

Forest Insect and Disease Conditions

**Cariboo Forest Region
1988**

R.D. Erickson & R.L. Ferris



**Forestry
Canada**

**Forêts
Canada**

TABLE OF CONTENTS

	PAGE
INTRODUCTION	1
SUMMARY	3
PINE PESTS	5
Mountain pine beetle	5
Pine engraver beetle	7
Lodgepole pine dwarf mistletoe	7
Pinewood nematode	8
Pine needle diseases	9
Stalactiform blister rust	10
Animal damage	10
DOUGLAS-FIR PESTS	11
Western spruce budworm	11
Douglas-fir beetle	12
Douglas-fir needle midges	12
Drought and salt damage	12
SPRUCE PESTS	13
Two-year-cycle spruce budworm	13
Spruce beetle	16
ALPINE FIR PESTS	17
Western balsam bark beetle-fungus complex	17
PESTS OF YOUNG STANDS	17
Lodgepole terminal weevil	19
A conifer weevil	19
MULTIPLE HOST PESTS	19
Black army cutworm	19
Cone and seed pests	20
DECIDUOUS TREE PESTS	21
Forest tent caterpillar	21
Gypsy moth	21
OTHER PESTS OF MINOR SIGNIFICANCE	23

INTRODUCTION

This report outlines the status of forest pests recorded by Forest Insect and Disease Survey (FIDS) in the Cariboo Forest Region in 1988, and attempts to forecast some of their trends. Pests are discussed by host, generally in order of importance.

The Forest Insect and Disease Survey is a nation-wide network within Forestry Canada, (formerly the Canadian Forestry Service). It has the responsibility for producing an overview of forest pest conditions and their implications; maintaining records and surveys to support quarantines; supporting forestry research; providing advice on forest pest conditions; developing and testing survey techniques; and conducting related biological studies. The cooperation of provincial, industrial and municipal agencies is essential for the effective fulfillment of these mandates and is gratefully acknowledged.

The 1988 field season extended from May 24 to September 24. During that time, 245 insect and disease samples and other pest data were collected from throughout the region by FIDS personnel. Pest damage was mapped and photographed during 14.3 hours of fixed-wing and 1 hour of helicopter surveys, **Map 1.** The British Columbia Forest Service (BCFS) supplied 9 hours of the fixed-wing time and the helicopter time; Forestry Canada provided the remainder. Additional information was obtained from a pest detection aerial survey privately contracted by the B.C. Forest Service.

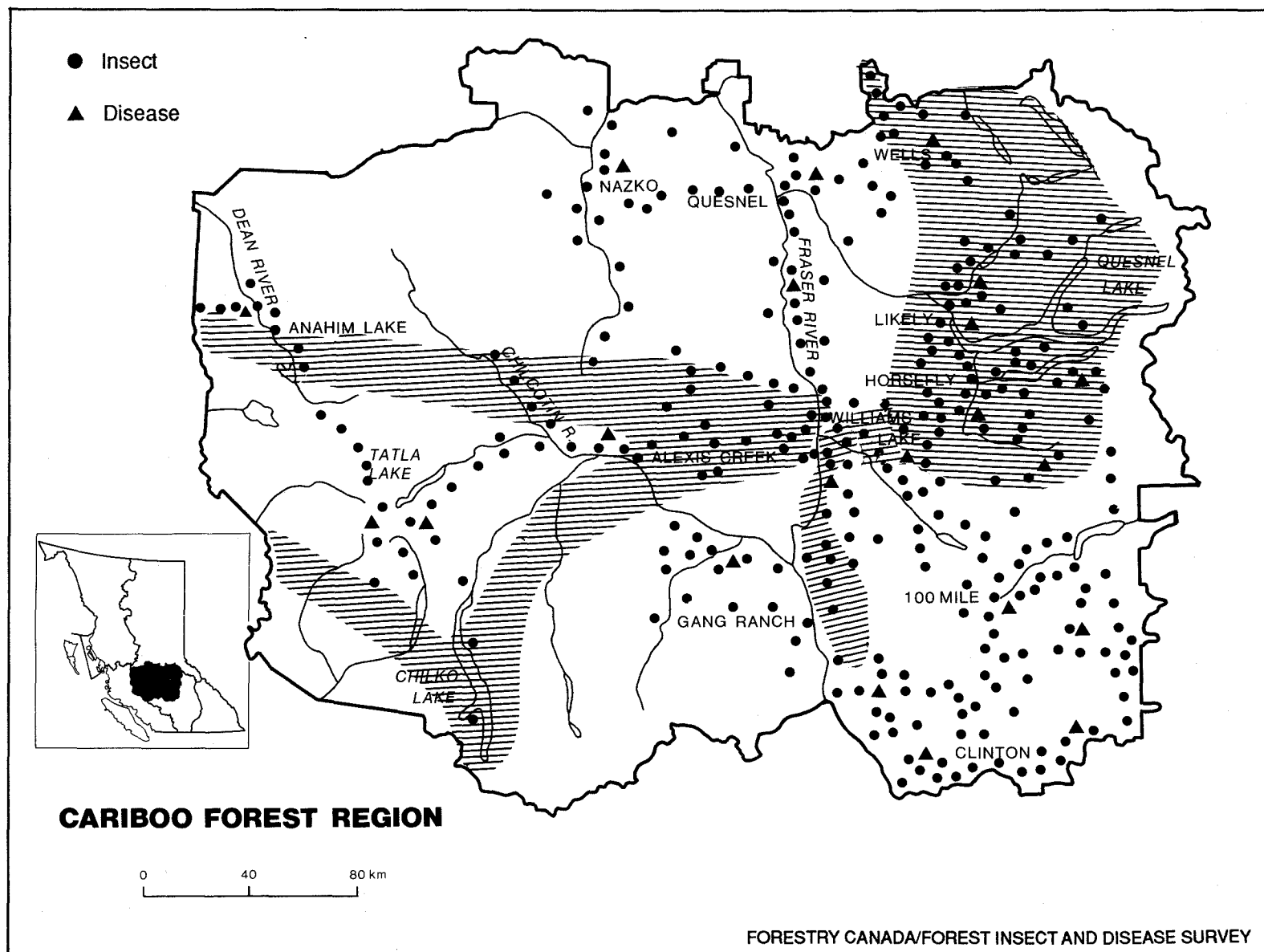
FIDS has conducted annual surveys in the Cariboo Forest Region since the late 1930s, and from an established field headquarters at Williams Lake since 1954. Inquiries may be directed to the field station from May 15 to September 30. The address is:

Forestry Canada
Forest Insect and Disease Survey
Sidcum Sub., Comp. 33,
Williams Lake, B.C.
V2G 1M3 Ph. 392-6067

From October to April the field station is closed; however, the FIDS ranger may be contacted anytime at:

Forestry Canada
Pacific Forestry Centre
506 West Burnside Rd.
Victoria, B.C.
V8Z 1M5 Ph. 388-0600

Large-scale copies of maps included in this report are available on request at the above addresses.



