

F I D S R E P O R T

HISTORY OF POPULATION FLUCTUATIONS

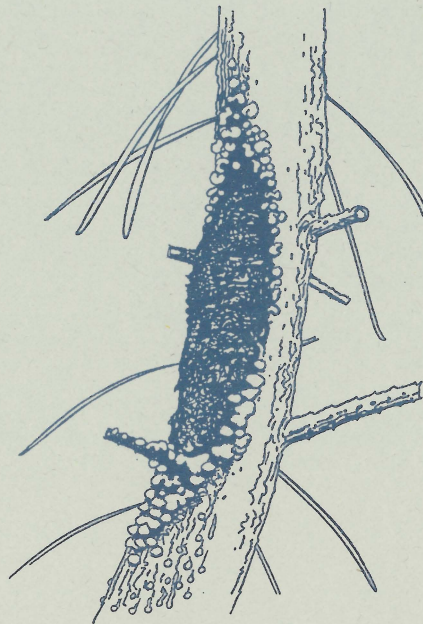
AND INFESTATIONS OF IMPORTANT

FOREST INSECTS IN THE

PRINCE GEORGE FOREST REGION

1942-1994

FIDS REPORT 95-9



# Forest Insect and Disease Survey

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Natural Resources  
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## INTRODUCTION

This report is the history of some important forest insects which have caused tree mortality, volume loss or growth suppression to forests in the Prince George Forest Region (Map 1) since the early 1940's. This report:

- designates the species of insects which have caused damage in the past and are presumably capable of causing damage in the future.
- records the pattern of population fluctuations.
- designates areas that appear to have chronic insect problems.
- points out the possibility of damage in different areas by insect species not known to have previously caused damage.

Logging in the Prince George Forest Region started in the early 1900's when the Grand Trunk Pacific Railway extended it's line through the Yellowhead Pass. This set off a boom based on tie-cutting and sawmilling. The boom ended with World War I and the lumber industry in the Region remained stagnant until 1939.

With the completion of the major highways and the extension of the Pacific Great Eastern Railway to Prince George in 1956, the forest industry began to expand and consolidate. Small portable mills in the outlying areas were brought into Prince George and pulp mills were built at Prince George and Mackenzie.

The Prince George Forest Region encompasses 29.6 million hectares, of this 16.8 million hectares are productive forest land. The volume of mature and immature timber is 2.4 billion m<sup>3</sup>, with white spruce comprising the largest component (Table 1).

Table 1. Volume of mature and immature timber, Prince George Forest Region, 1994.

Species Group	Volume (m <sup>3</sup> )
Spruce	945, 328, 000
Lodgepole pine	706, 289, 000
Deciduous	399, 000, 000
Balsam	311, 500, 000
Cedar	21, 700, 000
Fir	20, 000, 000
Hemlock	14, 600, 000
Other	460, 000



The majority of recorded forest losses have been caused by spruce beetle, mountain pine beetle, western balsam bark beetle and Douglas-fir beetle.

Large volumes of white spruce were killed by the **spruce beetle** during infestations in 1961-65, 1968-70, 1978-1982 and between 1989 and 1993. During endemic periods, the spruce beetle persisted at low levels and killed small numbers of trees annually.

**Mountain pine beetle** outbreaks in lodgepole pine stands occurred from 1948-68 in the Stuart-Takla-Trembleur lakes area and continue to date. Beginning in 1968, infestations started in white pine stands in the McNaughton Lake area and continue to kill lodgepole pine in 1993.

**Douglas-fir beetle** has been killing significant volumes of trees in the Pinchi and Tezzeron Lakes area in the Fort St. James Forest district since 1944. Mortality has also been reported south of Prince George and around McBride since the early 1960's.

**Western balsam bark beetle** has killed large numbers of alpine fir annually at higher elevations throughout the region. Secondary bark beetles, including **engraver** and **ambrosia** beetles have been active at various times in much of the region.

