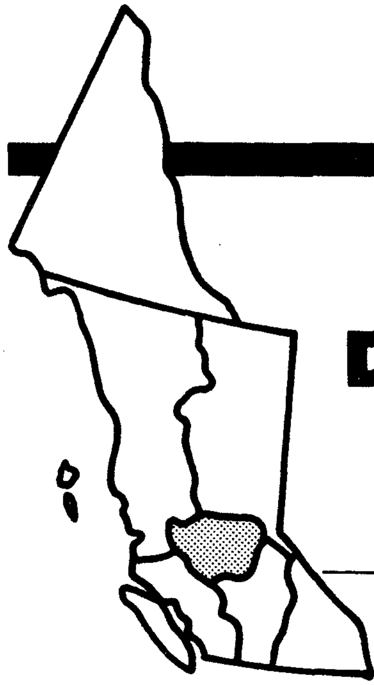
FIDS File Report 87-1



Forest Insect and Disease Conditions

Cariboo Forest Region 1986

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Government of Canada / Gouvernement du Canada
Canadian Forestry Service / Service canadien des forêts

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SUMMARY

This report outlines forest pest conditions in the Cariboo Forest Region in 1986 and attempts to forecast pest populations with emphasis on pests capable of sudden damaging outbreaks. Pests are listed by host in order of importance.

For the second consecutive year the area of lodgepole pine killed by the **mountain pine beetle** and **engraver beetle** decreased dramatically to 107 442 ha from 189 500 ha in 1985. The incidence of hyperparasites on **lodgepole pine dwarf mistletoe** was common in infected stands from Anahim to Tatla lakes. **Lodgepole pine weevils** infested fewer leaders of regeneration lodgepole pine in 1986 but continued for the second year to occur above the normal incidence. **Pinewood nematodes** were not found in 21 lodgepole pine stem and branch collections from throughout the Region in 1985; however, tentatively identified nematodes were found in wood chip collections from Quesnel in 1986.

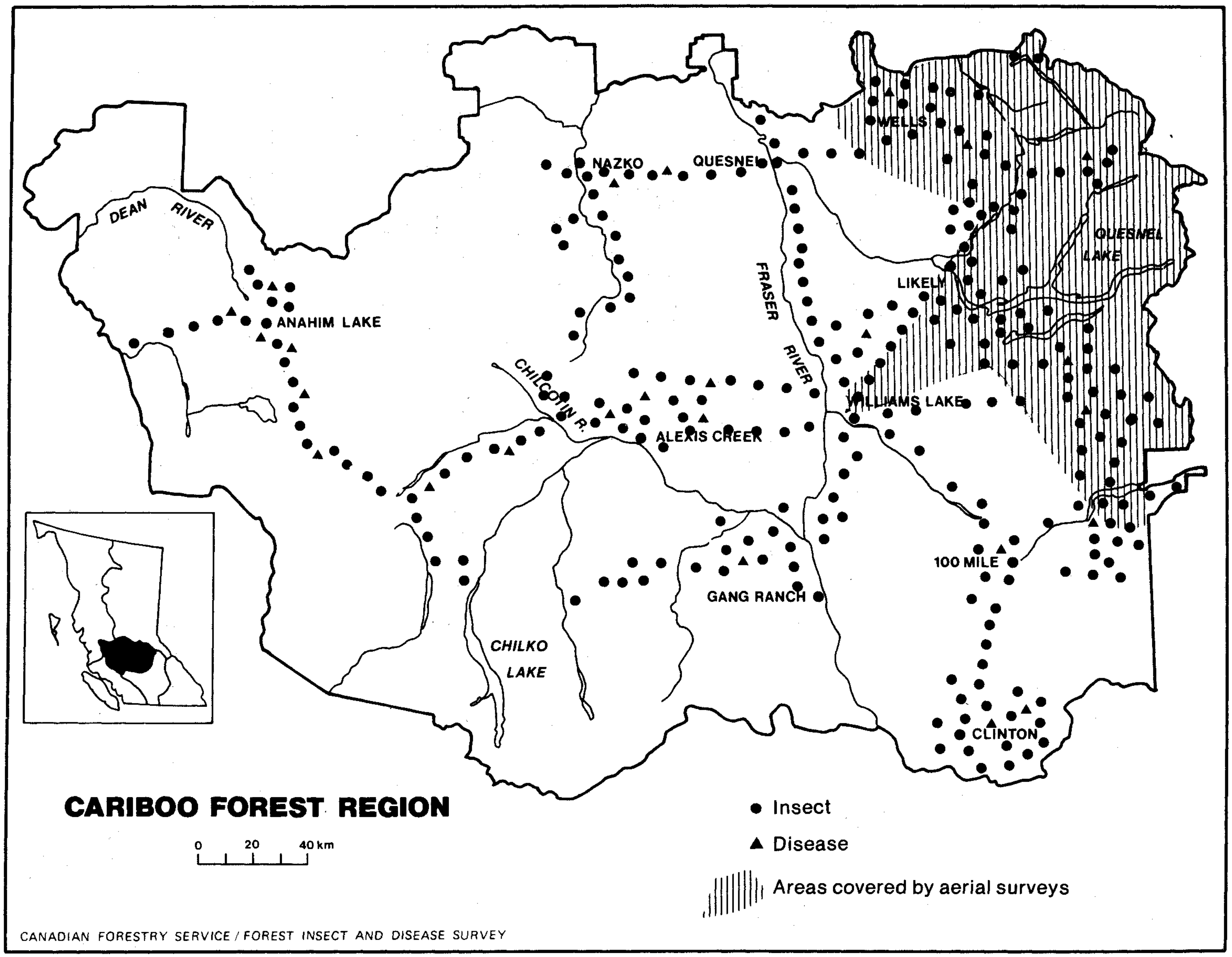
Mature Douglas-fir killed by **Douglas-fir beetle** were observed over 648 ha in 1986, down from 1 470 ha recorded in 1985. **Western spruce budworm** defoliation decreased dramatically to 182 ha in 1986 from 29 500 ha recorded in 1985, mainly due to abnormally low temperatures throughout the winter extending into May. Up to 32% of plantation Douglas-fir west of Quesnel Lake suffered from a **Douglas-fir dieback.** There was no recorded defoliation or incidence of **Douglas-fir tussock moth** in Douglas-fir collections in 1986.

