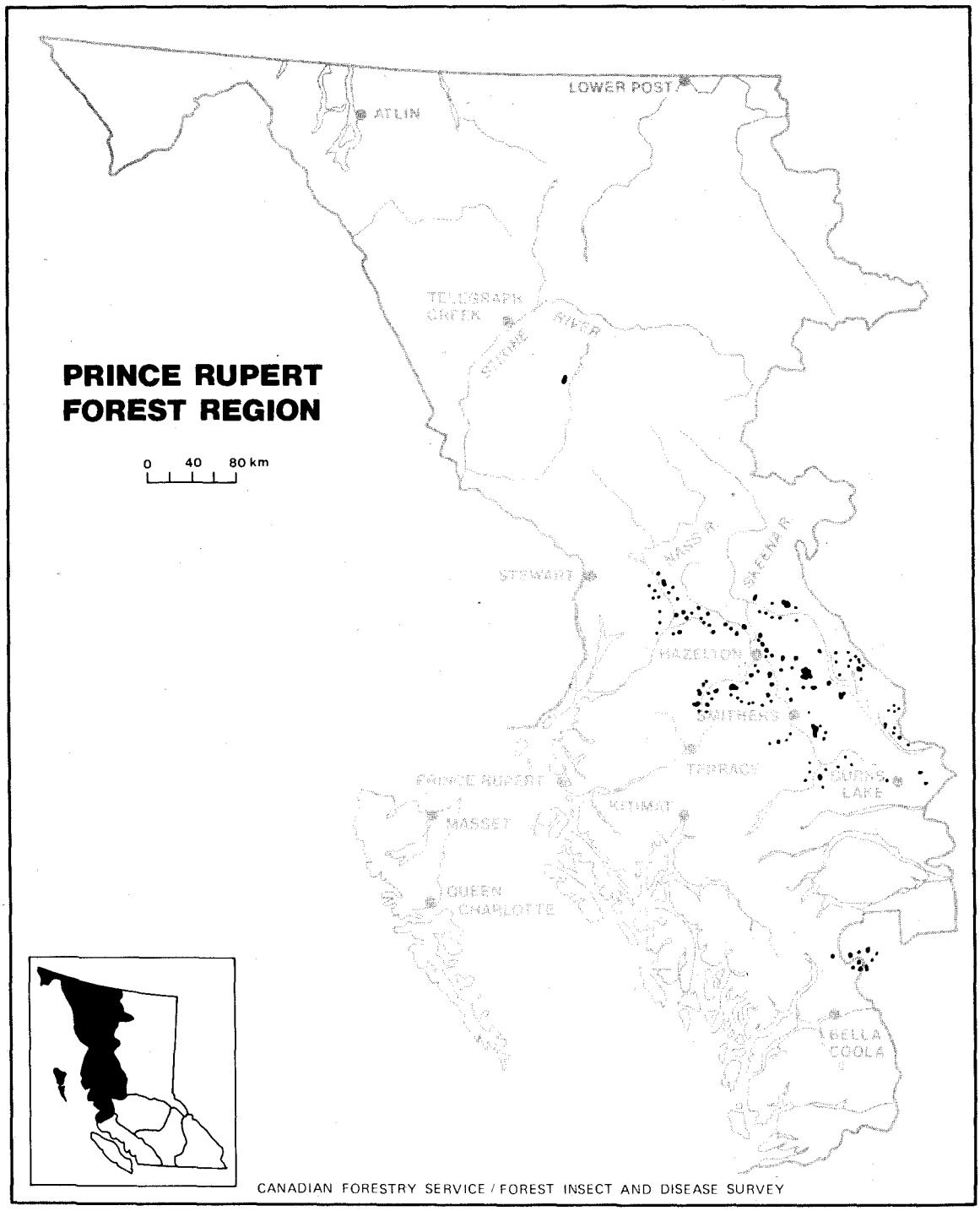
An estimated 314,000 recently killed lodgepole pine were mapped on over 6 200 ha in the Prince Rupert Region in 1982 compared to 190,000 trees on 5 700 ha in 1981 (Table 10).