**Eastern spruce budworm** has moderately to severely defoliated alpine fir and white spruce stands in the Liard River drainage since 1957. **Two-year-cycle spruce budworm** outbreaks occurred periodically from 1944 in the Stuart-Takla lakes area, Parsnip River Valley, west of McBride and in the Willow-Naver-Bowron River valleys. In 1991 and 1993 light to moderate defoliation of mature spruce-balsam stands were reported along the Omineca River and in drainages along Williston Lake.

**Western hemlock looper** moderately to severely defoliated western hemlock and western red cedar stands in mostly the ICH biogeoclimatic zone between Giscome and McNaughton Lake from 1953-56, 1963-65, 1983 and from 1991-93. In 1983-85 over 70 000 seedlings were killed by the **black army cutworm**. **Western blackheaded budworm** lightly to severely defoliated the current growth of white spruce and alpine fir in the McBride area and parts of the Rocky Mountain Trench between 1967 and 1969.

**Conifer sawflies** are common on most coniferous trees in the region and have occasionally caused significant defoliation in the Robson Valley. The **larch sawfly** has been a chronic pest of eastern larch around Cluculz Lake in the western portion of the region and along the Alaska Highway. The **spruce sawfly** has only occasionally reached epidemic proportions.

The **rusty tussock moth** reached epidemic levels for the first time in 1992.

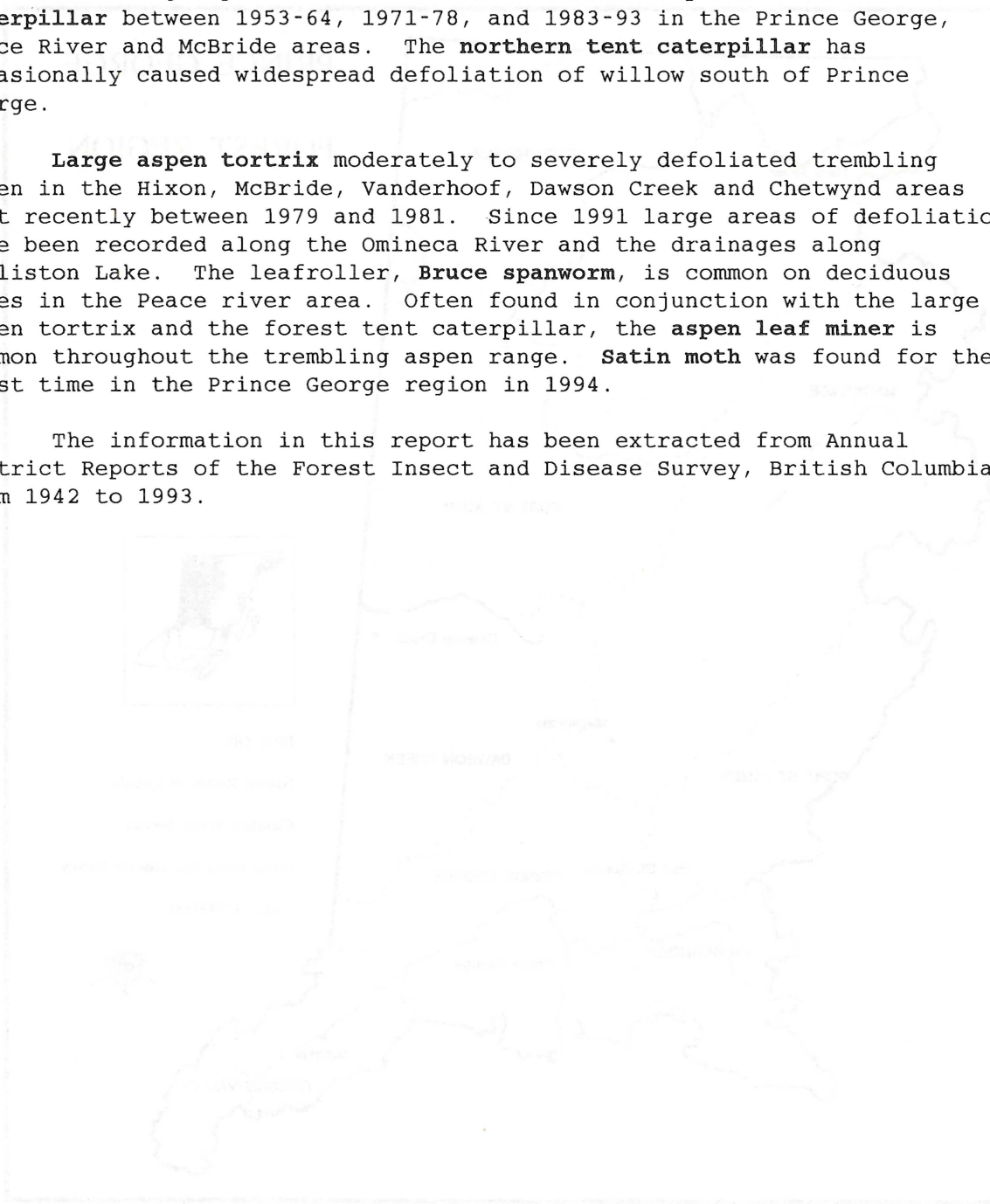
**Spruce weevil** continue to be a major pest of young white spruce stands in the southern half of the region. The **lodgepole pine terminal weevil** killed up to 50% of the natural regeneration along the Blackwater road in 1985.