A decreased incidence of white spruce trees killed by **spruce beetle** was noted over 290 ha in 1986, down from 2 160 ha in 1985. The second year larval stages of **two-year-cycle spruce budworm** caused defoliation over 21 000 ha in spruce-balsam stands in 1986, compared to 3 700 ha defoliated by immature larvae in 1985. **Spruce coneworm** caused light defoliation of Engelmann spruce branch tips over approximately four hectares near Bowers Lake.

Decreased populations of **black army cutworm** caused moderate to severe defoliation of ground cover plants but little damage to planted conifers in the upper Keithley Creek drainage. **Variegated cutworm** were found for the first time in epidemic numbers and caused severe defoliation of planted conifers near the north end of Quesnel Lake. A long term **ARNEWS research plot** was established in a semimature lodgepole pine-white spruce stand near Cottonwood to monitor possible environmental pollutants.

No male **gypsy moth** adults were caught in eighteen pheromone-baited sticky traps that were set out throughout provincial parks in the Region to monitor possible introduction of this serious defoliator.

The Forest Insect and Disease Survey field season extended from May 10 to August 4. Special surveys to appraise bark beetle and defoliator infestations were conducted from September 8 to October 4. A total of 200 insect and disease collections were submitted to the Pacific Forestry Centre by the Regional survey technician and personnel from the B.C. Forest Service. Locations where one or more insect and disease samples were taken are shown on Map 1. Fourteen hours of flying time funded by the B.C. Forest Service and Parks Branch were used to assess areas of defoliation and spruce beetle damage in the eastern portion of the Region including Bowron Lake Provincial Park (Map 1). Information supplied by the B.C. Forest Service and industrial agencies pertaining to bark beetles and planting locations is gratefully acknowledged.



Map 1. Areas covered by aerial surveys and locations where one or more forest insect and disease samples were collected in 1986.

PINE PESTS

Mountain pine beetle, *Dendroctonus ponderosae*
Engraver beetle, *Ips pini*

Brood assessment of mountain pine beetle populations in 1985-attacked trees in May indicated for the second year a high incidence of overwintering mortality and greatly decreased populations. A 15 x 15 cm bark sample was removed at breast height from the north and south sides of each of 20 trees at 17 locations from Gaspard Creek north to Nazko and near Matthew River. The number of larvae, pupae and teneral adults and entrance holes were counted and "R" values computed for each area. One location, south of Nazko at Km 5 - 8100 Road, disclosed "R" values of less than 2.0 which denotes decreasing populations. The remaining 16 locations disclosed zero "R" values. Engraver beetle attack was most common in samples but all larvae, pupae and young adults were dead. Mountain pine beetle parent galleries, with the dead adults in them, were common but brood galleries were very short (1 cm) and, in many instances, nonexistent. At dbh, overwintering mortality was equally devastating for both species. The density of further secondary beetle attacks below breast height was generally light but species often observed were *Dendroctonus murrayanae* and below duff level, *Hylurgops* sp.

Cruise strips representative of recently attacked stands were established at 14 locations in September to assess the number and status of beetle-killed lodgepole pine (Table 1). Current attacks by mountain pine beetle decreased from an average of 24% in 1984, to 2% in 1985 to less than 1% in 1986. Engraver beetle attack was observed on an average of 1.9% of the cruise trees examined in 1986.

Table 1. Location and status of lodgepole pine in mountain pine and engraver beetle-killed stands, Cariboo Forest Region, 1986.

	% of trees/ha					Avg. percent of vol/ha			
Location	Healthy	Current	Red	Gray	Ips sp.	Healthy	Current	Red	Gray
Mackin Cr.	94	0	0	5	2.7	83	0	10	7
Gaspard-Churn Cr.	87	0	1	12	0.3	57	0	30	12
Mons L.	100	0	0	0	0.3	97	0	0	3
Stum L.	70	0	0	30	3.2	58	0	0	42
Taseko L.	74	0	0	26	0.0	56	0	0	43
Palmer L.	87	0	0	11	1.4	81	0	0	19
Km 4602 Thunder Mtn.	89	0	0	11	2.6	77	0	0	23
Km 4713 Thunder Mtn.	92	0	0	8	0.0	83	0	0	17
Clusko R. Km 1731	95	0	0	5	1.3	90	0	0	10
Clusko R. Km 1735	98	0	0	2	11.3	96	0	0	4
Dean R.	98	0	0	2	0.0	98	0	0	2
Km 8103 Nazko R.	83	0.5	0.5	16	0.1	82	1	1	16
Km 8105 Nazko R.	84	0	0	16	0.0	67	0	0	33
Km 7820 Clisbako R.	99	1	0	0	3.0	95	0	0	5
Average	90	0.1	0.1	10	1.9	80	.07	3	17

Aerial surveys conducted by the B.C. Forest Service throughout the summer indicated a decrease in area of recent beetle-caused lodgepole pine mortality from 189 000 ha in 1985 to 107 500 ha in 1986 (Table 2).

Table 2. Area and volume of lodgepole pine killed by pine bark beetles by Timber Supply Areas and Supply Blocks in Cariboo Forest Region as determined by BCFS aerial surveys, 1986.

Timber Supply Areas & Supply Blocks	Area (ha)	Volume (m^3)
100 Mile House TSA		
Meadow	1 950	12 980
Loon	447	2 553
Bonaparte	17	55
Sheridan	39	128
Holden	1 100	8 857
Rail	43	187
Ruth	52	385
Canim	114	945
Subtotal	3 762	26 090
Quesnel TSA		
South Kluskus	515	4 377
Narcosli West	11 615	195 276
Narcosli East	7 709	83 532
S.S.A.	234	1 964
Cottonwood	145	2 911
Big Valley	1	2
Bowron	32	232
Cunningham	154	3 697
Subtotal	20 405	291 991

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Timber Supply Areas & Supply Blocks	Area (ha)	Volume (m^3)
Williams Lake TSA		
Anahim	4 564	18 772
Chezacut	23 417	330 565
Tatla	0	0
Chilcotin	7	23
Kloakut	11 689	120 070
Gaspard	10 870	95 190
Churn	1 355	6 610
Springhouse	2 165	16 265
Palmer Lake	26 958	345 690
Skelton	910	10 927
Moffat	125	895
Cariboo	670	7 373
Upper Horsefly	45	255
Junction	0	0
Subtotal	82 775	952 635
Military Reserve	285	3 376
Bowron Lake Provincial Park	270	2 834
TOTAL	107 497	1 276 926