Map 1. Locations where one or more forest insect and disease samples were collected and areas covered by aerial surveys to map bark beetle and defoliator infestations in 1988.

SUMMARY

Continuing an increasing trend started last year, mountain pine beetle killed lodgepole pine near Chilko Lake on 1290 ha in 230 separate patches, up from 500 ha last year. Pine engraver beetle populations in the Chilcotin collapsed. Surveys for pinewood nematode continued for the sixth consecutive year; results are pending. Infection of mature and immature pine by lodgepole pine dwarf mistletoe is widespread throughout the host range in the region and results in significant volume loss. Infection of lodgepole and ponderosa pines by Elytroderma needle disease was widespread, an increase from none in 1987. Needle casts lightly¹ defoliated and discolored year-old needles of mature and immature lodgepole pine at locations east and west of the Fraser River from Williams Lake to Clinton. Mature and immature lodgepole pine in the Chilcotin and near 100 Mile House were severely infected and cankered by stalactiform blister rust.

Douglas-fir defoliated by western spruce budworm was mapped over 8000 ha near Horsety and Mahood lakes, down slightly from 9000 ha in 1987. The number of mature Douglas-fir killed by Douglas-fir beetle declined to groups of 1-20 trees over a total of 20 ha, down from 590 ha in 1987; current attack increased. Douglas-fir needle midges mined and severely defoliated new shoots on Douglas-fir over 15 km east of McLeese Lake. Immature and mature Douglas-fir on drier sites east of Lac la Hache were top-killed by drought. Roadside trees with dead branches killed by salt spray were common along Highway 97 from Clinton to Williams Lake.

Mature and immature Engelmann spruce and alpine fir were lightly and moderately defoliated by 2-year-cycle spruce budworm over about 40 500 ha in the eastern part of the Cariboo, nearly double the area defoliated last year. Spruce beetle populations were reported at Big Valley Creek but remained low elsewhere.

Recent mortality of mature high-elevation alpine fir caused by western balsam bark beetle declined slightly to 1200 ha.

The most common pest of young pine in natural and planted sites was lodgepole terminal weevil, which killed new terminals in six of 11 stands.

Black army cutworm populations in recently burned sites were generally low for the third consecutive year, but recently planted seedlings and herbaceous growth were lightly defoliated at one site near Likely. Surveys for Rhizina root disease in recently burned and planted sites were negative.

Cone crops of most conifer species in the region were generally large, and an average of 28% were infested by cone and seed insects, mostly spruce cone maggot and spruce seed moth.

- ¹Light : discolored foliage barely visible from the air, some branch tip and upper crown defoliation
- Moderate: pronounced discoloration, noticeably thin foliage, top third of many trees severely defoliated, some completely stripped
- Severe : bare branch tips and completely defoliated tops, most trees sustained more than 50% total defoliation

Surveys and special studies were conducted for western spruce budworm and acid rain.

Forest tent caterpillar defoliated mainly trembling aspen over 460 ha in patches from Canim Lake to Green Lake, the first outbreak in the region since 1984. There were no adult gypsy moths caught in 22 traps placed in 17 provincial park campgrounds and picnic sites in the region.

PINE PESTS

Mountain pine beetle **Dendroctonus ponderosae**

Lodgepole pine, recently killed by mountain pine beetle, were mapped over 1290 ha in 230 separate patches this year, up from 500 ha in 1987 (Map 2). This followed the collapse of beetle infestations in 1985, and very low populations in 1986 and 1987. The two largest infestations occurred over 650 ha along Franklyn Arm on Chilko Lake, up from 500 ha last year and over 300 ha near Dorothy Lake east of Chilko Lake. To the south, 175 ha were mapped along Edmond Creek and 125 ha north of Mt. Kern.

Several groups of 2-20 recently killed lodgepole pine were scattered north to Stikelan Point along the west side of Chilko Lake and west of the lake along the Homathko and Nostetuko rivers and Nude Creek, a tributary of Homathko River. These infestations in the Chilcotin Supply Block, Williams Lake Timber Supply Area (TSA), occurred where tree mortality was extensive in the last outbreak in the early 1980s. Elsewhere, small infestations included a new 7-ha infestation at Zenzaco Creek near Alexis Creek in the Palmer Lake Supply Block. Other patches of 0.25 to 1 ha, which contained one to five discolored trees, were widely scattered throughout mature pine stands elsewhere in the region.