**Gall aphids** are an important pest of young white spruce stands.

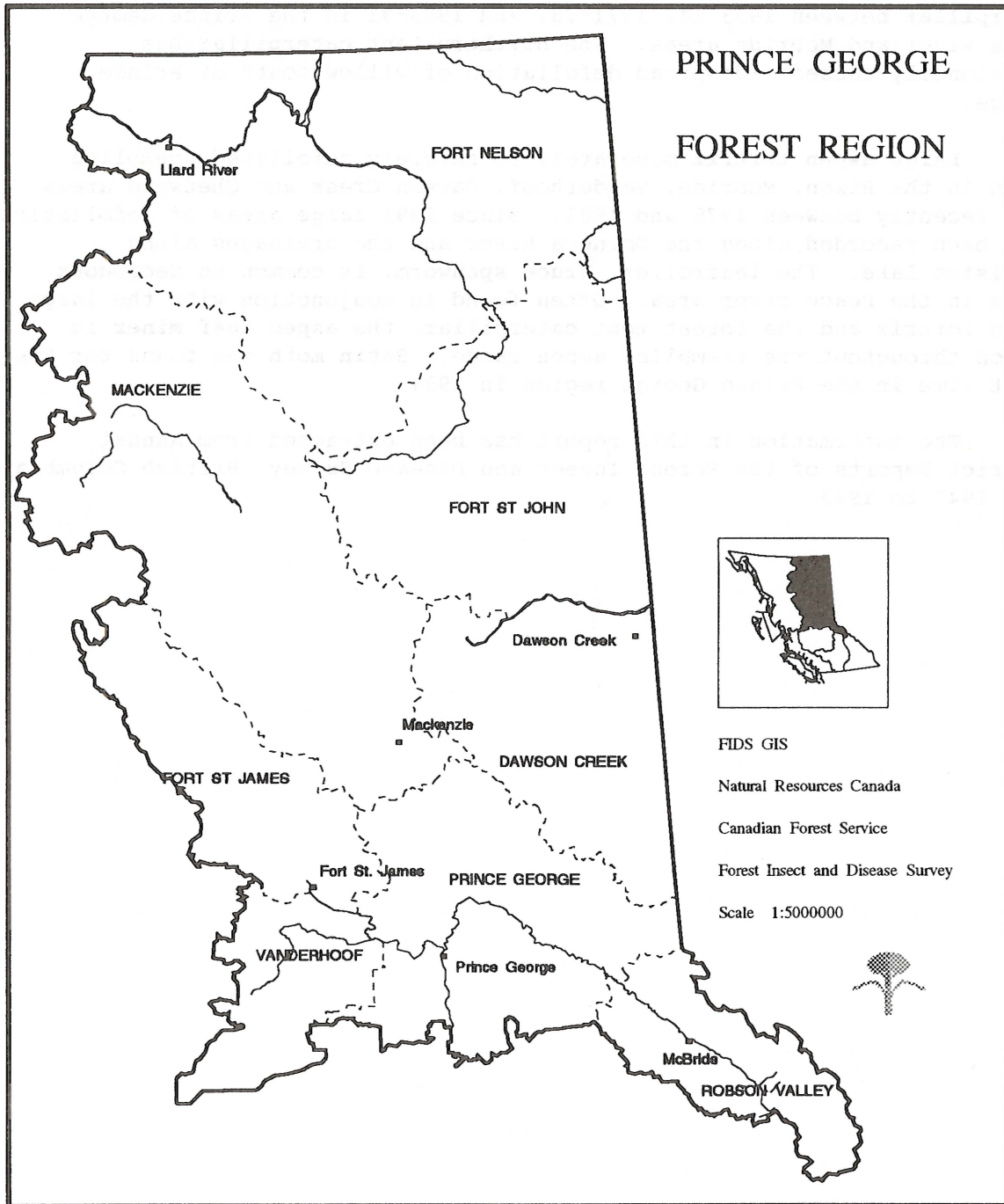
Trembling aspen stands were also defoliated by the **forest tent caterpillar** between 1953-64, 1971-78, and 1983-93 in the Prince George, Peace River and McBride areas. The **northern tent caterpillar** has occasionally caused widespread defoliation of willow south of Prince George.