Aerial surveys to determine lodgepole pine tree mortality caused by mountain pine beetle over the past two years have increasingly included tree mortality caused by the engraver beetle, Ips pini. Normally, populations of engraver beetles are secondary, attacking the tops of mountain pine beetle-attacked trees, damaged peripheral trees, suppressed stagnating trees and fire-scorched stems and slash. Engraver beetle populations expanded in conjunction with increased mountain pine beetle-caused tree mortality from 1973 to 1984. In 1984, extensive blowdown occurred throughout the Chilcotin and subsequently were heavily infested with engraver beetles. Increased logging in mountain pine beetle-killed stands produced greater quantities of slash and damaged peripheral trees, each contributing host material to increase an existing large engraver beetle population. At this time (1984-85) cool wet weather in early summer slowed mountain pine beetle brood development and mature beetle attack flights were prolonged from July (normal flight time) through to September. The progeny were forced to overwinter in the vulnerable egg and young larval development stages. Consequently, the well below normal early fall and winter temperatures of 1984-85 and 1985-86 caused increasingly extensive mountain pine beetle brood mortality. Engraver beetles continued to maintain high populations because they overwintered in the duff, thus having greater protection. With the decreased number of mountain pine beetle-attacked trees available to attack, engraver beetle attacked trees unsuccessfully attacked by mountain pine beetle in previous years and other less vigorous trees. The probability of continued attack by engraver beetle over the next two years is low because they cannot cope with tree vigor, as manifested by exudation of pitch in response to the attack. Two successive years of dramatically depleting mountain pine beetle populations gave rise to a situation where attack roles were reversed and, in fact, high intensity attacks by engraver beetles reduced mountain pine beetle brood production through overcrowding.

Engraver beetles normally have more than one attack flight in one year. In the United States up to four flights in one year are not uncommon. In the Cariboo Region, two flights are the norm: one flight in May, the next in July-August. Foliar color change, as a result of attack, varies considerably according to temperature. Observations during 1986 showed July-August 1985-attacked trees were sorrel-coloured in May 1986; May 1986-attacked trees began to change in July. Conducting aerial surveys throughout the summer months in changing color circumstances was extremely difficult. By late August, the previous year's midsummer attack was red and distinguishing the difference from an aircraft between red trees killed by engraver beetle over the past year and those killed by mountain pine beetle over the past two years was impossible.

Based on overwintering studies, limited aerial surveys and fall cruising, lodgepole pine tree mortality caused by the mountain pine beetle and engraver beetle is expected to be low in 1987.

Lodgepole pine terminal weevil, *Pissodes terminalis*

Terminal weevil damage decreased in natural regeneration stands in the Riske Creek area in 1986. Surveys along the Churn Creek, Big Creek and Palmer Lake roads showed 12, 7 and 9% infested leaders; corresponding counts in 1985 revealed 20, 11 and 16% leaders infested. A wider distribution of weevil damage was noted in 1986. South of Nimpo Lake along the Dean River 28% of the leaders were infested, 16% along the Chezacut Lake road and 30% near Twan Creek along the Mackin Creek road.

Examination of infected terminals in May along Dean River, Chezacut Lake road and near Twan Creek revealed an average of 1.6 larvae per infested leader. Length of terminals ranged from 17 to 25 cm. An average of 70% of the larvae were dead (50-90% range), presumably from low overwintering temperatures. Published material dealing with the biology of terminal weevil indicates that some of the brood overwinter as larvae and pupae in the terminals, some as adults presumably in the duff and that there is one generation per year. There was no indication of brood development beyond the larval stage in the infested leaders at Dean River, Mackin Creek and Chezacut Lake road. Based on these factors, damage by terminal weevil is expected to decrease in 1987.

Hyperparasites of lodgepole pine dwarf mistletoe, *Colletotrichum gloeosporioides*, *Wallrothiella arceuthobii*, *Cylindrocarpon gillii*

Sampling of nine dwarf mistletoe-infected pine stands from north of Anahim Lake south to Chilko Lake in the western Chilcotin disclosed a common occurrence of infection by *Colletotrichum gloeosporioides* on aerial shoots of dwarf mistletoe plants. At all locations a range of 2 to 20% of the dwarf mistletoe plants were infected with up to 50% of shoots showing a blight. In 1985, examinations of dwarf mistletoe infected pine stands along Churn Creek road indicated that seed production of the infected parasite plants had been reduced 60% by hyperparasite infection. Infections by Wallrothiella arceuthobii and Colletotrichum gloeosporioides were identified at this site.

At one location, 15 km south of Nimpo Lake, a dwarf mistletoe plant was infected by Cylindrocarpon gillii. This is a first record of infection by this hyperparasite in the Cariboo Region.

Shoot fungi such as Wallrothiella arceuthobii, Colletotrichum gloeosporioides occur frequently in the Cariboo Region (Map 2) and exert degrees of control over Arceuthobium species by reducing reproductive potential and seed production. While the control by these hyperparasites is effective on the aerial portions of the dwarf mistletoe plants, they are not known to destroy the endophytic system (root system in the wood) which continues to develop and produce shoots so long as the host remains alive.

Pinewood nematode, Bursaphelenchus xylophilus

Twenty-one samples of lodgepole pine were collected throughout the Region to determine possible nematode presence. None of the samples was positive. However, wood chips from Quesnel collected by Agriculture Canada contained nematodes; positive identification is pending.

