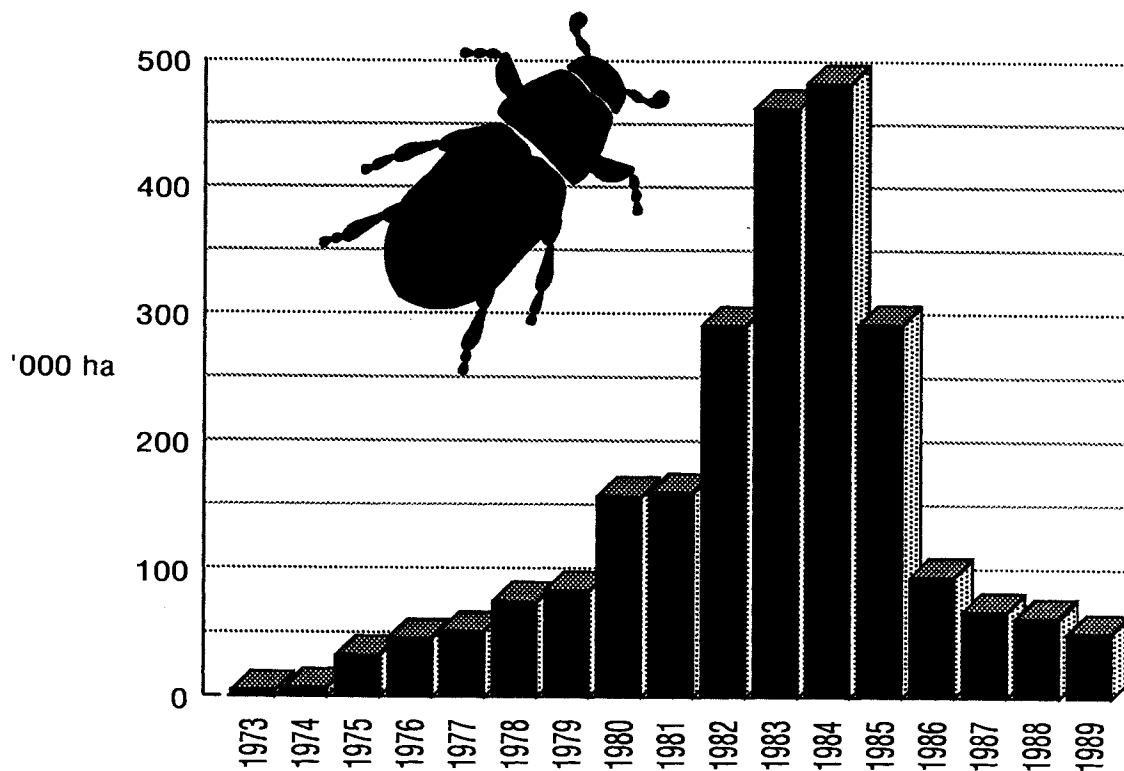




Forest Insect and Disease Conditions

Cariboo Forest Region
1989

R.D. Erickson & R.L. Ferris



Mountain Pine Beetle in British Columbia



Forestry
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INTRODUCTION

This report outlines the status of forest pests recorded by the Forest Insect and Disease Survey (FIDS) in the Cariboo Forest Region in 1989, and attempts to forecast some of their trends. Pests are discussed by host, generally in order of their importance.

The Forest Insect and Disease Survey is a nation-wide network working within Forestry Canada (formerly Canadian Forestry Service). It is responsible for producing an overview of forest pest conditions and their implications; maintaining records and surveys to support quarantines; supporting forestry research; providing advice on 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 1989 field season extended from May 23 to September 27, during which there were 320 insect and disease samples and other pest data collected by FIDS personnel. Pest damage was mapped and photographed during 21.2 hours of fixed-wing aerial survey and 2 hours of survey by helicopter (Map 1). The British Columbia Forest Service (BCFS), supplied 15 hours of the fixed-wing time and all the helicopter time; Forestry Canada supplied the remainder. Additional information was obtained from an aerial survey contracted by the BCFS.

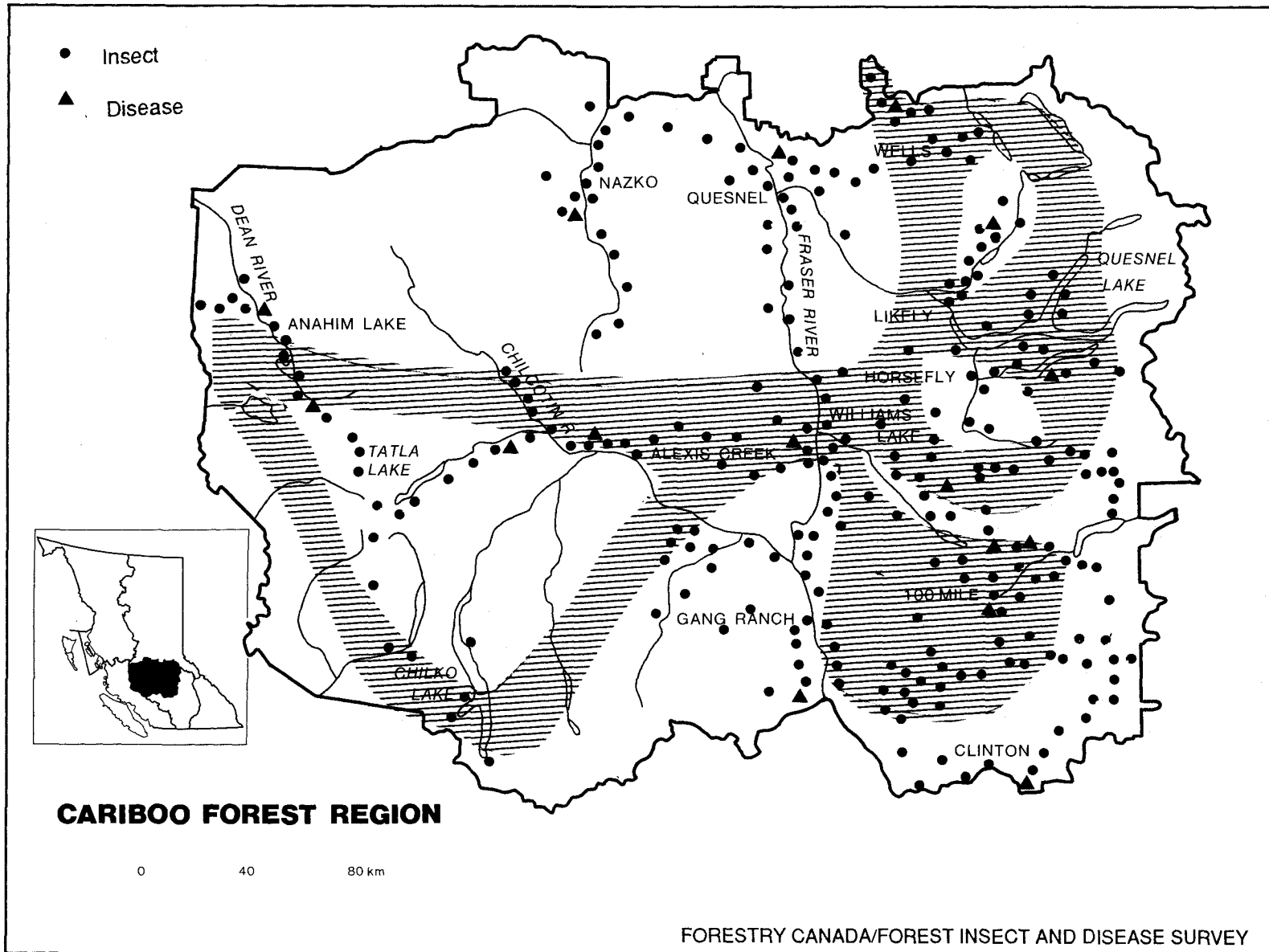
The Forest Insect and Disease Survey has conducted an annual pest survey in the Cariboo Forest Region since the late 1930s, and from an established field headquarters at Williams Lake since 1954. Inquiries can be directed to this field station during the field season to this address:

Forestry Canada
Forest Insect and Disease Survey
Sidcum Sub., Comp. 33,
Williams Lake, B.C.
V2G 2V4 Ph. 392-6067

The field station is closed from October to April; however, FIDS staff including the ranger may be reached anytime at:

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

Larger-scale copies of maps included in this report are available on request.



Map 1. Locations where one or more forest insect and disease samples were collected and areas covered by aerial surveys to map bark beetles and defoliator infestations in 1989.

SUMMARY

A large increase occurred in the number of Douglas-fir trees killed by **Douglas-fir beetle** and in the area of poplar defoliated by **forest tent caterpillar**. The number of lodgepole pine trees killed by **mountain pine beetle** declined slightly as did the area of spruce and alpine fir defoliated by **two-year-cycle spruce budworm**. **Drastic weather** changes caused defoliation of cedar and killed buds on regeneration-sized Douglas-fir, spruce and alpine fir.

Following four years of declining populations, **Douglas-fir beetle** populations increased, killing susceptible mature Douglas-fir in 1280 separate patches over 1160 ha from north of Quesnel south through the host range to Clinton. There was no defoliation of Douglas-fir by **western spruce budworm** recorded this year, down from 8000 ha of light defoliation¹ last year. **Rhizina root disease** killed Douglas-fir seedlings over five hectares near Cariboo Lake, for the first time in the region since 1983.

Mortality of lodgepole pine caused by **mountain pine beetle** occurred over 720 ha in 206 separate infestations, down from 1290 ha in 230 patches last year. Mature lodgepole pine, attacked by mountain pine beetle last year at Chilko Lake, were heavily attacked by **ambrosia beetles** this year. Ponderosa and lodgepole pine needles were less severely infected by **Elytrodema needle disease** in fewer areas through the region in 1989. The defoliation of the current growth of lodgepole pine by **conifer weevil** in the Chilcotin was not as wide-spread as last year.

Immature **two-year-cycle spruce budworm** lightly defoliated spruce and alpine fir stands over 2800 ha in the eastern portion of the region, down from 40 500 ha last year, a feeding year. The attack on immature Engelmann spruce leaders by **spruce weevil** continued throughout the spruce stands in the Cariboo Region.

Recent mortality of alpine fir caused by **western balsam bark beetle** was mapped at scattered locations throughout the region over 2160 ha, up from 1200 ha last year.

In 12 plantations 15 years old or less, the damage most commonly recorded was caused by **western gall rust, lodgepole terminal weevil, dwarf mistletoe, animals** and extremes of **climate**.

From the end of January to the first days of February, 1989, a drastic temperature change resulted in widespread **climatic damage** to Douglas-fir, spruce, western red cedar and alpine fir.

There was no reported damage to seedlings by **black army cutworm** this year. Damage to roadside conifers occurred again throughout the region, mainly caused by **roadside spray** and **seepage of salt**.

- 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 sustaining more than 50% total defoliation

Forest tent caterpillar moderately to severely defoliated mainly trembling aspen over 3200 ha in the eastern portion of the region for the third consecutive year, up from 460 ha last year. Surveys and special studies were conducted for **aspen decay** and **acid rain**. Willow, alder and poplar saplings were 60-100% defoliated by **western tent caterpillar** along the upper Horsefly River. There were no adult male **gypsy moths** caught in 25 sticky traps placed in 20 provincial parks, campgrounds and highway rest areas in the region.

DOUGLAS-FIR PESTS

Douglas-fir beetle
Dendroctonus pseudotsugae

Following four years of declining populations, Douglas-fir beetles increased, killing 26 600 m³ of mature and overmature Douglas-fir over 1160 ha in 1280 separate infestations of 3-50 trees each, from north of Quesnel south through the host range to the regional boundary south of Clinton (Map 2). This was up from 20 ha in 1988, 590 ha in 1987 and 650 ha in 1986 and represented enough lumber to build 380 averaged-sized houses. The population increase in 1989 was evident in late 1988.

The largest portion of the infestation occurred in the Chilcotin and Williams Lake districts in the **Williams Lake TSA**. In the Williams Lake District, infestations greatly increased in size to 405 ha in 583 patches. There were severe infestations mapped from McLeese Lake east to Tyee Lake, (82 ha in 120 patches); along the Fraser River from Macalister south to the Highway 20 crossing (56 ha in 83 patches); in the Military Block north of Riske Creek (77 ha in 115 patches), and across the plateau south of Williams Lake to Springhouse and Dog Creek (445 ha in 467 patches). Based on the cruise plot data, some of the most severe infestations occurred near Chimney Lake, six kilometers west of Williams Lake and at Hawks Creek north of Williams Lake.

In the **Chilcotin District**, infestations occurred in scattered patches of 3-50 red trees mainly in the Chilcotin and Chilko river valleys from Puntzi Lake to east of Hanceville with the most severe infestations southwest of Alexis Creek.