**Large aspen tortrix** moderately to severely defoliated trembling aspen in the Hixon, McBride, Vanderhoof, Dawson Creek and Chetwynd areas most recently between 1979 and 1981. Since 1991 large areas of defoliation have been recorded along the Omineca River and the drainages along Williston Lake. The leafroller, **Bruce spanworm**, is common on deciduous trees in the Peace river area. Often found in conjunction with the large aspen tortrix and the forest tent caterpillar, the **aspen leaf miner** is common throughout the trembling aspen range. **Satin moth** was found for the first time in the Prince George region in 1994.

The information in this report has been extracted from Annual District Reports of the Forest Insect and Disease Survey, British Columbia, from 1942 to 1993.







Map 1. Prince George Forest Region Timber Supply Areas.

BARK BEETLES

Spruce beetle  
Dendroctonus rufipennis

Spruce beetle has destroyed more timber than any of the other three important bark beetles in the Prince George Forest Region, especially since 1960. The majority of forest types contain more white spruce than any other commercial species (Table 1). The first beetle infestations began in 1962 lasted until 1965 and killed 12 572 000 m<sup>3</sup> of white spruce. In 1968 infestations developed and killed 829 500 m<sup>3</sup> by 1969. From 1978 to 1986 over 6 000 000 m<sup>3</sup> of white spruce was killed by the spruce beetle mainly in the Bowron and McGregor River drainages. Populations began to increase again in 1989 mainly in the Mackenzie, Dawson Creek and Prince George Forest Districts and continue in 1993 with an estimated 3 500 000 m<sup>3</sup> of white spruce killed to date.

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Year	Remarks
1947-48	No beetle attacks reported.
1949	Fresh blowdown recorded at Dome Creek, not attacked by Aug. 6 - foliage green.
1950	A few attacked white spruce were observed at Aleza Lake Experimental Station due to high amounts of slash and blowdown.
1951-52	No attacks reported.
1953	An outbreak was noted near Sinclair Mills with 7% of stand killed and also in a 265 ha stand near Red Mountain Creek. Beetle-killed spruce was reported 21 km southwest of Dome Creek.
1954	Scattered beetle-killed trees were reported in Ptarmigan Creek Valley, (windthrow nearby). Small infestations were found at Kenneth, Hungary and Slim creeks.
1955	Low populations persisted in Aleza Lake and Sinclair Mills areas, no mortality was reported.
1956-58	Scattered attacks were noted at Aleza Lake, along the McGregor River, at Pine Pass and in windfall at Stone Creek.
1959	Low populations in stumps and logs observed near Giscome.
1960	White spruce logs on Naver Access Road right-of-way were infested. Beetle was controlled by chemical spray.