The most expansive infestations are in the Kispiox TSA with 126,000 recently killed trees recorded on 2 200 ha, which represents a major increase in intensity of attack over the 44,000 trees recorded on 1 929 ha in 1981. The main infestation areas continued along the Skeena River (940 ha), Suskwa River (290 ha) and the Kispiox River (490 ha), with no new areas recorded. The mature pure pine stands are often isolated on ridges and separated by other tree species, and attacks have normally intensified within the stands before expanding into a new area.

The major infestation area in the Bulkley TSA, Harold Price Creek (1 610 ha) contained 75% of the infested area of 2 300 ha in the TSA. The infestation area within the valley has remained little changed compared to 1981, due to logging of beetle infested and killed stands, but spot infestations have increased east and southward towards Babine and Chapman lakes. Similar increases in the number of small localized infestations have occurred in the Telkwa-Goathorn rivers area (310 ha), Kitsequecla Lake (170 ha) and in scattered locations along the Bulkley Valley from Reiester Creek to Sharpe Creek (60 ha).

In TFL 1, within the Kalum TSA, the incidence of beetle attack intensified in the areas of mature pure pine along the Cranberry-Nass rivers and covered 765 ha which contained 52,600 recently killed trees, similar to 1981. The northern limits of the infestation remains in the pine flats just north of Van Dyke. However, further north, in the Cassiar TSA, along the Iskut River, south of Kanaskin Lake, a patch of 75 recently-killed lodgepole pine was also mapped, although no ground verification was made.

In the Morice and Lakes TSA's, 450 and 110 ha respectively contained



Map 4

Mountain Pine Beetle

Areas of recently killed lodgepole pine
as determined by aerial surveys, 1982

19,750 recently killed trees recorded during aerial surveys. The major infestation area continued in the Morrison Lake area (270 ha) with a scattering of small pockets of red trees expanding in widespread areas north and south of the Hearne Hill infestation. Increases were also noted in patches further south along the east side of Babine Lake, especially in the Fleming Creek area (50 ha); opposite Donald Landing (30 ha), near China Nose (50 ha), and in the Chapman-Fulton-Bristol lakes area (70 ha).

The Dean River infestation of 430 ha straddles the boundary between Tweedsmuir Provincial Park and the Mid Coast TSA, and expanded mainly in a westward direction along the Dean River to the Sakumtha River junction. Two thirds of the infestation is in the Mid Coast TSA. The Atnarko River Valley infestations, previously reported in the Prince Rupert Region Annual Report, is covered in the Cariboo Region in 1982.

TABLE 10. Area, number of trees and volume of lodgepole pine recently killed by mountain pine beetle. Prince Rupert Forest Region, 1982.

Location (TSA)	Area (ha)	Number of Trees	Volume (m^3)
Lakes	110	4,360	3 050
Morice	450	15,385	10 770
Bulkley	2 300	98,610	106 415
Kispiox	2 200	125,900	87 000
Kalum	765	52,580	36 810
Cassiar	3	75	45
Midcoast	265	10,600	7 420
Tweedsmuir Park (Dean R. only)	165	6,600	4 620
TOTALS	6 258	314,110	256 130

Cruise strips were run along the advancing edge of infestations at six locations to determine the degree of current attack (Table 11), the average of which was 35%, little changed from 1981 (38%), however, an area at Cedarvale increased to 40% from 2%. In the Nass-Cranberry rivers, Harold Price Creek and the Kispiox River infestations, current attack declined to 34% from 48% in 1981, as a result of some brood mortality in

the exposed portions of the tree boles during the 1981-82 winter.

TABLE 11. Status of lodgepole pine in stands infested by mountain pine beetle. Prince Rupert Forest Region, 1982.