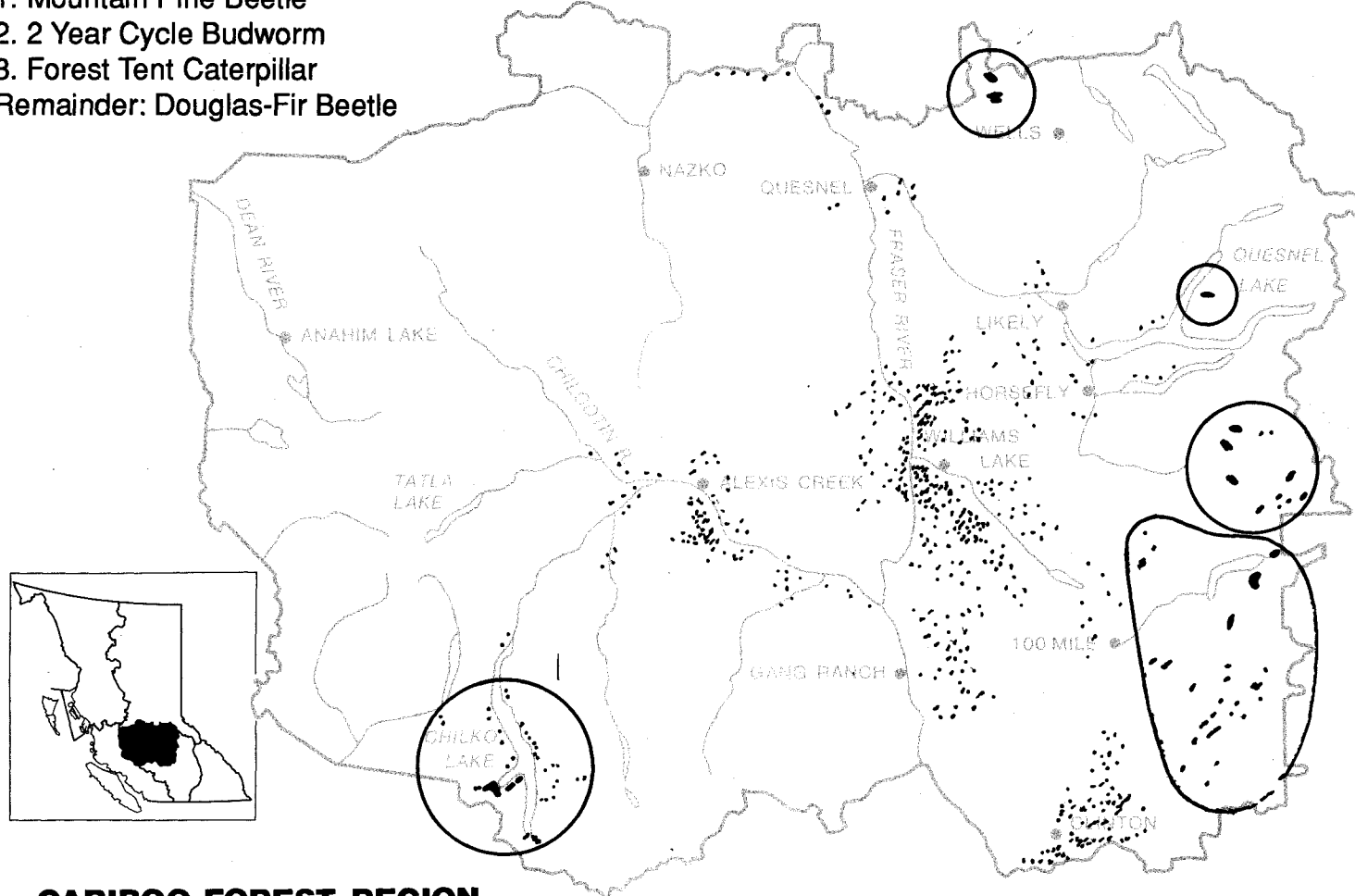
Infestations expanded in the **100 Mile TSA** north and west of 100 Mile House and in the Clinton area where about 100 small patches (70 ha) of recently killed trees were mapped along the Bonaparte River from Young Lake to Loon Creek. Nearly 160 patches (totalling 105 ha) were mapped near Clinton, and west to Kelly Lake and south to Loon Creek along Highway 97.

In the **Quesnel TSA** there were 38 new small infestations totalling 20 ha, located along the Blackwater River northwest of Quesnel and south from there along both sides of the Fraser River to the TSA boundary. There were 16 ha mapped in 32 small new infestations east of the Fraser to the Quesnel River.

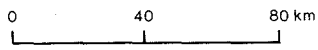
In the Horsefly District, part of **Williams Lake TSA**, previous infestations expanded and new ones were mapped totalling 120 ha at 67 locations between Horsefly and Quesnel lakes, and scattered from the Quesnel River south to near Moffat Lake.

The most recent, large, Douglas-fir beetle infestation recorded by FIDS in Williams Lake region was in 1974 when 7500 ha of recently killed trees were mapped. The largest infestation recorded since 1946, when records began, killed 33 000 trees in 1963. In comparison this year, there were 21 600 large-diameter recently killed Douglas-fir trees mapped, making the current infestation the second largest in recent recorded history.

- 1. Mountain Pine Beetle
- 2. 2 Year Cycle Budworm
- 3. Forest Tent Caterpillar
- Remainder: Douglas-Fir Beetle



CARIBOO FOREST REGION



FORESTRY CANADA/FOREST INSECT AND DISEASE SURVEY

Map 2. Areas where recent tree mortality and current defoliation were detected during ground and aerial surveys in 1989.

To assess the Douglas-fir beetle population and potential for 1990, 11 fixed-radius plots from 0.12 to 0.39 ha in size were established throughout the infestation (Table 1). The average current attack was 29% of the stems per ha (range 10-73%), and the number of recently killed red trees averaged 12% (range 6-23%). Some plots contained only current attack or current attack and previously killed, grey trees, indicative of previous infestations in the area. Recently killed trees were the source of the adult beetles; however, they were 500-1000 meters away from groups of currently attacked trees near Highway 20 approximately six kilometers west of Williams Lake, at Hawks Creek north of Williams Lake and southwest of Alexis Creek. This could indicate a declining population at those locations since the beetles had to travel some distance to find susceptible trees.

Table 1. Status of Douglas-fir beetle populations in cruise plots in the Cariboo Forest Region, 1989.

Location	Percent of stems/ha				
	Current ¹	Red	Grey	Healthy	Partial
Bonaparte R.	52	6	-	40	2
Clinton	12	23	12	46	7
Williams L.(W)	73	-	-	27	-
Williams L.(NW)	21	7	3	56	13
Williams L.(N)	10	8	25	55	2
Sheep Cr. Hill	24	18	5	48	5
Chimney L.	35	7	-	58	-
Hawks Cr.	29	-	4	66	3
McLeese L.	13	7	-	80	-
Lees Corner	12	22	3	61	2
Alexis Cr.	44	-	-	56	-

¹Current - trees attacked in 1989; red-trees attacked in 1988

Grey - trees killed prior to 1988

Partial - trees partially or strip attacked, still green.

The Douglas-fir beetle broods in trees attacked in 1989 were healthy, averaging 25 larvae/pupae/adults per 900 cm² of bark surface. Based on the amount of current attack and the viability of the brood at the individual infestations examined, the infestations are forecast to continue in 1990 at levels similar to 1989. Moderating factors such as the use of trap trees and control logging will reduce the expansion at infestations where those management practices have been used. New infestations are expected to become more evident at many locations next year, as trees attacked in 1989 change color.

The British Columbia Forest Service and all logging companies with Douglas-fir beetle problems in the region felled trap trees in many areas last winter to absorb the emerging beetles in May, 1989. Recently felled host material greater than 20-cm diameter is very attractive to the beetle. The absorption and removal of these populations will effectively reduce the hazard for beetle attack to adjacent, live, large-diameter Douglas-fir.