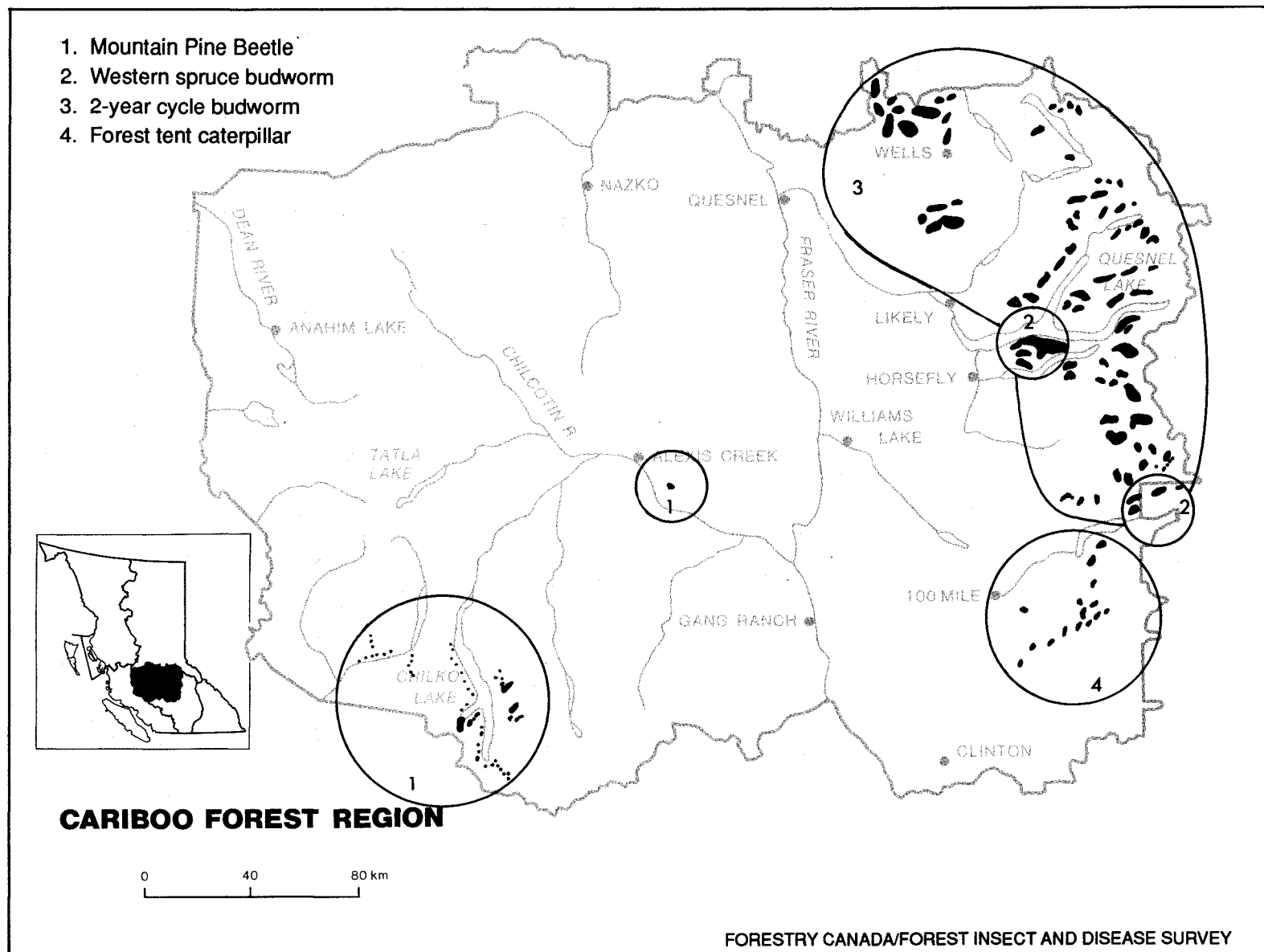
Since the earliest recorded pest history in the Cariboo in 1913, there have been two major mountain pine beetle outbreaks, both in the same area west of Williams Lake. Around 1936, there were an estimated 650 000 ha of pine infested in the Tatla Lake area. Small numbers of pine were killed through the 1960s. Then the second and most recent major infestation occurred, beginning in 1975 in the Chilcotin and in 1979 in the Cariboo, killing pine until 1986. The area of mortality peaked in 1983 and 1984 at 382 000 ha and 381 000 ha, respectively. The decline of that infestation began in 1985, caused mainly by the low temperatures in the fall and winter of 1984-85.

Forecasts

Current attack averaged 13% of the stems on a variable plot cruise in recently infested mature pine at Franklyn Arm on Chilko Lake. Additionally, 47% were healthy, 24% were red (killed in 1987), 7% were grey (killed prior to 1987), 6% were partially attacked, and 3% were dead from other causes. There were more than 50 larvae per 900 cm² of bark in the 1988 attacked trees. This is sufficient to support a new infestation in 1989 if the population overwinters successfully.

Since the Chilko Lake infestations were not readily accessible for logging to control the population buildup, the BCFS treated 30 spots along Chilko Lake and east around Dorothy Lake in August and September. Over 1000 trees were baited with pheromone to attract emerging beetles which were then killed by injecting MSMA into a frill cut into the lower stem. This should reduce the spread of mountain pine beetle infestations in the treated areas.

The area currently infested in the Chilcotin Supply Block was only partially infested when the last infestation collapsed in 1985. Sufficient susceptible host material near the 1979-1984 infestations remains to support



Map 2. Areas where recent tree mortality and current defoliation were detected during ground and aerial surveys in 1988.

another population buildup, if the brood survives naturally limiting factors such as climate. The expected population increase in the Supply Block, based on the current attack in the area, could be tempered by the control efforts. Elsewhere, at untreated locations, infestations will likely increase.

Pine engraver beetle

Ips pini

The very large populations of pine engraver beetle, which caused widespread mortality of mature lodgepole pine in the Chilcotin in 1987, collapsed in 1988. The collapse was probably due to the greatly reduced amount of suitable host material, including dying trees attacked by mountain pine beetle and logging slash.

Large numbers of engraver beetle attacks were recorded in 1986 primarily in previous mountain pine beetle infestations. They were a factor in helping to overcome the tree's natural resistance to insect attack; however, mountain pine beetle usually initiated the attack. In 1987 the beetle was identified as the major cause of pine mortality in 7250 separate pockets of dead trees over 3400 ha in the western part of the region.

Judging from the reduced size of pine engraver beetle populations in the Gaspard Creek and Palmer Lake areas, they are expected to revert to their normal role as a secondary beetle infesting recent slash, windfall and pine under stress.

Lodgepole pine dwarf mistletoe

Arceuthobium americanum

Dwarf mistletoe infections in lodgepole pine stands throughout the region have resulted in significant volume losses over the years. Up to 55% of the living lodgepole pine understory and 43% of the overstory were infected in eight mountain pine beetle-infested stands in the Chilcotin.¹ Roadside surveys in 1972 indicated that 41% of adjacent mature pine were lightly² infected, 20% moderately infected and 11% severely infected.³

Increased numbers of openings in infected pine stands due to mountain pine beetle salvage logging and other causes will stimulate mistletoe seed production and spread of the disease. All the pine regeneration in 0.5-ha patches around the edge of a recent cutblock at Km 19 Palmer Lake Road, were infected; each tree had 1-3 large dwarf mistletoe plants. Growth loss will continue to increase in these infected stands; therefore, identification and treatment of infected stands is a management objective which should be seriously considered in mistletoe infected lodgepole pine stands in the Cariboo Region.