Location	Percentage of stems attacked					
	1982	1982		1981	Prior to 1981	Healthy
		partial	pitchout			
Cranberry R.	34	4	0	13	8	41
Nass R.	33	0	4	21	10	32
Cedarvale	40	0	2	15	8	35
Kispiox R.	38	0	2	16	4	40
Suskwa R.	33	0	1	27	11	28
Harold Price Cr.	32	3	2	25	9	29

The cruise data indicates that the number of trees killed by the 1982 beetle attack was similar or slightly less than mortality from the 1981 attack (314,000 trees). Localized areas in the Kispiox, Skeena, Cranberry and Nass rivers should subside due to host depletion but more concentrated areas of attack will develop in nearby areas, presently only lightly attacked. In the Chapman Lake to the west side of Babine Lake, patch infestation areas increased in size and number during the past two climatically favourable summers, but despite this, the 1982 overwintering broods generally indicate a low brood productivity. The increase in the incidence of recently killed red trees in this area appears to be due to invasion by more productive broods from south and southwest facing slopes along Babine Lake and the Harold Price Creek infestations.

In broods examined in September, close to 70% of the 1982 attacks had only parent galleries with no eggs present, however, eggs will likely be produced in early 1983. This indicates that a portion of the beetle population has their life cycle shifted to a later attack, during mid to late August. As adults are less tolerant than larvae to climatic extremes, fewer productive broods could result if unseasonably cold temperatures persist during the fall or winter.

Western gall rust, Endocronartium harknessii

Western gall rust is one of the most prevalent canker diseases of young pine stands in the Region causing premature branch and stem mortality. Nine young stands examined in 1982 were infected by stem canker with an average incidence of infection of 14%, ranging from 2% in a 9 year old planation at McBride Lake to 44% in a naturally growing 25 year old stand near Co-op Lake. At the latter location in a nearby 25 year old plantation, only 15% of the trees were infected. In shore pine stands, where spore production conditions frequently are more favourable, stem infection averaged 16% at Iskhenish River, Diana and Oliver lakes, however, branch infection was present on over 60% of the trees in all areas. Since annual degrees of infection are often influenced by climatic conditions during aeciospores production and dispersal in the spring and early summer, infection intensities often vary with years and areas.

Aeciospore production can be effectively reduced by a pathogen, Fusarium eateritium, which was present on 20% of the galls collected from shore pine stands at Diana and Oliver lakes near Prince Rupert. This was the first record of the fungus in British Columbia, however further collections have since been made and distribution may be more widespread than currently recognized.

Pine needle miner, Coleotechnites sp.

Light defoliation of current needles of lodgepole pine by this pest persisted on 500 ha between Km 16 and Km 26 of the Topley Landing Highway. Defoliation of current foliage was limited to 40% in the upper crown of the immature lodgepole pine; the middle and lower crown showed only minimal feeding. Elsewhere in the interior trace feeding was recorded on occasional trees from Pine Creek to Ootsa Lake.

Previously defoliated trees were examined in the Topley Landing and Ootsa Lake areas to determine the effect of 3 years consecutive defoliation (Table 12). Both stands are approximately 35 years old and were damaged by a combination of pine needle sheath miner, Zelleria haimbachi and Coleotechnites spp. feeding for two to three years. Defoliation, which often destroys 100% of the terminal foliage each year, results in the reduction of the new year's terminal growth, after two consecutive years of defoliation no growth occurs and after three consecutive years of feeding multi-leaders develop and up to 75% of the tree's top whorl were killed.

Average height loss was calculated by subtracting the actual height attained during the last three years from the potential growth as determined by averaging the growth of the three years prior to defoliation.

TABLE 12. Effects on lodgepole pine of consecutive years of sheath miner feeding. Prince Rupert Forest Region, 1982.

Years of Feeding	Percent of Trees with dead terminals	Percent of Trees with multi-leaders	Percent of Trees with top whorl mortality	Average height loss
1	0	20	0	6.5 cm
2	56	89	22	20.75 cm
3	100	100	75	45.0 cm

With only two consecutive years feeding in young stands the accumulated impact can often affect log value, not only by the formation of crooks, or multi leaders, but also through the rots, such as Fomes pini, which causes extensive heart rot.

Atropellis cankers, Atropellis pinicola, Atropellis piniphila

Atropellis pinicola, a perennial branch canker of western pines, caused flagging on 15% of the shore pine on 40 ha of boggy sites near Mayer Lake in Naikoon Provincial Park north of the Park Headquarters. Infection and subsequent branch mortality is often confined to branches of trees on poor sites or suppressed lower branches of larger healthy trees.