DOUGLAS-FIR PESTS

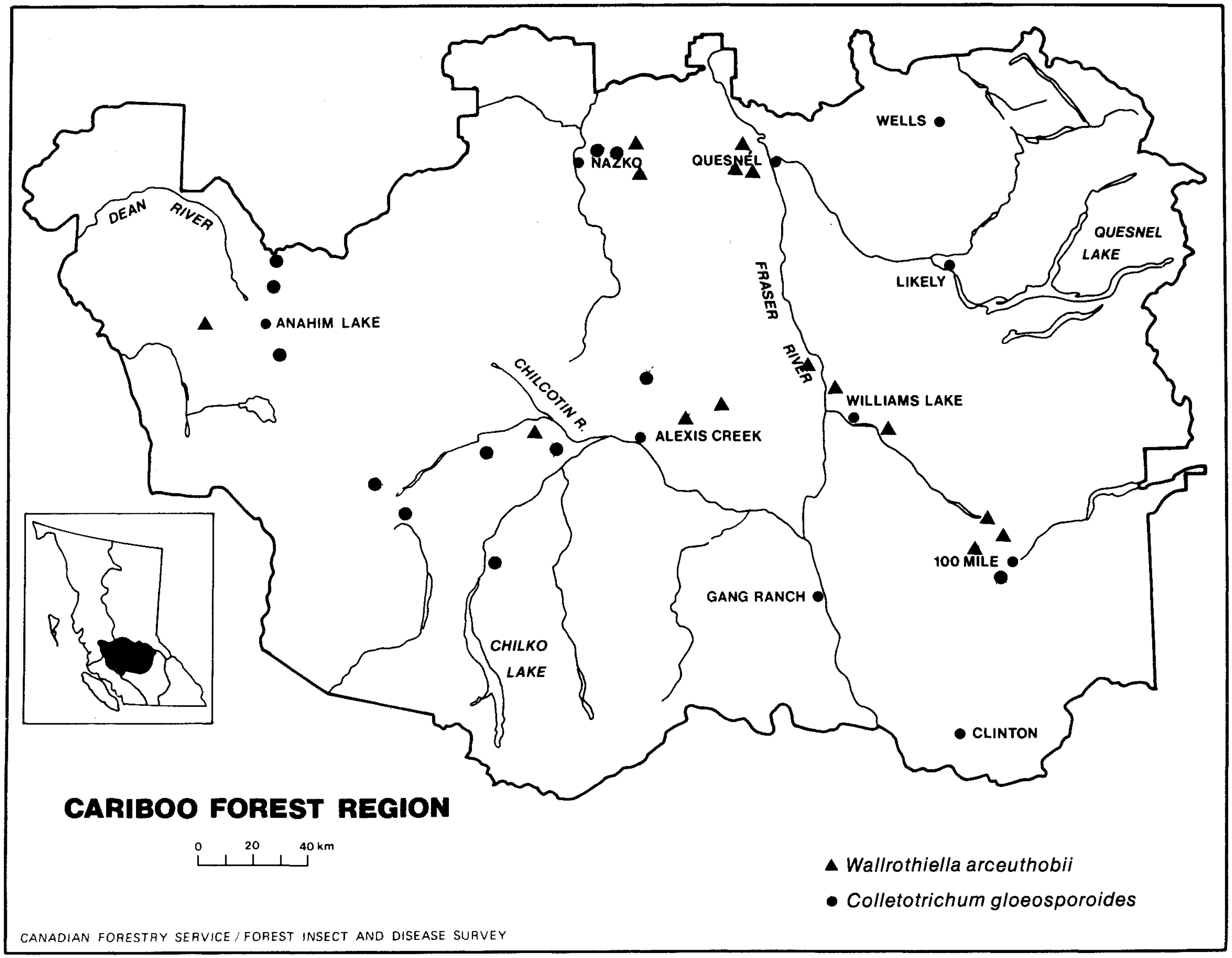
Douglas-fir beetle, Dendroctonus pseudotsugae

The area of mature Douglas-fir killed by Douglas-fir beetle, as determined by B.C. Forest Service aerial surveys, decreased to 648 ha from 1 470 ha recorded in 1985. The major areas of tree mortality were in the Gaspard, Churn and Springhouse supply blocks of the Williams Lake TSA covering 132, 85 and 177 ha, respectively.

Fifty sorrel-coloured trees over approximately two ha were observed south of Clinton in a 1984 tussock moth-defoliated area. Examination of the mature trees revealed numerous Polyporus volvatus conks on the outer bark, and under the bark, light attacks by Douglas-fir bark beetle and wood borer species. Brood production was light and, in most instances, did not reach maturity. Moderate to severe defoliation by the tussock moth reduces tree vigor for up to two years following infestation and during this time mature trees are susceptible to Douglas-fir beetle attacks. However, it is unlikely that further bark beetle damage will occur.

Western spruce budworm, Choristoneura occidentalis

The area of western spruce budworm defoliation in 1986 decreased dramatically to 182 ha from 29 500 ha recorded in 1985. The only active populations were near Mt. Grant in the Clinton area where 50 ha of Douglas-fir were lightly defoliated and near Mahood Falls and Bowers L. where 130 ha were lightly defoliated. The Mt. Grant infestation is in its second year while defoliation in the Mahood Falls area was new in 1986. The introduction of populations in this area was presumably a result of rapidly expanding infestations in neighbouring stands of the Kamloops Region. The cause of the rapid decline of budworm in the Clinton area was attributed to abnormally low



Map 2. Distribution of hyperparasites of lodgepole pine dwarf mistletoe.

winter temperatures that prevailed in November 1985 and in May 1986. Average minimum temperatures recorded at 100 Mile House in November were -13°C with an extreme low on November 27 of -40°C. In May, average minimum temperature at 70 Mile House was -4°C with an extreme low of -9.5°C on the 14th.

Early June examinations of 100 buds from each of five trees disclosed from 1 to 15% to be budworm-infested compared to 24 to 59% in 1985. The highest infested bud counts (15%) were in the Mt. Grant area. The remaining annually examined locations near Big Bar L. Road, Hart Ridge and near Loon Lake disclosed 1 to 5% infested buds.

Three-tree beating samples in Douglas-fir stands previously defoliated near Big Bar L. Road, Hart Ridge and Loon Lake yielded up to 5 larvae per sample and up to 30 larvae near Mt. Grant. Near Mahood Falls, Douglas-fir collections yielded up to 150 larvae per sample and up to 70 larvae per sample from Douglas-fir and alpine fir near Bowers Lake. Larval collections from this area sent to Pacific Forestry Centre revealed 4.5 and 7% parasitism, too low to significantly alter population impact.

Two branches from each of ten trees at six locations were collected to determine the number of egg masses from which population trends and damage potential are predicted (Table 3).

Table 3. Number of western spruce budworm egg masses per 10 m^2 of foliage and predicted defoliation of Douglas-fir in 1987, Cariboo Forest Region, 1986.