¹Shore, T., et al. 1982. Survey for dwarf mistletoe infection in lodgepole pine regeneration under mountain pine beetle attacked stands in the Chilcotin. Special Report, F.I.D.S.

²Light: <1/3 of trees infected; moderate, from 1/3 to 2/3 of trees infected; severe, >2/3 of trees infected.

³Van Sickle, G.A. 1975. Feasibility of roadside surveys for assessing the extent and severity of lodgepole pine dwarf mistletoe. Pac. For. Res. Centre. Unpub. Rept. 16 p.

Pinewood nematode
Bursaphelenchus xylophilus

Live adult woodborers and horntails (Table 1) from eight widespread locations in the region were collected to determine the presence of B. xylophilus. This was the sixth consecutive year of quarantine-related special surveys for pinewood nematode in the Cariboo Region; however, analysis of the samples was not available at the time of writing. The nematode was extracted in the region by Agriculture Canada in 1986, from wood chips collected at mills in Quesnel, Williams Lake, 100 Mile House and Clinton. None, however, have been found in wood samples from dead or dying trees.

The adult woodborers, potential vectors of pinewood nematode, were netted live from recently logged and decked lodgepole pine adjacent to dead standing trees, killed primarily by mountain pine beetle and pine engraver beetles. The most common longhorned woodborers, Cerambycidae, were the whitespotted sawyer, Monochamus scutellatus, and the spotted pine sawyer, M. maculosus. One or both of these species were collected at six of the eight locations.

Table 1. Adult woodborers and horntails collected for pinewood nematode extractions, Cariboo Forest Region, 1988.

Woodborer/Horntail	Number collected	Locations
<u>Monochamus maculosus</u>	18 16 12 7 1	Big Bar L. 100 Mile House Bullock L. Chasm Quesnel
<u>M. scutellatus</u>	6 5 3	100 Mile House Springhouse Quesnel
<u>Buprestis lyrata</u> [=rusticorum]	6 3	Farwell Canyon Quesnel
<u>B. nuttalli</u>	2	Chasm
<u>Pachyta lamed</u>	4	Anahim
<u>Dicerca tenebrosa</u>	2	Chasm
<u>Xylotrechus undulatus</u>	2	Quesnel
<u>Rhagium inquisitor</u>	1	Big Bar L.
<u>Sirex cyaneus</u>	2	Quesnel

Woodborer/Horntail	Number collected	Locations
<u>Strictoleptura canadensis</u> <u>cribipennis</u>	2	Quesnel
Total	92	

Since 1983, when sampling for pinewood nematode in British Columbia started, occasional positive collections have been made from wood samples; however, the sampled trees were predisposed by other causes and the nematode, although present, was not a major factor in the death of the trees. In Japan the pest does cause tree mortality. Nematode monitoring surveys are not scheduled in 1989.

Pine needle diseases
Elytroderma deformans
Davisomycella ampla
Lophodermella concolor

Lodgepole and some ponderosa pine were infected by Elytroderma needle disease, Elytroderma deformans, in patches at numerous locations in 1988 in the Chilcotin and southern Cariboo, an increase from 1987.

Up to one third of the lodgepole pine foliage was infected on 50-100% of the trees in 0.5 to 100-ha patches at widespread locations near Alkali Lake, from Hanceville to Alexis Creek, from Dog Creek east to Highway 97, Horse Lake to Green Lake, Green Lake to Highway 97, near the Dome west of Williams Lake, and on Mount Grant near Loon Lake. Forty percent of the foliage on 45% of the lodgepole pine from Deka Lake to Drewry Lake was infected. All the mature and immature ponderosa pine, the most common host of the needle disease, were moderately infected (35% of the needles) from Kelly Lake to Clinton and near Loon Lake.

Systemic infections on ponderosa pine result in growth loss; premature needle loss on lodgepole pine is common. Spores of the needle disease mature and spread for several months beginning in July. Their spread is favored by cool temperatures and high humidity. Temperatures in August and September at Williams Lake Airport were normal; however, precipitation was double the normal. These conditions would probably favor the spread of the disease, indicating the possibility of greater infection and damage in 1989.

Several patches of mature and immature lodgepole pine were infected by pine needle casts, D. ampla and L. concolor, for the first time since 1984. Infection and premature loss of new needles was most common near North Bonaparte east of 100 Mile House where 20% of the needles on 60% of the trees over 10 ha were infected. At South Anahim Creek half the new needles on all the pines were infected over 100 ha, and similarly 60% of the needles on all the trees were discolored over 10 ha at Wavey Lake near Bridge Lake. At Alkali Creek and at 40 km on Palmer Lake Road west of Riske Creek, 30% and 20% of the new needles

were infected on all the trees at each location, respectively.

Infection of young, succulent needles occurs in late spring and is favored by moist conditions at that time. Symptoms such as discoloration of infected foliage and subsequent defoliation occur the year after attack. Rainfall in April and May at Williams Lake Airport was 280% and 150% of normal, respectively, which could indicate severe infection and discoloration in 1989.

Stalactiform blister rust
Cronartium coleosporioides

Immature and mature lodgepole pine were severely infected by this canker disease at three locations surveyed in the region in 1988.

At 15.5 km on the 700 Road south of Hanceville in the Chilcotin, half the 6-m high pines over 10 ha were infected with stem cankers. The trees had been infected for many years with some cankers 3 m long. Rodents, attracted to sugary exudations, had chewed the margins of most cankers, thereby enlarging the wounded area. Approximately 2% of the infected trees were killed by the girdling of the stems and attacks by pine engraver beetles, Ips pini.

At 93 Mile, south of 100 Mile House, 5% of the 1-to 3-m high lodgepole pine over 2 ha were cankered. Stem cankers averaged only 25 cm long and there was no rodent feeding or tree mortality.

Along the Anahim Creek access road, 60% of the 10-m high pine over 150 ha were infected with cankers 1-to 3-m long. Rodents had chewed the canker edges however, tree mortality was not observed.

As the disease is very common in pine stands throughout the region it is expected to continue indefinitely causing tree mortality and reduced wood quality in surviving trees.