A more damaging stem canker, Atropellis piniphila, is often more severe in close growing natural stands than more open growing plantations. In a 25 year old lodgepole pine plantation near Co-op Lake 8% of the stems were infected compared to 16% in an adjacent similarly aged natural stand.

In recently spaced 35 year old stands, A. piniphila infected 3% of the trees north of Topley and 10% near the west end of Francois Lake. Candidate stands for spacing need to be critically examined for disease incidence to ensure that an acceptable level of spacing can be maintained. with the removal of diseased trees.

Pine engraver beetle, Ips pini

The number of lodgepole pine killed by this beetle continued to decline in the Francois Lake-Nadina main area, where individual and groups of up to five trees have been killed during the past two years. The two

dry summers predisposed mature lodgepole pine trees to attack by Ips pini and to a lesser degree by the lodgepole pine beetle, Dendroctonus murrayanae. Neither of these species are particularly aggressive and normally confine their attacks to stressed and weakened trees in the Region.

Warrens collar weevil, Hylobius warrenii

This weevil killed up to 10% of newly planted lodgepole pines in three of eight 10 year old pine plantations, at Suskwa River, 2%; McBride Lake, 8%; and at Lamprey Creek, 10%; an increase from an average of 2% in 1981.

Populations build up in loose sandy soils before spreading into the less favourable sites. Trees up to 20 years old are most susceptible especially in open growing stands where accumulated mortality can be significant. As closed canopies reduce weevil activity and damage, denser stocking should be considered where high hazards exist.

Lodgepole terminal weevil, Pissodes terminalis

Lodgepole pine terminal weevil damaged up to 40% of the trees in four of eight young stands in the interior of the Region. Current terminal mortality ranged from 2% to 7% at Suskwa River, Luno and Lamprey creeks and along the Tahtsa Lake Road. The weevil is most destructive in stands between two to eight metres. When infestations remain unchecked in young slower growing stands, accumulated terminal mortality can often reach 30-40%; which is evident in various aged stands along the Tahtsa Lake Road.

Western pine-aster rust, Coleosporium asterum

Up to 15% of the year old needles on the lower branches of 100% of the young pine trees over 100 ha near Cedarvale were infected by this rust, the only naturally occurring rust which infects the previous year's foliage of pines. Infected needles can continue to produce rust spores for up to three years, however, infection of the alternate host, Asters and goldenrod, is necessary prior to further infection of pine.

BALSAM PESTS

Balsam bark beetle, Dryocoetes confusus

Balsam bark beetle killed an estimated 52,000 overmature alpine fir trees over 17 700 ha, as observed aerially in the Prince Rupert Region in 1982 (Table 13). This was an increase over the 20,000 trees mapped on 2 450 ha in 1981, and is due to an increased incidence of beetle attack and to more extensive mapping of beetle-killed stands. Half of this area of 8 400 ha occurred in the Bulkley TSA, with an estimated 34,000 trees killed. Extensive areas were also mapped immediately to the south in the Morice TSA Supply Block C, with an estimated 5,000 trees killed on 2 500 ha.

TABLE 13. Area and volume of balsam bark beetle infestations by TSA as determined from aerial surveys. Prince Rupert Region, 1982.

Location (TSA)	Area (ha)	Volume loss (m^3)
Cassiar	2 400	5 600
Kalum	1 500	3 700
Kispiox	400	800
Bulkley	8 600	40 900
Morice	3 800	9 200
Tweedsmuir[1/]	1 000	2 400
TOTAL	17 700	62 600m^3

[1/] Only northern part of park.

A sawyer beetle - Monochamus sp.

The woodborers attacked 80-90% of the estimated 2 000 amabilis-fir logs at Erlandsen and Mayo Creeks north of Terrace, which had been left undecked, following falling and bucking in the winter of 1981. Since woodborers prefer open sun-exposed log surfaces, this provided an ideal situation for high intensity of attack on individual logs. Incidence of attack could have been reduced by tightly decking logs in shaded areas. Larvae were primarily feeding in the inner bark and outer sapwood by late 1982 and only immediate utilization of the logs can prevent significant boring hole damage and introduction of wood staining and decay fungi.