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Year	Remarks
1961	Small populations were recorded in the upper Willow River, Genevieve and Hay lakes areas. Light attacks noted at Tudyah Lake, Fleming Mills and Chief Lake.
1962	General increase in populations noted, attacks found at nine locations on Fraser and Crooked rivers. Tree mortality was recorded at: Hush Lake, 100 trees; Grove Fire, 200; decked logs in Torpy River heavily infested; Kerry Lake, 40 ha of attack, 34% of trees over 46 cm infested. The increase was related to fire damage, logging slash and heavy windfall of 1960-81.
1963	Aerial surveys recorded beetle attack over 182 000 ha with 10 137 000 m <sup>3</sup> of white spruce over 35 cm dbh killed from Peace River to Bowron S.Y.U.
1964	Aerial surveys in 1969 mapped 103 700 ha and estimated 1 472 000 m <sup>3</sup> of timber killed.
1965	The total volume of spruce killed at the end of 1964 was calculated as 12 572 000 m <sup>3</sup> over 222 000 ha and in 1965 covered 19 320 ha. The heaviest infestations in 1965 were at:  Isodore, Hodda - 465 ha Wansa - Pitoney - 2 335 ha Genevieve-Yardley - 390 ha  Moderate infestations at:  Firth Lake - 870 ha Seebach Creek - 380 ha Otter Creek - 430 ha McGregor River - 220 ha Ahbau Lake - 290 ha  In the Liard River area, beetles attacked some budworm defoliated trees.
1966	Losses decreased with overwintering beetle mortality heavy, and no 1965 attack noted in new areas.
1967	No standing white spruce was killed although populations remained high in windfall.
1968	Infestations increased in standing trees over previous three years with high populations in Willow River Valley.

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Year	Remarks
1969	<p>Aerial surveys showed heavier 1968 infestation than indicated by ground surveys. Spruce beetle populations increased due to warm, dry 1967 summer and local abundant windfall.</p> <p>Heavy attacks were widespread in the Willow and Naver river drainages and along Ahbau Creek; scattered light infestations noted in the Parsnip, Crooked, McGregor and Bowron River valleys; a total of 829 500 m<sup>3</sup> killed over 18 400 ha.</p>
1970	<p>Populations decreased with overwintering mortality calculated at 42% adults and 34% larvae. Moderate populations were found in upper Willow River region around Stony Lake, Rebman Creek and Ahbau Lake areas; 1245 trees examined in 6 strips, contained 3-1970 attacks.</p>
1971	<p>Low populations observed with no tree mortality recorded, small populations persisted in 1968-1969 partially attacked trees, several pitch outs noted.</p>
1972	<p>Low populations possibly a result of the previous severe winter cold prior to snow cover, caused brood mortality in logs, slash and windfall.</p>
1973-74	<p>Endemic populations.</p>
1975	<p>No currently discolored trees were detected. Low populations in windthrown spruce noted in the Bowron, Willow and McGregor river valleys.</p>
1976	<p>Blowdown during previous winter occurred in several areas. Patches totaling 740 ha at: Narrow Lake, Purden-Bowron Lake, Indian Point Creek, and Indian Lake. Bark samples at Thursday Creek and Narrow Lake contained an average of 15 larvae per .09 m<sup>2</sup>.</p>
1977	<p>There was a slight increase in number of currently attacked standing trees in the Carp-Weedon lakes area with 1200 ha of recently-killed spruce recorded. Also 8000 ha of light mortality was mapped southeast of Inzana Lake and 600 ha south of Chuius Mountain.</p> <p>Windfall and standing trees weakened by fume emissions from a pipeline were attacked from km 141 to km 146 on the Alaska Hwy. Current attack intensity ranged from four to eight brood per .09 m<sup>2</sup>.</p>