Western spruce budworm
Choristoneura occidentalis

There was no defoliation of Douglas-fir by western spruce budworm in the region in 1989. This was a drastic reduction from high populations and light defoliation over 8000 ha last year near Horsefly and Mahood lakes. The collapse was attributed to natural factors such as weather, parasites, predators and disease.

In May, infested bud counts, which predict defoliation later in the same year¹, averaged 40% at Jacques Lake and 20% at Viewland Mountain north of Horsefly Lake, indicating moderate and light defoliation, respectively. The population collapsed in the late larval instar stages, preventing significant feeding and visible defoliation. The average number of budworm larvae per three-tree beating sample dropped to four from 10 last year.

At a plot established in 1988 at Bridge Lake to monitor long-term budworm population trends, an average of 9 moths per pheromone-baited multipher trap were caught, down from 35 at the same location last year. A total of five larvae were collected in three branch-tip beating samples on each of 25 trees at the same location, similar to the numbers collected in samples there last year. These results indicate a low budworm population in 1990; however, trapping will continue as part of a province-wide study to improve the detection of rising western budworm populations by comparing numbers of larvae and adults to defoliation levels.

The moth flight occurred from the second to the fourth weeks of July; however, the numbers were low. Branch samples containing egg masses were collected in September to forecast² the 1990 population trend. There were only 10 egg masses per 10 m² of foliage at Viewland Mountain, indicating only light defoliation next year. This was markedly reduced from 271 egg masses per 10 m² of foliage last year at the same location.

The predictions in 1988 were for high populations and severe defoliation in 1989, barring any adverse effects from weather or parasites. Those factors did, however, reduce the population and resulted in low populations this year. The populations are expected to remain low in the Horsefly-Mahood lakes area next year; however, budworm numbers could begin to rebound in the Clinton area, since defoliation of Douglas-fir has been recorded in 15 of the past 17 years. The last major infestation collapsed in 1986.

- ¹ 0% 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

- ² 1-50 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

Rhizina root disease
Rhizina undulata

Approximately 12% of the newly planted two-year-old Douglas-fir seedlings were killed by Rhizina root disease over five hectares south of Jacobsen Brothers Forest Products camp, west of Cariboo Lake. The logged area on a south aspect was burned in 1988 and planted in 1989. The spores of the fungus were activated when the cutblock was burned so that when suitable moisture conditions occurred, the disease spread and killed seedlings.

The last documented infection and seedling mortality was in 1983 at Hen Ingram Lake east of Horsefly, where an estimated 30% of seedlings were killed in a single plantation over an unknown area. Collections of sporophores and infected seedlings have in the past been made from Raft Creek and Mitchell Bay near Horsefly in 1968 and in a fire-thinning project in 1977 near Riske Creek. It is likely that infection is more frequent in burned areas in eastern parts of the Cariboo. More intensive surveys will be conducted in 1989 in conjunction with black army cutworm surveys.

Elsewhere in British Columbia, Rhizina root disease has killed up to 25% of seedlings in parts of the Prince Rupert Region and lesser amounts in Prince George and Nelson regions.

PINE PESTS

Mountain pine beetle
Dendroctonus pseudotsugae

Mountain pine beetle killed lodgepole pine over 720 ha in 206 infestations this year mainly near Chilko Lake, a decline from 1290 ha in 230 infestations in 1988 (Map 1). This was the third consecutive year of low populations following the collapse of the last major infestation in 1985 in the western part of the region, caused mainly by cold weather and host depletion.

Most (95%) of the pine killed by mountain pine beetle was around Franklyn Arm on Chilko Lake, along Edmond Creek at the south end of the lake, and in small spots along both sides of the lake and near Dorothy Lake. Other small patches of 1-5 dead trees were mapped at widely scattered locations elsewhere throughout the region.

The largest single infestation, about half of the total area, occurred along Franklyn Arm on Chilko Lake and from the head of the arm up Nine Mile Creek to Torch Creek. Additionally, small spots of 1-10 dead trees were mapped along both sides of Chilko Lake at scattered locations along the lake, similar to 1988. Across from Franklyn Arm on the east side of the lake, there were a small number of new spots mapped. North of Dorothy Lake, however, the infestations declined to 150 ha from 450 ha last year. At Dorothy Lake the area mapped was reduced to 120 ha, from 390 ha in 1988. Only four small infestations totalling 10 ha were mapped along the Homathko and Nostetuko rivers and Doran and Nude creeks, down from 50 ha last year.

Overwintering surveys in 1988-89 by BCFS showed good brood survival with only 13% average mortality from 100 Mile, Horsefly, Chilcotin and Quesnel

districts. All the BCFS districts and most forest companies had pheromone-baiting programs followed up by single tree disposal. Chilcotin District BCFS applied pheromone to 1500 trees at 12 locations mainly along Chilko Lake. These methods are effective to control expansion of infestations when the patches are small.

Untreated infestations will expand, unless natural limiting factors such as adverse weather and lack of susceptible host affect them. The large infestations at Franklyn Arm and Edmond Creek will begin to decline in the next year or two, mainly because of lack of susceptible host.

Ambrosia beetles
Trypodendron lineatum
Gnathotrichus spp.

Mature lodgepole pine, attacked by mountain pine beetle last year at Franklyn Arm on Chilko Lake, were heavily attacked by ambrosia beetles this year. The attacked trees were observed in approximately six patches of 10-30 trees each. Each tree was severely attacked with 60-80 attacks per 900 cm² of bark surface.

Ambrosia beetle attack on logs is common; however, heavy attacks on standing, recently killed trees is not, since the moisture content of the tree is critical to the beetles' success. The tree must be weakened and already dying to be attractive to the beetle. If the moisture content is too high, the associated fungus from which it gets its name, Ambrosiella sp., will "choke" the beetles. If the host is too dry, the fungus will not grow and the beetle, which depends on the fungus for food, will starve. The moisture content of recently felled logs over 20 cm in diameter is usually perfect for ambrosia beetle.

As the beetles emerging next June will not attack standing, healthy trees, the hazard would be to logs destined for manufacture into building products. Salvage logging was not planned for Franklyn Arm so there will be no serious consequences of the emerging population next year; however, populations are expected to continue in the area in 1990.

Elytroderma needle disease
Elytroderma defomans

Ponderosa and lodgepole pine were less severely infected by Elytroderma defomans in fewer areas throughout the region than in 1988. Ponderosa pine were infected in the chronically infected areas near Loon Lake, where there were 5-30 brooms per tree on 60% of the trees over 200 ha. Infection of foliage this year was light compared to moderate (35%) discoloration last year in the same area. There was no evidence of foliage infection west of Clinton, where light (35%) discoloration occurred last year.

An estimated 20% of the foliage was infected on 40% of the lodgepole pine trees over 50 ha near Haines Lake, southwest of Alexis Creek, down slightly in intensity and area from last year.