Animal Damage

Mortality and removal of patches of bark of pines, attributed to rabbits and squirrels, was common at three locations in the Chilcotin.

Thirty percent of the whitebark pine 2-to 15-m high, were killed over 5 ha at Heckman Pass by rabbits feeding and removing patches of bark. Similarly, half of the 2-to 3-m high lodgepole pine near Km 22, Palmer Lake Road, had patches of bark removed which resulted in girdling and mortality in 1-to 2-ha patches throughout a 50-ha clearcut.

Additionally, 50% of the common juniper over 2 ha at Km 0.5, 2900 Road in the Gaspard Creek area were girdled and killed by rodents. Dead shrubs were visible on the southfacing slope of the creek.

Depending on natural predators, diseases and weather, damage will likely occur in the same areas in 1989.

DOUGLAS-FIR PESTS

Western spruce budworm
Choristoneura occidentalis

Defoliation of Douglas-fir by western spruce budworm was light over 8 000 ha near Horsefly and Mahood lakes, down from 6 000 ha of light and 3000 ha moderate in the same area last year (**Map 2**). Most (95%) of the defoliation occurred between Quesnel and Horsefly lakes including Jacques, Hen Ingram and Keno lakes and Viewland Mountain. Near Mahood Lake defoliation was over 300 ha in nine 10- to 70-ha spots, down from 3200 ha of light and moderate defoliation last year. Infestations collapsed at Big Bar Mountain, where 550 ha of mostly moderate defoliation occurred last year. The collapse was attributed to natural factors such as weather, parasites, predators and disease. Very light defoliation of current growth, not visible from the air, occurred in a mature Douglas-fir stand over 20 ha along the Quesnel River north of Likely. Very light defoliation of the current growth of Douglas-fir, spruce and alpine fir occurred also in mixed stands from Mahood Lake southeast to the regional boundary.

Light defoliation¹ was predicted for 1988 from infested Douglas-fir buds examined in May at four previously infested stands. At Mahood Lake 12% of buds were infested; at Viewland Mountain, 8%; at Big Bar Mountain, 6%; and at nearby China Gulch, 3% of the buds were infested. The defoliation predictions were correct at Mahood Lake and Viewland Mountain, where light defoliation was mapped, but at Big Bar Mountain and China Gulch, defoliation did not occur as forecasted.

Parasitism of late-instar larvae by Hymenoptera and Diptera at Horsefly Lake averaged 7%, but was too low to significantly affect the population. Parasites play a larger role in reducing small budworm populations but are not as effective in reducing high populations ("Western spruce budworm", USDA Technical Bulletin No. 1694).

The moth flight occurred during the second and third weeks of July at Horsefly and Mahood lakes, but there were no reports of any extremely large numbers.

A province-wide study using pheromone-baited plastic traps to improve the detection of rising populations was begun in 1987. Sampling in the Cariboo Region was initiated at Viewland Mountain and Roserim Lake but these locations were dropped in 1988 because budworm populations were too large. At a plot established in 1988 near Bridge Lake, an average of 35 moths were caught in each of five traps and only four larvae were collected in three branch tip beatings on each of 25 trees. These results indicate a low western spruce budworm population which fits the parameters of the study; therefore, trapping will continue and ultimately should provide forest managers with a useful predicting tool.

- ¹0% of the buds infested = no defoliation
- 1-15% of the buds infested = light defoliation
- 16-30% of the buds infested = moderate defoliation
- 31%+ of the buds infested = severe defoliation

Egg samples were collected in September to forecast 1989 population trends. Foliage containing egg masses was collected from two 45-cm branch tips from the mid-crown of each of ten trees at each location. There were 271 egg masses per 10 m² of foliage at Viewland Mountain and 28 per 10 m² at Likely. The egg mass counts indicate severe defoliation at Viewland Mountain and light defoliation at Likely. Predictions in 1987 for 1988 were more severe than the actual defoliation, presumably because natural control factors reduced the populations. The western spruce budworm infestations should expand in 1989, precluding any adverse effects from weather or parasites.

Douglas-fir beetle **Dendroctonus pseudotsugae**

In the fourth consecutive year of declining infestations, only 25 groups of 1-20 red trees were mapped over approximately 20 ha, down from 590 ha in 82 infestations last year.

The groups occurred at widely scattered locations from Big Bar Mountain to Quesnel along the Fraser River and in the Alexis Creek area. These drier Douglas-fir stands have historically been very susceptible to Douglas-fir beetle. Forest Insect and Disease Survey records, beginning in 1946, show that infestations were largest from 1963-65 when a total of 96 800 mature Douglas-fir trees were killed. Those losses were preceded in 1961 and 1963 by 18% and 24% less precipitation than normal at Williams Lake Airport. In 1987 precipitation was 30% less than normal, indicating a potential for increased losses of drought-stressed mature Douglas-fir from beetle attacks.

During abnormally dry years, mature Douglas-fir attacked by the beetle in the spring can change color before the end of the same year, usually in the late fall or early winter. In 1988 the BCFS reported more Douglas-fir turning red in October near the patches mapped in July. This indicates the possibility of increased tree mortality in 1989 near those mapped this year. Removal of 1988 beetle broods before May 1989 could reduce populations and potential tree mortality.

Douglas-fir needle midges **Contarinia spp.**

Most (80-100%), of the current growth of all Douglas-fir trees was defoliated east of McLeese Lake for 15 km toward Big Lake. The premature needle loss was widespread and affected mainly the lower crown of mature trees and the complete crown of immature trees. The impact on the affected trees is considered significant only if the trees are being grown for Christmas trees. The last severe damage in the region was in 1977; none is forecast to occur in 1989.

Adults emerge from the soil in May and lay eggs on the needles. The larvae emerge and mine the needles, damaging and discoloring them until they eventually drop.

Drought and salt damage

Top-kill of 1- to 3-m high Douglas-fir undergrowing regeneration, caused by lack of moisture, was common east of Lac la Hache near Lake of the Trees. In

several 0.25-ha patches, 20% of the trees had 1-to 1.5-m long tops killed. The affected stands were pure, multi-aged Douglas-fir on southern aspects in rocky soils. Stands on these sites are most vulnerable to this type of damage during drought periods.