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Year	Remarks
1978	<p>A large increase in the number and area of recently killed standing spruce was mapped in the Fort St. James - Summit Lake area: 21 080 ha light, 6600 ha moderate and 2180 ha severe. At Chuchi and Boomerang lakes an average of 7% of the trees were currently attacked, (ranging 0% - 22%). In the Bowron and Willow river areas populations persisted in windfall with 8-16 attacks/.09 m<sup>2</sup> of bark. No attacks were recorded in standing trees.</p>
1979	<p>There was a dramatic increase, 53 330 ha, in beetle attack in the region, infestations were recorded east of Hixon near Stony Lake and north of Fort St. James at Trembleur and Kazchek lakes. Scattered infestations occurred along Bowron, McGregor and Parsnip river drainages and near Takla, Tarnezell and Tchentlo lakes. In the Carp, Weedon and McLeod lakes area infestations continued to decline. The average percent of stems affected in prism cruises in 10 areas were: healthy 60%, current 15%; red 5%; partial 13%; grey 7%.</p> <p>Several BCFS trap tree programs in Hixon and Summit Lake areas were monitored by FIDS. The results (detailed in Forest Insect and Disease conditions 1979) showed that fallen trees are the most effective attractant.</p>
1980	<p>Large increases continued from the previous year to 64 400 ha: 27 000 ha light, 16 500 ha moderate, 20 900 ha severe. This increase occurred in the Bowron, McGregor and Upper Parsnip river valleys and the Fort St. James areas but declined in the Carp-Weedon lakes area.</p> <p>Bowron - Willow 34 000 ha; severe 20 200 ha; moderate 11 500 ha; light 3100 ha. Parsnip - McGregor 8100 ha; severe 700 ha; moderate 5000 ha; light 2400 ha. Fort St. James 13 800 ha; Carp-Weedon lakes 7700 ha; The average percent of stems affected in 19 stands were: healthy 62%, current 12%, red 10%, partial 7%, grey 9%.</p>
1981	<p>A slight decrease occurred in area of the epidemic to 59 000 ha; 24 000 ha light, 25 600 ha moderate and 9400 ha severe. The most severe recent mortality continued in the Bowron and Willow river valleys; in the McGregor and Parsnip river drainages and the Seebach and Herring Creek drainages. Less extensive mortality occurred in Goat and Morkill river valleys, West Twin Creek, Carp-Weedon lakes; Stuart-Trembleur-Takla lakes in the Williston Lake area north of Mackenzie.</p>

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Year	Remarks
	The average percent of stems affected in 18 locations cruised were: healthy 63%; current 2%; red 29%; partial 3%; grey 3%. The volume of spruce killed by spruce beetle in 1979 and 1980 was 3 000 000 m <sup>3</sup> .
1982	Epidemic continued with 2 million m <sup>3</sup> killed over 57 500 ha, down slightly from 1981. Light mortality (5%) over 30 650 ha; moderate (6-30%) 14 300 ha; severe (31%+) 12 550 ha. Major infestations in the Bowron-Willow river drainages; near Stoney Lake, Stephanie, Indian Point, Haggen and Pinkerton creeks and Slender Lake, McGregor and Torpy river drainages.
1983	The epidemic continued at a declining rate, with 1 400 000 m <sup>3</sup> of spruce killed over 32 980 ha, down from 1982 by one quarter. Light mortality (5%) was recorded over 9 565 ha, moderate (6-30%) over 17 240 ha and severe (31%+) over 6175 ha. Major infestations continued in the Bowron, Willow and the McGregor river drainages, particularly in the Haggen and Kitchi Creek areas and in the Goat river and associated drainages.
1984	Spruce beetle caused mortality continued, but at reduced levels for the second consecutive year, 525 900 m <sup>3</sup> of spruce were killed over 25 470 ha. Overall decline was attributed primarily to host depletion in the Bowron and McGregor river drainages caused by previous years mortality and extensive salvage logging. Light mortality (5%) occurred over 19000 ha, moderate (6-30%) over 6070 ha and severe (31%+) over 400 ha. Major infestations continued in the drainages around the McGregor, Bowron, Willow, Missinchinka and Goat Rivers, and along the west side of Williston Lake. No new mortality was recorded in the Stewart-Trembleur Lakes area. Salvage logging in the Tarnegell Creek area contributed to this decline.
1985	Populations begin to collapse in this third consecutive year of decline. Only 78 200 m <sup>3</sup> of spruce trees were killed over 4 000 ha, just 15% of the 1984 total. Light mortality (5%) was recorded over 2 400 ha, moderate (6-30%) over 1 600 ha. No severe mortality recorded. The most notable decline occurred in the McGregor, Bowron and Goat river drainages. Areas of continuing recent mortality were Upper McGregor River and associated drainages including Bastille, Revolution, Kitchi and Einar creeks; mortality continued in Bowron River drainages including Haggen, Indianpoint, Slim and Fly Creeks. Infestations also continued at Dome Creek. No recent mortality was seen in the Goat River and associated drainages.