The consequences of infection are slight in lodgepole pine stands, depending on the severity of infection and the condition of the trees; however, ponderosa pine, the main host of Elytroderma, can be severely affected. In the

United States when up to 75% of the foliage is infected, a weakened host and increased susceptibility to bark beetle attack is expected (FPL #43, United States Department of Agriculture). When defoliation is 75% or greater, observations in the USA indicate that mortality of trees is likely. In British Columbia where infections are generally not as intensive, *Elytoderma* needle disease is still the most important foliar disease of ponderosa pine.

A conifer weevil
Magdalis sp.

Defoliation of the current growth of lodgepole pine by this conifer weevil was less widespread than in 1988. There was defoliation at only two sites in the Chilcotin.

The most severe damage occurred near km 43, Palmer Lake Road, where all ages of pine around the edges of a cut block were 20% defoliated in a 5-m-deep band at the stand edge. All the 3-m-high, spaced lodgepole pine were 15% defoliated over 120 ha along the Bluff Lake Road southwest of Tatla Lake. At both sites, large amounts of fresh slash were present which contributed to brood production and population build-up.

Populations will diminish in areas where the slash has become dry and unattractive to the weevils; however, fresh slash from logging or silvicultural treatments could contribute to similar levels of defoliation in those areas next year.

SPRUCE PESTS

Two-year-cycle spruce budworm
Choristoneura biennis

Immature two-year-cycle spruce budworm lightly defoliated spruce and alpine fir stands over 2800 ha in the eastern portion of the region mainly in the 100 Mile House TSA (Map 1, Table 2). This was a decrease from 1987 when the immature larvae defoliated 11 200 ha but similar to 1985 when 3700 ha were lightly defoliated; however, it was a significant decrease from last year, when mature larvae lightly and moderately defoliated 40 500 ha of spruce and alpine fir stands from Willow River Valley to Mahood Lake.

Light defoliation occurred in the **100 Mile House TSA** over 2020 ha (70% of the total) at Rushing, Deception and Spanish creeks north of Canim Lake. New infestations occurred adjacent to stands defoliated last year at Spanish Creek; however, most (95%) of the other infestations occurred in previously infested stands.

Table 2. Location and area of spruce and alpine fir defoliated by two-year-cycle spruce budworm, as determined from aerial and ground surveys, Cariboo Forest Region, 1989.

TSA and location	Area of light defoliation (ha)
<u>QUESNEL TSA</u>	
Paput Cr.	50
Archer Cr.	140
TSA Subtotal	190
<u>WILLIAMS LAKE TSA</u>	
Isaiah Cr.	110
Crooked L.	280
McKusky Cr.	190
TSA Subtotal	580
<u>100 MILE HOUSE TSA</u>	
Rushing Cr.	1150
Deception Cr.	550
Spanish Cr.	320
TSA Subtotal	2020
GRAND TOTAL	2790

In the **Quesnel TSA**, light defoliation was mapped over 190 ha in three infestations at Paput and Archer creeks northwest of Barkerville in the middle of the largest area defoliated last year. Light defoliation was visible from the ground near Yanks Peak south of Barkerville. In other areas of Quesnel TSA defoliated last year, populations were not large enough to cause visible defoliation; however, budmining and trace defoliations did occur.

In the eastern part of **Williams Lake TSA**, light defoliation was mapped over 110 ha at Isaiah Creek on the North Arm of Quesnel Lake, south of Crooked Lake over 280 ha and at the top end of McKusky Creek over 190 ha. These were the areas most severely defoliated last year.

- 1 1-15 buds infested = light defoliation
 16-30 buds infested = moderate defoliation
 31+ buds infested = severe defoliation

Populations are forecast to continue in the region in 1990. High numbers of larvae (60-190 per sample) in standard beating samples were common throughout the infestation, indicating a large population to overwinter and feed next spring. An average 68% of buds were infested in the Willow River area which indicates¹ possibly severe defoliation at those locations in 1990. An average 23% of buds sampled near Swift River were infested, which predicts moderate defoliation in 1990.

This year was a "non-feeding" year of the two-year-cycle spruce budworm life cycle, during which the populations passed from 1st- to 3rd-instar larvae; however, next year, as the larvae mature and feed on spruce and alpine fir, defoliation will be more severe. Based on bud and population sampling combined with the two-year biology of the insect, defoliation should be more severe and widespread in 1990, similar to 1988.

Spruce weevil
Pissodes strobi

Attacks on immature Engelmann spruce leaders by spruce weevil continued at varying intensities throughout spruce stands in the region.

The highest incidence of recent terminal mortality was near Walker Creek along the Horsefly River, where 40% of 1- to 15-year-old, 2-m-high spruce were attacked. Half the affected leaders were currently infested with large numbers of progeny to continue the infestation next year. Elsewhere in the region, infestations ranged from very light to severe (2-30% attack), and are also expected to continue in 1990.

The most effective method of control for weevil populations is to clip and store the infested leaders at the clipping site in a way that allows the parasites to emerge while containing the emerging adult weevils. Several criteria should be followed for the method to be effective (personal communication with J.W.E. Harris). These criteria include:

- 1) select a young plantation, isolated from other infested stands by approximately 1-2 kilometers.
- 2) clip all old and currently infested leaders.
- 3) take enough of the leader to ensure all of the progeny are removed.
- 4) treat the plantation again the following year to ensure all the weevils were collected.
- 5) maintain quality control of work performed.

This method, while not perfect, is the only one available at present and will greatly reduce the losses in infested plantations.

ALPINE FIR PESTS

Western balsam bark beetle-fungus complex Dryocoetes confusus Ceratocystis dryocoetidis

Recent mortality of alpine fir was mapped over 2160 ha in high-elevation alpine fir stands in 70 separate infestations from Chilko Lake to Bowron Lake Park, up 30% from last year, killing an estimated 12 950 m³ of wood.

There were 7650 recently killed trees mapped over 80 ha in 50- to 250-ha patches along Franklyn Arm on Chilko Lake to Tatlayoko Lake and near Taseko Lake. Last year there were only 300 trees mapped over 580 ha in widespread infestations throughout the same area.

East of the Fraser River near Hendrix Lake 700 alpine fir were recently killed over 410 ha, up from 150 trees on 190 ha last year. North and south of the east arm of Quesnel Lake, counts of dead alpine fir also increased to 900 trees over 850 ha from 300 trees on 520 ha in 1988. Only one small infestation was mapped in Bowron Lake Park, where 50 trees were mapped over 50 ha along Betty Wendle Creek in the eastern portion of the park.

Western balsam bark beetle is a chronic forest pest throughout high-elevation alpine fir stands in British Columbia. The number of trees killed fluctuates from year to year, generally expanding until the fir component is depleted. The large increase in the 1989 dead tree count could be attributed to the sudden cold weather in January-February, which partially desiccated the trees, increasing the speed of tree mortality and color change. Infestations and tree mortality are expected to continue or possibly decline next year.