A fir-spruce budworm, Choristoneura orae

Twenty-five percent of the upper crown of immature amabilis-fir was defoliated by this budworm over 15 ha near Onion Lake in the Kitimat River valley. Similar levels of defoliation were recorded in the same area in 1980 but none in 1981. In 1982 larval populations increased to an average of 11 per sample from the 45% positive three tree beating samples of amabilis-fir and spruce in the Kitimat Valley area compared to only four larvae from one positive sample in 1981.

Pheromone baited traps at two locations in the Kitimat valley continued to be tested under field conditions and attracted male moths at levels similar to 1981. Traps were located near Prince Rupert and Bella Coola to determine the distribution of budworm populations and attracted less than 10 adults per trap which is non-significant.

Blackheaded budworm, Acleris gloverana

In the interior of the Region an average of 23 larvae were collected in the 65% positive three tree beating samples, compared to only 5 larvae in 35% of the samples in 1981. Populations at Byman Creek near Houston (190 larvae) and along the West Morice FDR (95 larvae) caused trace to light defoliation of the current year's foliage on spruce and alpine fir on 150 ha at each location for the third consecutive year.

HEMLOCK PESTS

Dwarf mistletoe, Arceuthobium tsugense

Hemlock dwarf mistletoe is a forest pest which plagues most of the natural regeneration stands in the coastal areas of the Region. Extensive losses can result, however, proper control methods implemented during harvesting program can greatly reduce the incidence of infection. In young stands where infected overstory residuals remain from previous harvesting, removal is mandatory if mistletoe control is to be achieved. In a 20 year old recently spaced stand along the Yakoun River on Graham Island in the Queen Charlotte Islands scattered infected residuals remained after logging and are continuing to be a source of infection for approximately 50% of the regeneration.

Root and Butt Rots, Fomes annosus and Armillaria mellea

The root and butt rot, Fomes annosus, is present in most mature coastal western hemlock stands, but is most damaging in pure stands. Tree mortality is usually limited to trees 15 years or younger, however extensive

butt rot weakens the lower boles of mature trees, and frequently results in blowdown and stand openings. Openings of up to 0.1 ha occurred in hemlock stands at Burdick Creek, west of Hazelton, and an estimated 10% of the hemlock had been windthrown. At Hoeft Mountain smaller infection centers had coalesced into areas encompassing 3 to 4 ha.

The root rot, Armillaria mellea, was isolated from chlorotic western hemlock in a stand near the Skeena and Babine rivers junction where root rot symptoms were evident on 14% of the trees.

Heart Rots, Fomes pini and Echinodontium tinctorium

Two of the most common and destructive heart rots in British Columbia are Fomes pini and Echinodontium tinctorium. Infection intensities of several hemlock stands in the Kispiox TSA were assessed and E. tinctorium ranged from 30% to 70%, with Kludo Creek at 35%, Kisgegas 70%, Suskwa River 30%; Fomes pini infection was 35% at Kludo Creek, 18% at Suskwa River, and a single stand at Kisgegas was free from infection.

Red belt

Winter drying resulted in severe foliage discoloration of mature western hemlock and western red cedar on almost 1 000 ha between 500 - 700 m elevation near Legate Creek.

Hemlock sawfly, Neodiprion sp.

An average of 65 hemlock sawfly larvae were collected in 30% of the beatings in 1982 compared to less than 1% in 1981. The greatest numbers were in stands from the Suskwa River to the Kispiox River area, where an average of 219 larvae per sample were collected. Light feeding of understory and lower branches of overstory trees was noted on 10 to 20 ha patches at elevations above 500 metres in the Suskwa River and Luno Creek areas. Since larval feeding is primarily on old needles, initial defoliation is less obvious. Growth loss is the major impact from successive years of moderate and severe defoliation and tree mortality can result from successive years of severe defoliation or when feeding is in combination with defoliators of the current foliage; most commonly blackheaded budworm. Insect parasites normally keep sawfly populations under control.