Location	Number of egg masses per 10 m^2 of foliage	Predicted defoliation[1]
Mahood L.	690	Severe
Mahood Falls	50	Light
Bonaparte R. (Mt. Grant)	270	Severe
Canim L.	0	None
Big Bar L. Rd.	20	Light
Loon L.	30	Light

[1] 1-50 egg masses = Light defoliation
51-150 " " = Moderate defoliation
151+ " " = Severe defoliation

Because of the increasing intensity and distribution of budworm infestations in neighbouring stands of the Kamloops Region and the history of infestations in the Clinton area, it is likely that increasing populations will re-infest Douglas-fir stands between 800 and 1 000 metres elevation. Over what time period this will occur depends on the continuing intensity of infestations in neighbouring stands and weather conditions over the next two years. Moderate to severe defoliation was monitored in 1986 along the north shore of Mahood Lake in the Kamloops Region in Wells Gray Park adjacent to susceptible Douglas-fir stands that extend beyond Canim Lake into the Cariboo Region. In anticipation of expanding populations into the Cariboo Region, extensive monitoring of budworm populations will be conducted in these stands over the next two years.

A Douglas-fir dieback, Sclerophoma pithyophila

West of Quesnel Lake along the Raft Creek - Gavin Lake road, 32% of the plantation Douglas-fir were infected by S. pithyophila which resulted in dieback of 0.5 to 1.5 metres in the 12 to 14-year-old trees. Extensive damage to plantation Douglas-fir was also reported near Keithley Creek by BCFS silviculture personnel.

A review of samples submitted to PFC over the past 20 years shows a province-wide distribution of occurrence extending into the Yukon Territory. While infections occurred on all native conifer hosts and on some exotic species, Douglas-fir is the primary host (41% of samples submitted), followed by lodgepole pine (26%). In the Cariboo Region, 14 identified samples have been submitted over the past 20 years and show a wide distribution throughout the Region (Map 3). Hosts infected were primarily Douglas-fir (8 collections), with collections also from alpine fir (2), lodgepole pine (2), whitebark pine (1) and Scots pine (1).

Adverse climatic influences such as extreme frost and drought are most often associated with the occurrence of infections.

Douglas-fir tussock moth, Orgyia pseudotsugata

Populations of Douglas-fir tussock moth remained low in Douglas-fir stands south of Clinton in 1986.

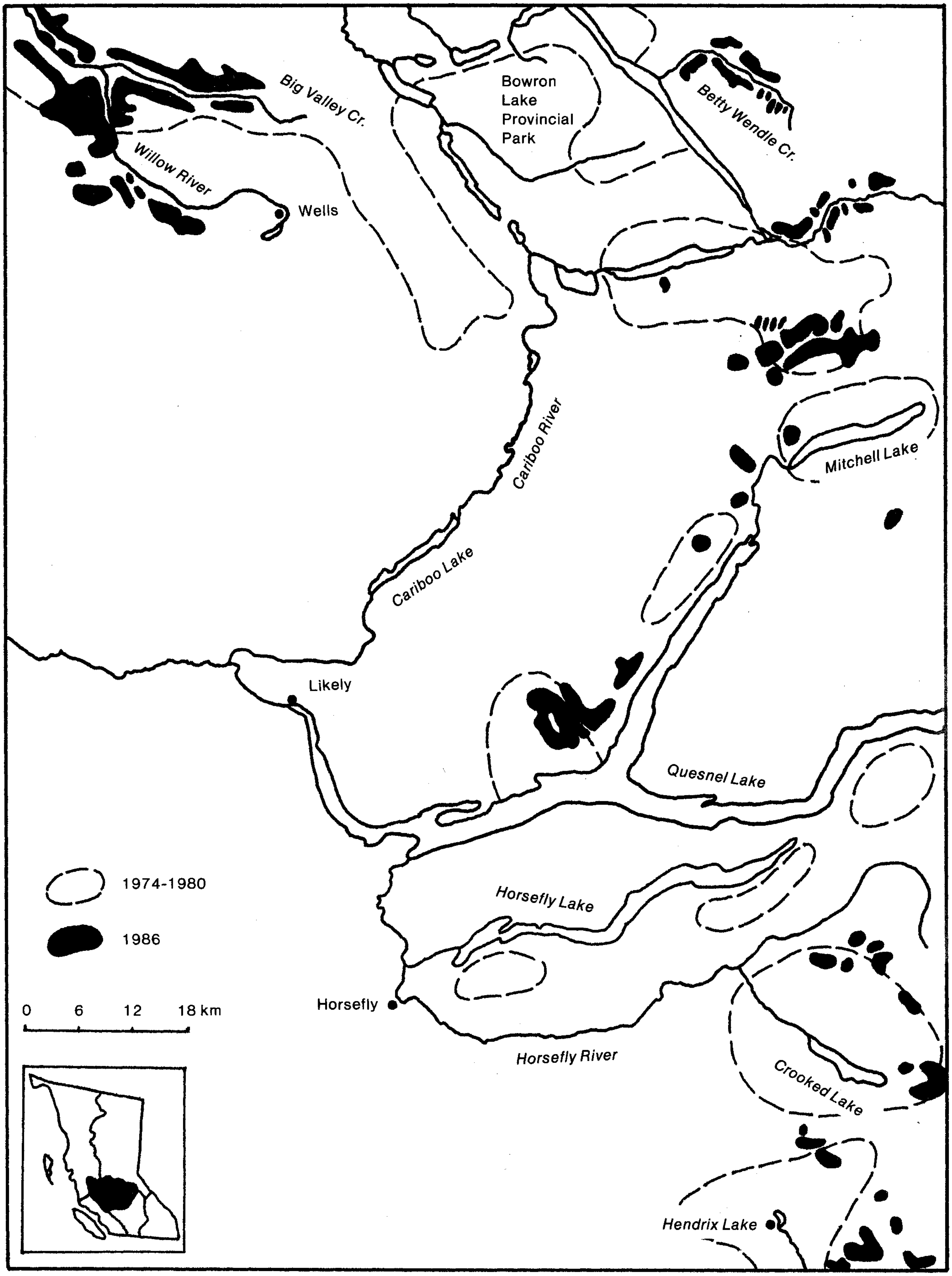
SPRUCE PESTS

Spruce beetle, Dendroctonus rufipennis

A total of 290 ha of beetle kill was observed in 1986, a significant decrease from 2 160 ha in 1985. Additional spruce mortality by spruce beetle, determined by B.C. Forest Service aerial surveys was observed over 49 ha at 10 locations. Aerial surveys conducted by FIDS in Bowron Lake Provincial Park disclosed an additional 240 ha of recent tree mortality at 20 sites along Isaac Lake in the northeastern section of the Park.