PESTS OF YOUNG STANDS

Surveys of young stands, 7 to 17 years old, were carried out to monitor and identify major forest pests at 12 locations throughout the region, in the 10th consecutive year of investigations. The young stands were sampled using fixed-radius plots on transects through the plantations, and the results summarized (Table 3).

More pests were recorded in lodgepole pine stands examined than in other conifers. The most common pest in pine stands (60% of plots) was **western gall rust**, Endocronartium harknessii. The trees infected had 90% branch galls and 10% stem galls, causing mainly reduced growth and some branch or tree mortality. **Lodgepole terminal weevil**, Pissodes terminalis, was recorded in five plantations, similar to 1988, with an average 2% of terminals infested in 42% of the plots compared to an average 2.6% of trees in 46% of the plots last year. From 1 to 10% of the trees were infested by **Warren's root collar weevil**, Hylobius warreni, similar to 1988. However, most of the attack was latent (not causing mortality) this year, down from an average mortality rate of 5% last year. At one plot **stalactiform blister rust**, Cronartium coleosporioides, infected 3% of the trees. There was also an average 4% infection of old needles on all the trees at the same plot by the **pine needle cast fungus**, Lophodermella concolor. At five plots an average 6% of the 7- to 10-year old pine seedlings

were bent over by snow, cattle or other **mechanical damage**. An average 4% of the stems were infected by **pine dwarf mistletoe**, Arceuthobium americanum, at 4 sites, the infections usually arising from residual trees. **Conifer weevil**, Magdalis sp., populations were down causing only 10% defoliation at one area, from 30% defoliation at four locations last year. There is little permanent damage from defoliation by this pest since the populations are usually only high the year following logging.

Table 3. Summary of pests of young stand surveys in the Cariboo Region, 1989.

Host/Pest	Percent trees affected	No. of stands affected	Remarks
Lodgepole pine			
Lodgepole terminal weevil <u>Pissodes terminalis</u>	1-5	5	5% of young pine, 15 years old, infested at Tusulko R. near Anahim L.
Armillaria root disease <u>Armillaria ostoyae</u>	20	1	Recently thinned stand 14-years old near Narcosli Cr.
Western gall rust <u>Endocronartium harknessii</u>	1-10	7	90% of infections caused branch galls and 10% caused stem galls on 10% of the trees near Trio L.
Pine root collar weevil <u>Hylobius warreni</u>	1, 7	2	7% latent attack at Moffat L. Road.
Stalactiform blister rust <u>Cronartium coleosporioides</u>	1	1	3% of trees with stem cankers at Narcosli Cr.
Pine needle cast <u>Lophodermella concolor</u>	2, 6	2	5-20% total defoliation at Trio L. and Narcosli Cr.
Mechanical damage	1-20	5	20% of 7-year-old seedlings trampled by snow and cattle near Gaspard Cr.
Dwarf mistletoe <u>Arceuthobium americanum</u>	1-5	4	severe stem infection on 90% of trees infected at all locations.
Animal damage	1-39	4	39% of pine stems were partially girdled at Tusulko R. near Anahim L. Remainder of damage at other locations was partial girdling and tree mortality.

Host/Pest	Percent trees affected	No. of stands affected	Remarks
Conifer weevil <u>Magdalis leonti</u>	80	1	10% total defoliation at Bluff L. in a 17-year-old stand.
Douglas-fir			
Animal damage	20	1	Trees affected near Trio L. were partially girdled at the base and some terminals were browsed.
Engelmann spruce			
Cooley spruce gall adelgid <u>Adelges cooleyi</u>	24	1	10-20% of current shoots were galled at Trio L.
Climatic damage	62	1	2-20% of buds were killed in the top half of tree at McKay R.
Two-year budworm <u>Choristoneura biennis</u>	14	1	Light defoliation at McKay R.
Spruce weevil <u>Pissodes strobi</u>	4	1	Current attack (1989) at McKay R.
Alpine fir			
Climatic damage	16	1	5-10% of current growth was killed by cold weather at Tusulko R.
Whitebark pine			
Animal damage	70	1	90% of trees affected were partially girdled and killed at Tusulko R.

The least-affected conifer species in young stands was Douglas-fir. About 20% of the 15-year-old Douglas-fir at Trio Lake was partially girdled by **rodents**. This was the most serious pest damage recorded to date in Douglas-fir stands where prior to this time **Cooley spruce gall adelgid**, Adelges cooleyi, has been the major pest causing only light needle discoloration.

Climatic damage caused 2 to 20% bud mortality in the Horsefly River area in 12-year-old Engelmann spruce plantations.

Surveys of young stands for pest damage will continue in the region in 1990; however, more emphasis will be placed on stands in higher-rainfall areas

to concentrate on stands susceptible to **Rhizina root disease**, caused by Rhizina undulata, which has caused severe damage in adjacent forest regions this year.

MULTIPLE HOSTS PESTS

Climatic injury

From the end of January to the early days of February, 1989, a drastic temperature change occurred throughout British Columbia. At the Williams Lake airport, records show the temperature dropped from a daily maximum of 7.9° C January 30 to -20.7° C January 31. This overnight change from a period of abnormally warm and wet to extremely dry, cold and windy resulted in widespread damage to conifers. All species were damaged; however, western red cedar, Engelmann spruce and Douglas-fir were hardest hit. The cold dry wind desiccated the foliage and buds which resulted in tree and bud mortality and defoliation.

The largest patches and area of damage occurred in the eastern portion of the region from Likely to Horsefly Lake where western red cedar was 30-100% defoliated over 2600 ha in 31 separate patches. Defoliation was mapped along the north shore of Quesnel Lake, around Likely, and near Hen Ingram, Jacques and Keno lakes. Other areas less severely affected included Sovereign and Lynx creeks, north and east, respectively, of the major part of the damage and a 40-ha area south of Canim Lake. Most cedar stands affected were in exposed aspects along lakeshores, on the edge of cut blocks and in more open growing stands. Additionally, patches of 2 to 10 recently killed Engelmann spruce were located along Highway 24 from 100 Mile House to Bridge Lake and from Williams Lake east to Rose Lake.

Douglas-fir 1- to 3-m high were either killed or top-killed over 50 ha west of Bull Canyon near the Chilcotin River. The trees affected were open growing on exposed aspects, similar to those damaged in the eastern portion of the region.

The other type of damage was visible as dead or dying buds on Engelmann spruce, alpine fir and Douglas-fir. The damage was widespread east of the Fraser River mainly on immature trees, killing 2 to 30% of buds and some terminals on those portions of the trees above the snow line. This damage resulted in late flushing of adventitious buds in late July, giving a "tufted" appearance to the new growth.

Secondary insects and diseases may cause deformation of the trees affected and some branch dieback may occur; however, mortality of the whole tree is unlikely.