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Year	Remarks
1986	The infestation collapsed with only 2 050 m <sup>3</sup> of spruce killed over 147 ha in this fourth year of decline. Only light (5%) mortality recorded, mostly within large areas of old dead trees. Only areas of recent mortality recorded were at Upper McGregor River, Jarvis, Revolution, Kitchi and Bastille creeks. Small pockets of 1-5 trees were mapped along the Hominka River. No mortality was recorded in the Bowron River and associated drainages.
1987-88	Endemic populations, mainly in blowdown.
1989	Spruce beetle-caused mortality was mapped over 22 ha in widely scattered pockets of 1-10 trees. Mature spruce was killed in the Weedon, Davie and Kerry lakes areas north of Prince George, and in Table, Anzac, Hominka and Missinka river valleys northeast of Prince George. Spruce beetle populations had been declining for six consecutive years prior to 1989.
1990	Populations increased for the second consecutive year, with recent mortality in numerous widely scattered patches totaling 11 160 ha (175 000 trees, 297 000 m <sup>3</sup> ). Most of the population increase was in the Carp, McLeod, and Weedon lakes area, and in the upper Parsnip and McGregor river drainages over 3 850 ha, and over 7 300 ha west of Williston Lake. New attacks also increased between Pine Pass and Chetwynd, south of Dawson Creek, and southwest of Hudson Hope.
1991	Mortality caused by the spruce beetle populations increased for the third consecutive year; cumulative (2+ years) mortality of approximately 942 000 m <sup>3</sup> over 43 900 ha was mapped, by the B.C. Forest Service, from the Stony Lake area on the southern edge of the Prince George Region to Kotcho Lake east of fort Nelson. This is more than three times the 296 530 m <sup>3</sup> killed over 11 160 in 1990. All of the infestations mapped during aerial surveys were in the Prince George, Mackenzie, and Fort Nelson Timber Supply Areas. Infestations ranged in size from single trees to several hundred hectares.
	Infestations increased in the Prince George TSA to 11 155 ha in over 700 individual infestations, the majority along the Parsnip and McGregor rivers, and in the Wichcika, Seebach and Averil creek drainages. Infestations were mapped over 32 400 ha in the Mackenzie TSA from Mischinsinlika Creek in the south to Fox Lake in the north and east from Ominicetla Creek to the Nabeshe River. Active populations were record in the Dawson Creek TSA in the Silver Sands, Carbon and Table creek drainages. Beetle attacks were noted for the first time in the Fort Nelson TSA with 900 ha mapped near Kotcho Lake.