Because of concern over possible active spruce beetle in the Park, two representative cruise strips were run during fall surveys west and south of Wolverine Creek near Isaac Lake. The cruise strips along an estimated 3 000 metres contained 58 prism plots and 390 trees. Approximately 45% of the trees on the plots were white spruce; the remainder included western hemlock, western red cedar, alpine fir and black cottonwood. Sixty-one percent of the spruce were healthy, 36% had been killed by spruce beetle prior to 1984 and 3% successfully strip-attacked in 1984 but no longer contained brood. The beetle-killed trees ranged from 41 to 53 cm dbh and healthy trees averaged 35 cm dbh.

Contrary to concerns expressed to Parks Branch, current spruce beetle populations in Bowron Lake Provincial Park, based on the results of the cruising, do not pose a threat to spruce stands in the Park nor to adjacent Crown lands. The foliar discoloration observed during 1985 aerial surveys attributed to possible one-year-cycle beetle populations was a result of normal two-year-cycle attack in 1984.



Map 3. Area of alpine fir and spruce defoliated by two-year cycle budworms in the Cariboo Region, 1974-1980 and 1986.

Two-year-cycle spruce budworm, Choristoneura biennis

Mature second year larvae of two-year-cycle budworm defoliated over 21 000 ha of spruce-balsam stands in 1986, compared to 3 700 ha in 1985 caused by immature larval feeding. Severe defoliation was recorded over 900 ha along the Willow and Big Valley drainages, moderate defoliation over 5 850 ha along Betty Wendle Creek, Mathew River and near Grain Creek, and light defoliation over 14 250 ha along twenty drainages from Little River south to Deception Creek near Hendrix Lake.

During the first weeks of June, 95 and 79% of the buds of understory alpine fir and white spruce were infested in the upper Willow River and Big Valley Creek drainages, respectively. In mid-June, between 40 and 60% of alpine fir buds were infested along Hendrix Mtn. and near Deception Creek. Between these two locations, infested bud counts ranged from 5 to 20%.

Standard FIDS three-tree beating samples yielded from 200 to 300 larvae in the severely infested areas and 5 to 25 larvae in the lightly infested stands. Collections containing 100+ larvae were submitted to PFC from Willow River, Big Valley Creek, Grain Creek and MacKay River to determine the incidence of parasitism in the increasing populations; however, no parasites were evident.

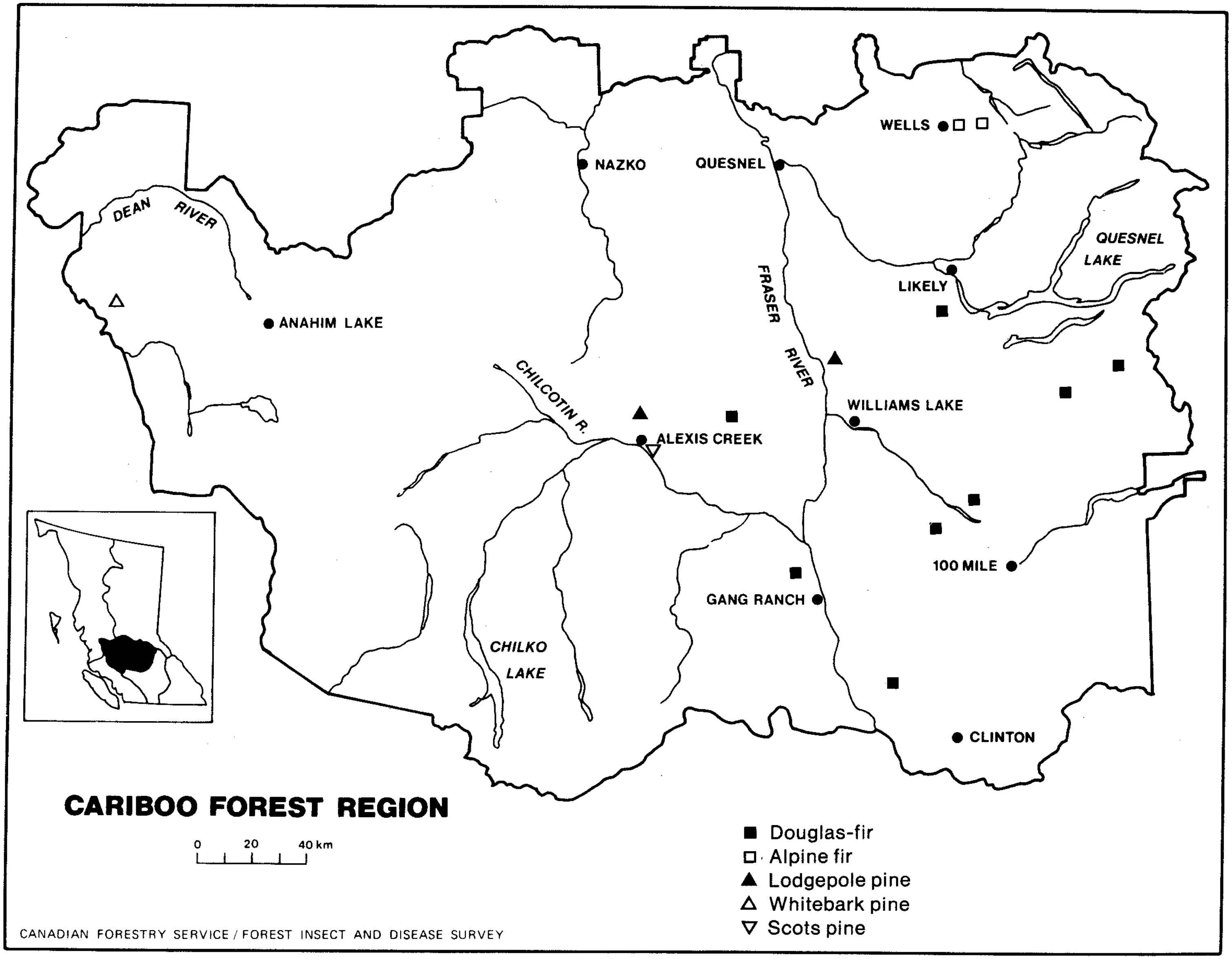
Two 50-cm branches from each of ten trees were collected from each of six locations in September to determine the number of egg masses from which the damage potential could be evaluated for the coming year (Table 4).