Black army cutworm **Actebia fennica**

There were no reports of cutworm populations or damage to seedlings in the region this year. Areas defoliated last year at Bootjack Lake west of Likely re-foliated and no further damage occurred.

Cutworm infestations have historically occurred in the wetter parts of the region in spruce-alpine fir forest types particularly in the Cariboo and

Horsefly lakes area. As part of a province-wide study to develop a predictive warning system to monitor adult populations, pheromone-baited sticky traps were placed at four locations. These were set at McKay River and at three locations near Cariboo Lake. An average of six male moths per trap were caught at Frank Creek southeast of Cariboo lake, an average of 10 at Seller Creek southwest of the lake, 27 moths per trap north of the camp near the west end of the lake, and an average of 20 moths per trap were caught at McKay River near the Horsefly River. The traps were placed in recently burned areas not yet refoliated but black and attractive to black army cutworm. While the numbers of moths caught in the sticky traps do not relate directly to population figures or levels of damage, the number of moths caught (average 16) indicates that a population does exist at each area sampled. The numbers are well below the tentative infestation threshold; however, areas will be checked in 1990. If weather conditions favorable to black army cutworm development occur such as an early warm spring, there could be a build-up of populations at those locations next year.

Salt damage

Damage to roadside conifers occurred again throughout the region mainly beside major roads where salt was applied to control ice throughout the winter. Similar damage has occurred at varying severity for many years.

Damage was most severe along Highway 97 from 10 km north of Williams Lake, south to 150 Mile; from Hawks Creek to McLeese Lake; from Lac la Hache to 100 Mile House; east on Highway 24 from Highway 97 to Lone Butte; in Boitanio Park in Williams Lake; from 100 Mile House east to Horse Lake; along Highway 20 in a few patches near Alexis Creek, and farther west along the highway from Heckman Pass to Stuie.

The damage resulted from salt spray caused by snowplows, and also from saline run-off permeating the soil supporting the trees. The damage was most severe on the lower parts of the roads and on hills and corners where large amounts of salt were applied. Salt damage was manifested as discolored foliage and dead branches, tops or whole trees at some locations. Mortality of Douglas-fir was associated with attack by Douglas-fir beetle, if the tree was larger than 20 cm diameter at breast height (dbh). Secondary beetles such as Scolytus spp. and Ips spp. were found in lodgepole pine and Engelmann spruce weakened by the effects of the salt. The smaller trees were more severely discolored than the larger ones at areas where airborne spray was the main hazard. There was no consistent pattern to the damage from tree to tree. On some trees the upper crown was affected, on others, the lower crown and, on some, the whole crown which resulted in tree mortality.

At Boitanio Municipal Park in Williams Lake, 30 mature Douglas-fir were currently attacked by Douglas-fir beetle, Dendroctonus pseudotsugae, and seven were partially attacked. The trees ranged from 20-50 cm dbh and averaged 20 m in height. Forty other trees, primarily salt-killed, and the beetle infested trees were scattered for 200 m below the highway into the park. The salty run-off was the obvious factor that predisposed the Douglas-fir trees to attack by beetles. Damage will probably recur next year, since there is no economical alternative to salt application for ice control on highways.

DECIDUOUS PESTS

Forest tent caterpillar
Malacosoma disstria

Forest tent caterpillar moderately to severely defoliated mainly trembling aspen over 3200 ha in the eastern portion of the region this year, a significant increase from 460 ha last year (Map 1).

Numerous patches of defoliated aspen from 10-350 ha, were mapped including near 108 Mile, south of Canim Lake, along the east shore of Deka Lake, south of Horse Lake, from Bridge Lake south to Eagan Lake, and around the northeast end of Green Lake. The largest areas of defoliation occurred in the Bridge Lake area and south of Canim Lake. The most severe defoliation was mapped in a large, 350-ha infestation east of Deka Lake and over 330 ha along Jim Creek south of Canim Lake.

Egg masses were assessed on each of three trees at three locations throughout the defoliated area to assess the tent caterpillar population and help predict the trend of the infestation (Table 4). These surveys indicated that most previously infested stands will be severely defoliated in 1990.

Table 4. Location, number of egg masses and predicted defoliation of trembling aspen by forest tent caterpillar, Cariboo Forest Region, 1989.

Location	Avg. no. of egg masses/tree		Avg. dbh(cm)	Predicted ¹ defol. 1990	Avg. defol. 1989
	New	Old			
Jim Cr.(Canim L.)	41	7	17	severe	60%
Lac des Roches	14	5	15	moderate	70%
Eagan L.	12	11	12	moderate	70%

¹A 10 cm dbh tree would be 100% defoliated with 11+ egg masses.

In 1983-84, infestations occurred in the same areas that were infested this year. At that time, the Quesnel River Valley and areas near Horsefly and Likely were also infested. It is expected that the tent caterpillar populations will spread into these areas in 1990. Tent caterpillar infestations were characterized by Sipple, 1962, as follows: 1) incipient period lasting two or three years when populations build; 2) period of excess lasting one or two years when there was a marked excess in the number of insects needed to strip the foliage from the trees; 3) declining period usually lasting one year, leading to the collapse of the outbreak. Analysis of the Cariboo infestation in these terms indicates that infestations will probably build and/or spread in 1990.

Aspen decay

A study to determine the amount of decay and wood discoloration in trembling aspen in central and northern British Columbia was initiated in the region in 1989.

Staining and decay were present in 86% of the stems, averaging 27% (range 4-51%) of the core length at 11 locations from Quesnel to Bridge Lake (Table 5). An average of 67% (range 35-100%) of the stems contained stained wood and 55% (range 10-100%) had rot present. Stain was present in an average of seven (range 3-10) of the cores at each plot and decay occurred in five (range 1-10). Increment core samples were taken from breast height on each of 10 trees at each location. The size of the trees averaged 26 cm dbh (range 21-37) and 17 m high (range 11-29 m).

Table 5. Summary, trembling aspen decay survey, Cariboo Forest Region, 1989.

TSA and Location	No. of cores		Avg. % of b.h. core			Avg.	
	stained	decayed	stained	decayed	total	dbh (cm)	ht (m)
<u>QUESNEL TSA</u>							
S. of Quesnel	5	6	11	11	22	21	16
Cottonwood	8	5	24	14	38	33	21
<u>WILLIAMS L. TSA</u>							
Cariboo L.	3	3	2	2	4	37	29
Sheridan Cr.	10	2	30	3	33	22	13
Williams L.	5	1	16	1	17	23	13
Gaspard Cr.	9	7	29	22	51	23	11
Puntzi L.	10	10	11	8	19	24	14
Anahim L.	4	5	9	14	23	23	15
Horsefly	7	9	9	16	25	36	21
Moffat L.	5	8	20	15	35	25	18
<u>100 MILE TSA</u>							
Bridge L.	8	4	23	13	36	24	17
Total	74	60					
Average			16	11	27	27	19

The most severely infected stand was near Gaspard Creek west of the Gang Ranch where an average of 51% of the wood volume was stained and decayed in 90% of the trees. The largest in size and least-infected stand was north of Cariboo Lake where only 4% of the wood was infected in only 3% of the trees. These trees averaged nearly 30 m in height compared to the smallest stand near Gaspard Creek that averaged only 11 m, probably since it was also the most infected of all the stands examined. The core samples will also be measured for growth loss.