Drought-stressed mature Douglas-fir in this area would also be susceptible to attacks by Douglas-fir beetle and should be monitored closely. Secondary fungi and insects could also cause more damage to the regeneration trees already affected.

Dead and dying Douglas-fir were common along major highways where snowplows had thrown salty spray. Damage was widespread from Williams Lake to Clinton along Highway 97, with the most severe damage recorded from 100 Mile House to Clinton. The direct effects of the salt on the foliage were dramatic, resulting in foliage discoloration and branch and tree mortality. As with the drought damage, the effects of secondary beetle attacks on the weakened, damaged trees could also be severe.

SPRUCE PESTS

Two-year-cycle spruce budworm Choristoneura biennis

Mature 2-year-cycle spruce budworm lightly and moderately defoliated spruce and alpine fir stands over ~~11 200~~ ha in the Cariboo, nearly double the 21 000 ha defoliated by mature larvae in 1986 (Map 2, Table 2). Last year, immature budworm larvae lightly defoliated 11 200 ha, three times the corresponding amount defoliated in 1985.

Defoliation was widespread through the eastern portions of the Quesnel, Williams Lake and 100 Mile TSAs. In the Quesnel TSA, 15 310 ha light defoliation occurred in the Big Valley Creek-Willow River area, nearly half of the total for the region. Two years ago there were only 9300 ha; however, it was more intensive with 880 ha severe, 4320 ha moderate and 4100 ha light defoliation. South of the Willow River along the Swift and Little Swift rivers, 4810 ha were lightly and 400 ha moderately defoliated, where none occurred in 1986 or 1987.

Infestations occurred over similar areas and at the same intensities, as in 1986, with 4970 ha lightly and moderately defoliated along the north side of the North Arm of Quesnel Lake to Mitchell and Ghost lakes. New defoliation was light over 5780 ha and moderate over 200 ha near Quesnel Lake from Niagara Creek to Wasko Lakes and Bouldery Creek. Light defoliation occurred over 8590 ha and moderate on 210 ha from Bill Miner Creek near Quesnel Lake to Hendrix Lake, up from 4200 ha light and 200 ha moderate in 1986.

Table 2. Location and area of spruce and alpine fir defoliated by 2-year cycle budworm, as determined from aerial and ground surveys, Cariboo Forest Region, 1988.

TSA and location	Area of defoliation (ha)		
	Light	Moderate	Total
<u>QUESNEL TSA</u>			
Willow R.	9150		9150
Tregillus Cr.	2320		2320
Big Valley Cr.	3370		3370
Wells	150		150
Bowron Provincial Park	500		500
Swift R.	4810	400	5210
Ghost L.	900		900
Subtotal	21 200	400	21 600
<u>WILLIAMS LAKE TSA</u>			
Cameron Cr.	460		460
Grain and Service Cks.	1870	1060	2930
Mitchell L.	730		730
Niagara Cr.	540		540
Roaring R.	810		810
Wasko Lakes-Roaring Peaks	2060		2060
Lynx Cr.-Bouldery Cr.	2370	200	2570
Horsefly R.	1790		1790
MacKay R.	1000		1000
Subtotal	11 630	1260	12 890
<u>100 MILE HOUSE TSA</u>			
Crooked L.-Deception Cr.	4590	210	4800
Hendrix L.	1210		1210
Subtotal	5800	210	6010
GRAND TOTAL	38 630	1870	40 500

To predict defoliation of alpine fir and spruce stands in 1988, 100 buds were examined at each of seven locations throughout the infestation in May (Table 3). At all locations, the resulting defoliation was as predicted.

Table 3. Percent buds infested by 2-year-cycle spruce budworm and predicted defoliation and actual defoliation, Cariboo Forest Region, 1988.

TSA and location	Percent of buds infested (May)	Defoliation	
		Predicted ¹	Actual (August)
<u>QUESNEL TSA</u>			
Bowron L. Rd.	20	L	L
Upper Willow R.	17	L	L
Dillabough L.	5	L	L
Wells	20	L	L
<u>WILLIAMS LAKE TSA</u>			
MacKay R. (1)	21	L	L
MacKay R. (2)	24	L	L
Archie Cr.	14	L	L

¹Percent buds infested in second year of life cycle = percent defoliation, (FIDS Report 84-1).

The moth flight and egg laying occurred during the last part of July at most locations. Five pheromone-baited plastic Multipher R traps caught an average of 117 moths per trap at Bowron Lake and 62 per trap near Wells. There was less than one larva per 45-cm branch tip beating sample from each of three branches from 25 trees at each location. The numbers of adults, however, indicate a sufficient population to continue the infestation.

To predict populations and defoliation next year, two 45-cm branch tips were collected from each of 10 trees at each location and the number of egg masses counted and extrapolated to the number per 10 m² of foliage. An average of 276 egg masses per 10 m² of foliage were collected at eight locations throughout the infestation, slightly more than an average 259 from five of the same locations sampled in 1986 (Table 4). Additionally, defoliation in 1990 is predicted to be severe at six locations and moderate at two, in the second year of the budworm's two-year life cycle.

Table 4. Number of 2-year-cycle spruce budworm egg masses per 10 m² of foliage and predicted defoliation of spruce and alpine fir in 1989, Cariboo Forest Region, 1988.

Location	No. of egg masses per 10 m ² of foliage		Predicted ¹ defoliation
	1988	1986	
Big Valley Cr.	372	340	severe
Pundata Cr.	189	483	severe
Dragon Mtn.	161	-	severe
Paput Cr.	199	-	severe
Swift Cr.	97	-	moderate
Grain Cr.	124	333	moderate
Mitchell R.	620	95	severe
MacKay R.	396	44	severe

- ¹1-50 egg masses/10 m² of foliage - light defoliation
 51-150 egg masses/10 m² of foliage - moderate defoliation
 151+ egg masses/10 m² of foliage - severe defoliation

Two-year-cycle spruce budworm infestations have been recorded periodically in the same eastern part of the Cariboo Forest Region since 1913. The area from the Willow River to the Cariboo River has been infested most often and with the most severe defoliation intensity. From Quesnel Lake south to Mahood Lake, defoliation has occurred in varying intensities at areas such as MacKay River, Hendrix Lake, Crooked Lake and Deception Creek.