Table 4. Number of two-year-cycle spruce budworm egg mases per $10m^2$ of foliage and predicted defoliation of alpine fir and spruce in 1987, Cariboo Forest Region, 1986.

Location	Number of egg masses per 10 m^2 of foliage	Predicted Defoliation[1]
Big Valley Cr.	340	Severe
Willow R.	483	Severe
Grain Cr.	333	Severe
Little R.	95	Moderate
MacKay R.	44	Light
Hendrix Mtn.	72	Moderate

[1] 1 to 50 egg masses = Light defoliation
51 to 150 " " = Moderate "
151+ " " = Severe "

Two-year-cycle spruce budworm has a history of cyclic occurrence in the northeastern section of the Cariboo Region (Map 4). Since 1913, infestations have been recorded in 35 of the 78 years. The duration of infestations ranged from 2 to 11 years and resulted in loss of increment, top-kill and multiple-topping of pole-sized and mature spruce and alpine fir as well as extensive regeneration mortality. The present infestation will be regulated by weather conditions, and the incidence of parasitism and disease in the population. Based on the complete lack of parasitism and disease symptoms in reared larval



Map 4. Distribution of *Sclerophoma pithyophila*, 1965-1986.

collections and the high numbers of egg masses collected in September, continuing large populations can be expected in 1987. However, because 1987 is the "off" or immature year of larval development, defoliation may not be as severe, but a wider distribution of increasing populations will likely be evident.

Spruce coneworm, *Dioryctria reniculelloides*

Near Bowers Lake, south of Mahood Falls, up to 5% of Engelmann spruce branch tips were defoliated over an estimated four hectares.

Spruce coneworms mine one or two needles in the spring before entering a developing bud, cone or staminate flower and are often associated with *Choristoneura* spp. when in outbreak numbers. Concentrations of populations are seldom encountered but rather occur in a range of from 1 to 5 larvae in three-tree beating collections.

WESTERN HEMLOCK PESTS

Western blackheaded budworm, *Acleris gloverana*

Populations of western blackheaded budworm collapsed in 1986 as a result of abnormally low winter temperatures. In 1985 increasing populations had caused light defoliation of western hemlock over 4 480 ha along both sides of Quesnel Lake. Populations are expected to remain at low levels in 1987.

ALPINE FIR PESTS

Balsam bark beetle, *Dryocoetes confusus*

Increased numbers of alpine fir recently killed by the bark beetle fungus complex were noted over 970 ha along the eastern portion of the Region in 1986 compared to 470 ha in 1985. The largest area of tree mortality was in the Hendrix Lake area along Big Timothy and Hendrix mountains, where over 500 trees were counted in 12 groups. Little change is expected to occur in 1987.

MULTIPLE HOST PESTS

Black army cutworm, *Actebia fennica*

A cooperative trapping survey with BCFS in the Horsefly District in 1985 indicated that continuing high populations could be expected in 1986 near Cariboo and Edney lakes and to a lesser extent near Gavin Lake. Surveys conducted during the first two weeks of May 1986 near these locations uncovered few larvae per 1000 cm^2 soil sample and little evidence of plant feeding. Near Wilby Creek along Cariboo Lake up to 10 larvae in one soil sample indicated a large enough population to warrant further sampling. On May 14, 10 soil samples were taken along a compass line in the planted area. Each sample was placed in a bucket, willow and/or fireweed placed on top of the soil and a lid placed on the container. Similar samples were taken on the 18th, 20th, 21st and 22nd. Each morning following the sampling, the containers were opened and the number of feeding larvae counted (Table 5).

Table 5. Number of black army cutworm larvae in 1000 cm^2 soil samples, Wilby Creek, Cariboo Forest Region, 1986.

Date	Total no. samples	No. positive samples	Total no. of larvae	Maximum no. larvae/sample	Avg. no. larvae per sample
May 14	10	5	9	4	0.9
May 18	10	3	4	2	0.4
May 20	10	2	2	1	0.2
May 21	10	1	1	1	0.1
May 22	10	1	1	1	0.1

In the Prince Rupert Region in 1984 it was found that "some light and occasional small patches of moderate feeding of white spruce seedling buds occurred where second to third instar larvae counts exceeded two to three per 1000 cm^2 soil samples". Based on this survey, average number of larvae per 1000 cm^2 samples near Wilby Creek were well below hazard levels.

Abnormally low winter temperatures during November 1985, and to a lesser extent in early May 1986, were presumed to be the cause of the decreased population in the Horsefly District. Weather records from a range of elevation levels (725 to 1 200 m) similar to the infested areas from Gavin to Cariboo lakes were consulted to determine the range and abnormality of temperatures (Table 6).

Table 6. Recorded temperatures at 3 station locations near black army cutworm infestation areas, November 17-30, 1985 and May 1-16, 1986, Cariboo Forest Region.

		Actual Temperatures				Normal temperatures (1951-80)		
		Average		Extreme				
Location	Elev. (m)	Max.	Min.	Max.	Min.	Max.	Min.	Avg. mean daily
November 1985								
Likely	730	-18.4	-26.3	11.5	-35.0	2.9	-5.0	-1.1
Barkerville	1 200	-19.7	-31.5	-14.5	-42.0	0.4	-8.7	-4.1
Bowron L.	896	-20.3	-30.8	-14.0	-39.0	-	-	-
May 1986								
Likely	730	15.8	2.2	29.5	-3.0	16.2	1.6	9.0
Barkerville	1 200	10.8	-2.1	25.0	-9.0	12.0	-0.6	5.7
Bowron L.	896	13.2	0.7	27.5	-5.5	-	-	-

Snow cover during overwintering periods contributes a nullifying factor to lethal temperatures by acting as insulation. However, November 1985 weather records showed no snow accumulation near Likely, 13 cm at Bowron Lake and 41 cm at Barkerville. This would indicate that larvae in proposed planting sites at elevations lower than 800 metres would be most vulnerable to the abnormally low temperatures and those populations at sites of higher elevation would be less vulnerable.

On June 25 a report of black army cutworm activity causing extensive feeding damage was received from the Likely BCFS office. Investigation disclosed severe defoliation of herbaceous ground cover but no feeding damage to newly planted lodgepole pine and white spruce seedlings. Site locations were at Four and Weaver creeks in the Upper Keithley Creek drainage; elevation levels were in excess of 1 100 metres. Severe ground cover defoliation was also observed along French Snowshoe Creek, scheduled to be planted in 1987. Due to delayed snowmelt, these locations were not planted until mid-June, confining black army cutworm larval feeding to existing ground cover. By the time tree planting was underway, larvae were near ultimate instar and little feeding was observed on planted stock. Mass larval collections from Keithley and Four creeks reared at PFC disclosed 42 and 7% parasitism, respectively.