The staining and decay are caused by many different fungi in the class Basidiomycetes. Some of the most common fungi were: **False tinder conk**, Phellinus tremulae; **white rot**, Peniophora rufa; **white stringy rot**, Radulodon americanus and another fungus, Pleurotus subareolatus. The most common pathogen was P. tremulae, based on the observation of disease signs in the plots. Infections are spread through root contact or wounds in the bark, caused by weather, machines or animals.

As new products and markets develop, there will be more interest in harvesting poplar. At present the Lake States of Minnesota, Michigan and Wisconsin are the leaders in poplar utilization in North America; however, Alberta and British Columbia are rapidly closing the gap. Poplar makes up 11% of the forest growing stock in Canada and 4% in British Columbia. In the Cariboo Forest Region, poplar, mainly aspen, accounts for 3% of the forested area and less than 1% of the total merchantable volume; however, the stands are usually easily accessed for harvesting making aspen more attractive as a crop species.

Northern tent caterpillar **Malacosoma pluviale**

Shrubby poplar, willow and alder were 60-100% defoliated in clearcuts from the valley bottom to 1350 m elevation along the upper Horsefly River near McKay River. The trees were small (1-3 m high) on flat or northern aspects. There was a small population in the same area last year; however, no defoliation occurred.

The range of this colonial defoliator is very large, usually infesting deciduous trees in areas of moderate rainfall. It has been more common in coastal areas of British Columbia than in the interior. Egg-mass sampling at two locations averaged 9 masses per tree which indicates the infestation will probably continue next year.

Gypsy moth **Lymantria dispar**

There were no adult male gypsy moths caught in 25 pheromone-baited sticky traps placed in 20 forest recreation areas, parks and highway rest areas in the region in 1989 (Table 6).

The continuing gypsy moth survey is a cooperative project with Agriculture Canada (Plant Health), Forestry Canada and the British Columbia Forest Service, to monitor the spread of this important defoliator of deciduous trees.

Elsewhere, male moths were caught again near Parksville, at Kelowna for the third consecutive year and in West Vancouver for the second year, 8, 1 and 5 moths, respectively. Single moths were caught for the first time in Manning Park, Chilliwack, Fort Langley, Cultus Lake, Jericho Beach, and at Thetis Lake Park near Victoria. There were also 5 moths caught on the Saanich Peninsula near Victoria. Trapping will continue at areas frequented by tourists throughout the region next year.

Table 6. Gypsy moth trapping program, Cariboo Forest Region, 1989.

Location	Number of sticky traps per site	Number of male moths caught
Loon Lake Provincial Park	1	0
Chasm " "	1	0
Downing " "	1	0
Green Lake " "	3	0
Lac la Hache " "	2	0
Canim Lake " "	1	0
Mahood Lake " "	1	0
Ruth Lake " "	1	0
Bridge Lake " "	1	0
Horsefly Lake " "	1	0
Bull Canyon " "	1	0
Tweedsmuir " "	2	0
Bella Coola Airport	1	0
Australian Creek Rest Area	1	0
Ten Mile Lake Provincial Park	1	0
Bowron Lake " "	1	0
Cottonwood " "	1	0
Barkerville " "	2	0
McLeese Lake Rest Area	1	0
Riske Creek DND	1	0
Total	25	

OTHER PESTS OF MINOR SIGNIFICANCE

Collections and observations of other potentially damaging pests, currently of minor significance, are listed by importance in Table 7.

Table 7. Pests of minor significance in the Cariboo Forest Region, 1989.

Host/Pest	Location	Damage	Status ¹
<u>Conifer Hosts</u>			
Douglas-fir			
<u>Cicadas,</u> <u>Okanagan spp.</u>	Williams L.	All trees had 5-80% of branch tips killed over 2 ha.	S
<u>Twig beetles</u> <u>Pityophthorus spp.</u>	Loon L.	Nearly 40% of all-aged trees had 10% of branch tips killed over 2 ha.	S

Host/Pest	Location	Damage	Status ¹
Douglas-fir needle cast <u>Rhabdocline pseudotsugae</u>	Macalister	40% of the trees had 20% of the foliage infected over 5 ha.	S
Sawflies <u>Neodiprion</u> spp.	Ten Mile L.	Trace defoliation of branch tips over 2 ha.	S
Alpine fir			
Fir-fireweed rust <u>Pucciniastrum epilobii</u>	Hendrix L.	All of the immature trees over 20 ha had 80% of the current growth infected.	I
Red flag disease <u>Potebniamyces balsamicola</u>	Black Dome Mtn.	10% of branch tips were killed on 40% of the trees over 10 ha.	S
Engelmann spruce			
Spruce bud scale <u>Physokermes</u> sp.	Km 15, Swift R.	10% of the foliage was discolored on all trees over 1 ha.	S
Spruce gall adelgids <u>Adelges lariciatus</u>	Km 15, Swift R.	15% of current growth was discolored over 0.5 ha.	S
<u>A. strobilobius</u>	" "	10% of current growth was discolored over 1 ha.	S
Whitebark pine			
Animal damage	Black Dome Mtn.	100% of trees had 5-30% of branch tips killed over 50 ha.	S
Lodgepole pine			
Gall midges <u>Cecidomyia</u> spp.	Nimpo L.	50% of the multi-aged trees had 15% of branch tips killed over 100 ha.	I
Dwarf mistletoe <u>Arceuthobium americanum</u>	Horn L. Fletcher L. Deserters Cr.	Mature 15-30-m-high pine were 80-100% infected with 1-8 brooms visible per tree.	I
Rocky Mountain Juniper			
Cicadas <u>Okanagan</u> spp.	Comer	All trees had 5-20% of branch tips killed over 0.5 ha.	S

Host/Pest	Location	Damage	Status ¹
<u>Deciduous Hosts</u>			
Trembling aspen			
Slime mold <u>Trichia decipiens</u>	Redstone	All trees over 0.5 ha had red fruiting bodies on the bases of standing trees. This is a non-pathogenic fungus.	S
White birch			
Birch leafminer <u>Fenusa pusilla</u>	Williams L.	Ornamental planting of birch was 80% discolored by mining.	S
Amber-marked birch leafminer <u>Profenusa thomsonii</u>	Bull Mtn.	50% of trees over 0.25 ha had 30% of the foliage discolored.	I
Alder			
Birch-aspen leafroller <u>Epinotia solandriana</u>	Chilko L. Macalister	All the trees over 2 ha at Chilko L. had 30% of leaves rolled. There were several 0.5-ha patches of aspen 30-90% defoliated at Macalister.	S

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

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