The current infestation has spread through all the historically infested areas and beyond into new stands. Next year, during which early instar budworm larvae only are present, there will be bud mining and possibly severe defoliation of undergrowing regeneration in areas defoliated in 1988. This prediction is based on egg mass studies and historical trends. Defoliation of mature trees will probably occur over a reduced area and at a less severe intensity; however, if a warming climate occurs due to the "greenhouse effect", there may be greater spread of 2-year spruce budworm populations, resulting in more damage to spruce and alpine fir stands.

Spruce beetle **Dendroctonus rufipennis**

Spruce beetle populations remained low for the second consecutive year. There was no recent tree mortality observed during aerial surveys, compared to 290 ha in 1986 and 2160 ha in 1985.

Reports from the British Columbia Forest Service indicated a small infestation at Big Valley Creek, 7 km east of its junction with the Willow River, but its area is not known. Salvage logging of the block should eliminate the infestation before beetle flight time in the spring of 1989.

ALPINE FIR PESTS

Western balsam bark beetle-fungus complex

Dryocoetes confusus Ceratocystis dryocoetidis

There were 1200 ha containing 7320 m³ of recently killed alpine fir mapped in the region this year, in 18 high elevation spruce and alpine fir stands, down from 1600 ha last year.

Most of the infestations (730 ha) were in the Williams Lake TSA from Mitchell Lake to MacKay River. Other areas of recently killed trees included Betty Wendle Creek (80 ha), Stiklan Pass near Chilko Lake (170 ha) and above Yohetta Lake (240 ha).

Western balsam bark beetle is a chronic pest problem of mature alpine fir stands through the region. Populations fluctuate, although not as dramatically as some other bark beetles. Based on historical trends, infestations usually expand slowly until the alpine fir stand component is depleted. This trend is expected to continue in the region next year.

PESTS OF YOUNG STANDS

Surveys of 2-to 25-year-old, natural and planted conifer stands in the region continued, to monitor and identify major pests and their impact. Thirteen stands were surveyed using fixed-radius plots on transects, and the pest damage assessed (Table 5).

The most common pest was lodgepole terminal weevil, Pissodes terminalis, which top-killed an average of 2.6% of trees at six plots. Significant damage to mainly lodgepole pine seedlings caused by 11 other insect and disease pests occurred in varying degrees. Warren's root collar weevil, Hylobius warreni killed up to 10% of the pine at three regeneration sites. Conifer weevil, Magdalis sp., partially defoliated the new shoots of an average of 7% of the regeneration pine at four locations. Animal damage in the form of browsing and girdling caused some mortality and deformation to 7% of saplings at four locations. Other less common pests were snow damage; sunscald; western gall rust, Endocronartium harknessii; pitch nodule moth, Petrova albicapitana, and lodgepole pine dwarf mistletoe, Arceuthobium americanum.

Recommendations for management action to alleviate damage from pests at the plantations sampled must be site-specific; therefore, control actions are not outlined in this report.

Table 5. Summary of pests of young stands in the Cariboo Forest Region, 1988.

Host/Pest	No. of stands affected	Percent trees affected	Remarks
<u>Lodgepole pine</u>			
Lodgepole terminal weevil <u>Pissodes terminalis</u>	6	1-4	4% of terminals killed at Palmer L. Rd. and Meadow L.; less elsewhere.
Conifer weevil <u>Magdalis</u> sp.	4	3-16	5% of current foliage defoliated; 16% of 2-m trees affected at Gavin L.; average 5% elsewhere.
Pine root collar weevil <u>Hylobius warreni</u>	3	1-10	10% of 4-m trees killed at Wild Goose L.; 1% and 2% elsewhere.
Dwarf mistletoe <u>Arceuthobium americanum</u>	2	1, 3	1 to 3 stem infections per tree on 3% of the 2-m pine.
Western gall rust <u>Endocronartium harknesii</u>	2	10, 14	1-10% of the branches infected.
Pitch nodule moth <u>Petrova albicapitana</u>	1	3	Pitch nodules on 10% of the branches at Likely.
Pine needle cast <u>Lophodermella concolor</u>	1	8	30% of year-old needles discolored on lower 25% of the crown at Palmer L. Rd.
Cattle browse	1	5	20% of branches on 2-m saplings damaged at Gavin L.
Rodent damage	1	9	3% mortality from girdling at Palmer L. Rd.
<u>Douglas-fir</u>			
Animal damage, (Moose)	1	10	Tops of 2-m trees browsed at Wild Goose L., causing bushy tops.
Spruce gall adelgid <u>Adelges piceae</u>	2	9	10-20% of current growth of 4-m trees infested at Raft River and Lily Pad L.
Snow damage	1	7	Trees broken at Lily Pad L.
<u>White spruce</u>			
Sunscauld	1	56	1.5-m regeneration damaged at Wells.

Lodgepole terminal weevil
Pissodes terminalis

The incidence of attacks on young lodgepole pine leaders declined to an average of 4% (range 0-10%) at eight locations from 6% last year. The attacks tended to be in groups of two to six trees scattered throughout cutblocks. The pine regeneration was mainly in clearcuts and averaged 2 m high (range 1.5 to 3.5 m) and was 5- to 10-years old.

This pest of planted and natural regeneration pine, native to British Columbia and widespread throughout lodgepole pine stands in the Cariboo Forest Region, is expected to continue and attack terminals next year, based on historical trends.

A conifer weevil
Magdalis sp.

Regeneration lodgepole pine at widely scattered sites from Clinton to Alexis Creek was severely defoliated by increased populations of conifer weevil. Up to 80% of the current growth of 1-to 3-m high pine in and around recently logged areas was defoliated by adult maturation feeding. Abundant fresh slash in logged areas and spaced stands provided a breeding ground contributing to the population increase.

Defoliation of current growth occurred at scattered locations along the Military Road to Nemaiah Valley, near Meadow Creek north of Clinton and near Moffatt Creek east of 150 Mile. Other areas included stands east of Alexis Creek and along Patrick Creek east of Alkali Lake, in a Forest Renewal Development Agreement (FRDA), juvenile spacing contract.

Populations are expected to diminish in areas where the slash has become dry and unattractive to the weevils; however, young pine near to 1989 logged areas will probably sustain similar levels of defoliation as occurred in 1987 and 1988.