In anticipation of producing a hazard rating for areas to be planted the following year, pheromone-trapping was continued in 1986. A total of 102 pheromone-baited traps were set out at 12 locations in 1985 and 1986 burn sites to be planted in 1987 (Table 7).

Table 7. Locations and average number of black army cutworm moths caught in attractant-baited sticky traps at 12 proposed 1987 planting sites, Cariboo Forest Region, 1986.

Location	Burn yr.	C.P. no.	No. of traps	Lure strength[1] 0.4%	Struble
Polley L.	1985	109	6	2.0	15.0
Wilby Cr.	1985	179	6	9.3	13.0
Frank Cr.	1985	125	6	7.3	14.0
Little R.	1986	127	6	18.3	24.6
Keithley Cr.	1986	122	6	6.0	20.6
Snowshoe Cr.	1986	123	6	9.3	24.0
Snowshoe Cr.	1985	113	6	8.3	17.0
Snowshoe Cr.	1985	114	6	4.0	13.0
Horsefly L.	1985	318	6	2.3	7.6
MacKay R.	1986	320	12	6.6	9.1
Bosk L.	1986	311	12	11.3	12.3
Divan Cr.	1986	307	17	15.8	16.0

[1] 0.4% Z-7 dodecenyl - cautionary hazard level of 10 moths per trap set on low strength lure.
Struble-mixture of z-7-12 acetate, z-11-14 acetate and z-5-14 acetate used by Dr. D.L. Struble, Crop Ent. Sect. Agr. Can., Lethbridge, Alberta.

Without a defined hazard index to predict the damage potential, an arbitrarily set cautionary hazard index was set at 10 moths per trap. Locations where average number of moths/trap exceeded 10 were: CP 127 Little River, CP 311 Bosk Lake and CP 307 Divan Creek. Relating numbers of larvae in soil samples and feeding damage in 1987, with the average number of moths caught per trap in 1986, will further refine hazard levels.

The following summarizes the use of pheromone baited-traps to assess and predict black army cutworm populations.

Synthetic pheromones have been used in sticky traps as a survey tool in British Columbia since 1972. They were initially employed to determine the presence or absence of insect populations but with calibration could be used for predicting levels of infestations. Eventually the number of moths caught in the fall could be related to potential damage caused by larval feeding the following planting season. This would allow adjustments of planting schedules or other courses of action to be taken in threatened areas to minimize losses.

Five different lures containing synthetic pheromone have been tried over the years but only two types are now in use. The first, used for the past five or more years, was a solid plastic polyvinyl chloride (PVC) 3 x 5 mm rod, containing a specific concentration of pheromone. More recently, a rubber septa was introduced. The traps containing the baits were most commonly a two-litre paper milk carton modified to a triangular cross-section with the interior walls covered with adhesive (bird tanglefoot). A number of shortcomings were evident with this trap, particularly their limited capacity. Traps can fill up surprisingly fast, even when populations are low, thus precluding comparison of densities.

For black army cutworm a non-sticky trap is being proposed. The base of the trap is a plastic bucket with a lid suspended above a funnel opening. The pheromone is placed under the lid and an insecticide strip (VAPONA) is placed inside the bucket to kill the moths. This trap has been part of an extensive trial during the past two years and the best lure and trap have been selected. The optimum placement height of the trap is one metre above ground level.

The black army cutworm shows a preference for planting sites in wet belt zones, on sites burned the previous year or prior to flight time the same year, at lower elevations and on southerly exposed sites. While these are preferences, actual numbers of moths caught varies greatly from site to site. Within the next three years, trap catches may be related to subsequent damage over a range of sites and vegetative regrowth conditions. Until a data base is obtained, trap counts cannot reliably be used as an indicator of potential damage.

Variegated cutworm, *Peridroma saucia*

This primarily agricultural and forest nursery pest was found for the first time severely defoliating ground cover and newly planted seedlings in part of a 93-ha plantation, burned and partially planted in 1986, near the north end of Quesnel Lake. Further planting of lodgepole pine and white spruce was postponed until after the larval feeding stage. Of 237 larvae sent to PFC in August, 27% were parasitized. Pupal samples sent on September 16 and October 15 disclosed 1 and 0% parasitism. One hundred and eighteen soil samples collected along three lines throughout the plantation produced a range of 1 to 5.7 pupae per 1000 cm^2 sample. Separate samples taken along the edge of the access road through the plantation yielded up to 30 pupae per sample. One adult was found in a single sample and 30% of the pupae collected in September and October were adults on arrival in Victoria.

An Agriculture Canada Research Station publication[1] by G.L. Ayre in Winnipeg stated that "it is generally assumed that populations (of variegated cutworm adults) are transported on frontal systems from breeding areas in the southern United States". In addition, coldhardiness tests conducted in Manitoba disclosed that variegated cutworm pupae were unable to survive temperatures below 0^{o} C. Populations near Quesnel Lake were unable to reach the adult stage before low temperatures commenced and based on the above information would not survive winter temperatures prevalent in the Quesnel Lake area.

It is unclear at the present time how this pest was introduced in such large numbers to this plantation, what its life cycle is or where the insect overwinters. However, pheromone-baited traps will be set out in the Horsefly District to determine adult flights and intensities in 1987.

Acid Rain National Early Warning System (ARNEWS)

In 1984 a national program was instituted to closely monitor forest conditions with respect to airborne pollutants. Though acid rain is not known to be a problem in the Cariboo Region, there is a need to collect baseline data representing the normal forest conditions so that changes can be detected and monitored over time.

In the summer of 1986 a long-term ARNEWS research plot was established in a semi-mature lodgepole pine-white spruce stand near Cottonwood. This plot is one of 15 established province-wide. At regular intervals over at least the next 25 years, samples of the soil, tree and undergrowth foliage will be analyzed in order to detect changes in chemical composition that could signal future problems. Samples taken from the plot in the fall of 1986 are currently being analyzed.

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[1] Ayre, G.L. Cold tolerance of Pseudaletia unipuncta and Peridroma saucia (Lepidoptera:Noctuidae). Can. Ent. 117:1055-1060 (1985).