Green striped forest looper, Melanolophia imitata

The average number of larvae per positive three tree beating sample in hemlock stands on the Queen Charlotte Islands increased to 38 from 4 in 1981. The highest number of larvae (97) was from Geike Creek, west of Tlell; however, no defoliation was evident. In 1963 only 180 larvae were collected at this location and a severe outbreak developed over a 14 000 ha stand in which up to 38% of the trees were killed.

CEDAR PESTS

The redwood bark beetle, Phloeosinus sequoiae

This bark beetle, which normally confines its attack to weakened and stressed cedar, attacked a pocket of 25-30 western red cedar trees growing on a poor site near Phantom Creek on Graham Island. Five trees were killed from the 1981 attack and further light mortality can be expected from the 1982 attack.

DECIDUOUS TREE PESTS

Poplar shoot blight, Venturia macularis

Poplar shoot blight infected both trembling aspen and black cottonwood at trace to light levels throughout most of the Region in 1982, but with localized severe pockets of infection. Five hundred ha between Km 10 and 20 along the Morice River were severely infected with scattered patches of moderately infected stands extending to Owen Lake and in scattered clones between Houston and Topley.

Tent caterpillars, Malacosoma spp.

Light defoliation of willow and alder by tent caterpillars was common in the Meziadin Lake area between Strohn Creek and the Nass River Crossing. Along Hanna Creek, where up to 40% defoliation occurred on the deciduous hosts, light defoliation of the current year's needles of Sitka spruce was also present. Egg mass surveys indicate that forest tent caterpillar defoliation will continue in 1983.

Leaf beetles, Chrysomelidae

Leaf beetles moderately to severely defoliated black cottonwood and willow in the Bear River Valley from Sueur Creek to Stewart. Defoliation of 80% of the trees in the area ranged from 10% of the lower branches of mature trees to 90% of the foliage on young and understory trees. Defoliation was also noted on alder and willow at numerous locations along Highway 16 between Terrace and Prince Rupert where the most intensive feeding resulted in total defoliation of 15% of the young alder over 10 ha at Andesite Creek.

TABLE 14. Pests which caused minor damage. Prince Rupert Forest Region, 1982.

Host	Pest	Location	Remarks
Spruce	animal damage	Alliford Bay (plantation)	Feeding on 22% of seedlings
	frost damage	Sweetin River (plantation)	18% terminal mortality
	Pineus spp.	Pine Creek (plantation)	80% of shrubs affected on 20% of trees
Pine	Cronartium coleosporiodes	McBride L. (plantation)	2% of trees with stem cankers
	C. commandrae	McBride L. (plantation)	2% tree mortality
	C. comptoniae	Cedarvale (natural)	4% of trees with cankers
	C. ribicola	Sweeney L. (natural)	Flagging prominent scattered tree mortality
	Rodent damage	Francois L. (spaced)	2% tree mortality due to squirrel chewing around stem cankers
		Mayer L. (natural)	8% of trees with top and branch chewing by squirrels
		Sweeney L. (natural)	Scattered porcupine mortality
		Kitsumkalum Lk. Pk. (natural)	17% of 30 yr. old pine killed by porcupine

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TABLE 14. ...continued

Host	Pest	Location	Remarks
Pine	Snow damage	Kispiox R. (roadside)	15% terminal breakage on 2 to 6 metre trees
	Tipula sp.	Salmon R. Rd. (plantation)	Larvae present in planted stock
True Fir	*Lirula punctata*	McDonell C. (natural)	Patches of 2-3 trees with 80% of 3 year old needles infected
Hemlock	Rodent damage	Dasque Cr.	4% of trees killed by porcupine
	Woodborers	Kleanza Cr. Noble Five Rd.	40% of felled and bucked wH attacked by Cerambycidae + Buprestidae
Douglas-fir	*Contarinia pseudotsugae*	Young Cr.	50% of foliage on young D-fir infested
Deciduous	*Archips cerasivoranus*	Nelson R. (natural)	10% defoliation on 90% of willow
	Cryptorhynchus lapathi	Leanto Cr. Chindemash Cr., Onion Cr., Dosque Cr. (natural)	Scattered mortality of open growing willow

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