MULTIPLE HOST PESTS

Black army cutworm
Actebia fennica

Although populations remained low throughout most of the eastern part of the region, planted seedlings and herbaceous growth were severely defoliated by the cutworm over approximately 1 ha in an isolated infestation at Bootjack Lake west of Likely. Fifty to 100% defoliation of seedlings and herbaceous growth occurred in three 0.25- to 0.5-ha patches in a logged area burned in 1987. Several black cutworm larvae, Agrotis ipsilon, were also collected at the same location.

Five pheromone-baited¹ sticky traps were set out at three locations to monitor the distribution and density of adult male populations. An average of five male moths were caught per trap at Cariboo River, three at MacKay River and

¹cis-7-docenyl + cis-11-tetradecenyl

less than one at Bootjack Lake. These numbers indicate endemic populations at the locations trapped; however, warm, dry, spring weather on very black burns can accelerate development of populations.

Cone and seed pests

Cone crops were generally heavy on Engelmann spruce and alpine fir and moderate on ponderosa pine and Douglas-fir.

An average of 28% of the cones collected were infested by seven species of cone and seed insect pests (Table 6). Thirty-five percent of Engelmann spruce cones, 18% of Douglas-fir and 20% of alpine fir were infested. Fifty cones were collected from a total of five trees at each of 10 locations.

An average of 23% (range 5 to 45%), of the spruce seed were destroyed by spruce cone maggot, Strobilomyia neanthracinum. The spruce seed moth, Cydia strobilella, infested an average of 15% of the seed at three locations and the spruce cone axis midge, Dasineura rachiphaga, destroyed only 2% of the seed at one location.

At two locations, 5% of the Douglas-fir cones were infested by the Douglas-fir scale midge, Contarinia washingtonensis; 20% by Douglas-fir gall midge, C. oregonensis; 5% by a Douglas-fir coneworm, Dioryctria pseudotsugata, and 5% by Douglas-fir cone moth, Barbara colfaxiana.

A fir cone maggot, Earomyia aquilonia, destroyed 20% of alpine fir cones at Gavin Lake near Likely.

Table 6. Percentage of cones infested by cone and seed insects, Cariboo Region 1988.

Host/Pest	Percent cones infested	Location
<u>Engelmann spruce</u>		
Spruce cone maggot	45	The Dome
<u>Strobilomyia neanthracinum</u>	30	Gavin L.
	14	Hawks Cr.
	5	Quesnel Forks
Spruce seed moth	10	The Dome
<u>Cydia strobilella</u>	20	Gavin L.
	15	Quesnel Forks
Spruce cone axis midge	2	Hawks Cr.
<u>Dasineura rachiphaga</u>		
<u>Douglas-fir</u>		
Gall midge	20	Canim L.
<u>Contarinia oregonensis</u>		

Host/Pest	Percent cones infested	Location
Scale midge <u>C. washingtonensis</u>	5	Lac la Hache
A cone worm <u>Dioryctria pseudotsugata</u>	5	Canim L.
Cone moth <u>Barbara colfaxiana</u>	5	Canim L.
<u>Alpine fir</u>		
Fir cone maggot <u>Earomyia aquilonia</u>	20	Gavin L.

DECIDUOUS TREE PESTS

Forest tent caterpillar Malacosoma disstria

For the first time since 1984, 460 ha of mainly trembling aspen were 60-100% defoliated in 28 separate infestations from Canim Lake to Green Lake. There were scattered 10-to 40-ha patches of defoliated aspen along Jim Creek south of Canim Lake; near Deka and Bridge lakes, and south to the Bonaparte River and Green Lake.

The previous infestation in 1983 and 1984 in the Quesnel River Valley and near Horsefly and Likely covered 400 ha. The history of forest tent caterpillar infestations in Cariboo Region goes back to 1937 in the same areas infested this year, plus areas along the Fraser River from Quesnel to Williams Lake.

The numbers of new and old egg masses on trees at representative infestations forecast a continuation of infestations next year.

Gypsy moth Lymantria dispar

There were no male gypsy moth adults caught in 22 pheromone-baited sticky traps placed in 17 provincial parks and highway rest areas throughout the region in 1988 (Table 7). This was the thirteenth consecutive year of the cooperative survey to monitor the spread of this serious deciduous defoliator into British Columbia. The gypsy moth trapping program is a cooperative project with Agriculture Canada (Plant Health), Forestry Canada and the B.C. Forest Service.

Elsewhere in British Columbia there were 12 male adult gypsy moths captured in 12 traps at seven locations, down from 216 moths in 56 traps at six locations last year. Moths were trapped at Kelowna (4), CFB Colwood (1), Parksville (2), Point Roberts (2), Coquitlam (1), West Vancouver (1) and at Yard Creek east of Sicamous (1).

Quarantine-related surveys to monitor male adult populations will continue in parks, recreational and other areas throughout the region next year.

Table 7. Locations of provincial parks and rest areas where single pheromone-baited sticky traps were placed to monitor adult male gypsy moth in the Cariboo Forest Region, 1988.

Location	No. of traps
Loon Lake	1
Big Bar Lake	1
Green Lake	3
Lac la Hache	2
Canim Lake	1
Ruth Lake	1
Bridge Lake	1
Horsefly Lake	1
Bull Canyon	1
Tweedsmuir	2
Ten Mile Lake	1
Bowron Lake	1
Cottonwood House	1
Barkerville	2
Cedar Point	1
Likely	1
McLeese Lake Hwy. Rest Area	1

OTHER PESTS OF MINOR SIGNIFICANCE

Collections and observations of other potentially damaging pests, currently of minor significance throughout the region, are listed by importance (Table 8).

Table 8. Pests of current minor significance in the Cariboo Forest Region, 1988.

Pest	Host	Location	Damage	Status ¹
Pine needle sheathminer, lodgepole <u>Zelleria haimbachi</u>	pine	Mahood L.	All trees had 20% of tips defoliated over 10 ha	I
Corky bark disease	alpine fir	SE of Mahood L.	5% of mature trees infested over two 2-ha patches	S
Poplar shoot blight, <u>Venturia macularis</u>	trembling aspen	Big Bar L.	All trees 80% discolored on 3 ha	D

¹I = Increasing; D = Decreasing; S = Static

Canada