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Year	Remarks
1992	<p data-bbox="431 353 1433 604">BCFS aerial and ground surveys indicate that spruce beetle caused mortality increased for the fourth consecutive year to over 65 000 ha. More than 50 000 ha were mapped by the BCFS in the Mackenzie and Dawson Creek forest districts. Increases in spruce beetle caused mortality were recorded in all forest districts in the region except Vanderhoof. Timber loss has been estimated at over 1 500 000 m<sup>3</sup> of recently killed white spruce.</p> <p data-bbox="431 644 1433 1023">Approximately 10 000 ha of beetle attack was mapped in the Dawson Creek TSA, mostly in the following drainages; Eleven Mile, Carbon, McNairn, Doonan, Silver Sands, Little Boulder, Mountain, Windfall, Wolverine and Fisher creeks. In the Fort Nelson TSA attacks were noted over 5 000 ha near Kotcho Lake. More than 40 000 ha of attack was recorded in the Mackenzie TSA with major increases recorded in the Clearwater River and Ross Factor Creek drainages. The area of spruce beetle infested white spruce remained relatively constant in the Prince George TSA at 9620 ha. Mortality in the Prince George Forest District decreased to 7070 ha but increased in the Fort St. James Forest District to 2550 ha.</p>
1993	<p data-bbox="431 1064 1433 1408">British Columbia Forest Service aerial and ground surveys indicate that spruce beetle caused mortality decreased to almost 51 000 ha after four consecutive years of increase. The decrease in area occurred mostly in the Dawson Creek Forest District which had reported 50 000 ha of infestation in 1992 but only 6800 ha in 1993. Decreases in area of attack were also noted in the Mackenzie, Fort Nelson and Fort St. James Forest Districts. Timber loss has been estimated at over 1 200 000 m<sup>3</sup> of recently killed white spruce. Infestations ranged in size from single trees to several thousand hectares.</p> <p data-bbox="431 1449 1433 1766">In the Mackenzie TSA spruce beetle caused mortality of white spruce remained static in 1993 with 41 000 ha of attack mapped by the BCFS over the same geographic area as in 1992. A more precise BCFS aerial survey in the Dawson Creek TSA resulted in a decrease to 6 800 ha in the estimated area of beetle infestation. Infestations continued in basically the same areas as 1992, between the Rocky Mountains and the foothills south of the western arm of Williston Lake and north of the Hart Highway. The area of spruce beetle infested white spruce decreased by 70% in the Prince George TSA to 2850 ha.</p>

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Year	Remarks
	Mortality in the Prince George Forest District decreased to 1620 ha and in the Fort St. James Forest District to 1230 ha. Scattered current attack was noted at Kotcho Lake and the Liard River in the Fort Nelson TSA. Scattered individual beetle attacked trees were noted in the Graham River drainage in the Fort St. John TSA.
1994	Spruce beetle caused mortality of white spruce was reported over approximately 72 000 ha. The majority of the increase in mortality was noted in the Mackenzie TSA with over 53 000 ha reported. More than 12 000 of mortality was reported in the Prince George TSA, 7 000 ha in the Prince George Forest District and 5 200 in the Fort St. James Forest District. The area of beetle attack in the Dawson Creek TSA decreased to 5 500 ha.

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Mountain pine beetle  
Dendroctonus ponderosae

The principle host tree in the Region is lodgepole pine. Most of the mountain pine beetle activity has been in the Stuart-Takla-Trembleur Lake drainages where infestations occurred from 1956 to 1968, peaking in 1964-65. An increase in the number of pine killed began in 1975 and continued to 1982 when over 6 000 m<sup>3</sup> were killed.

Western white pine stands are also killed by mountain pine beetle attacks. Along McNaughton Lake, mortality began in 1968, and continued to 1982 when 7000 m<sup>3</sup> were killed.

Regional infestations continued to fluctuate between 1000 to 4000 ha until 1990 when approximately 8 000 ha of beetle killed pine was recorded. Mortality continued at about the same level for 1991 and 1992 but increased in 1993 to over 12 000 ha mostly in the Fort St. James Forest District.

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Year	Remarks
1942-47	No records.
1948	Beetles killed approximately 70% of lodgepole on 2 ha at Takla Landing. Other isolated pockets of attack were noted on the east and west sides of Takla Lake, the largest on the West side of Takla Narrows.

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Year	Remarks
1949-54	No records of attacks.
1955	Overmature lodgepole pine was killed at the south end of Takla Lake: Bivouac Creek, 300 trees; Leo Creek, 800 trees; Sakeniche River, 300 trees; small groups between Tarnezell and Trembleur lakes.
1956	Attacks continued in the Takla Lake area with an estimated 65 000 trees killed since 1948.
1957	Infestation continued in the Takla Lake area over 6000 ha.
1958-59	Declining populations were noted at Takla Lake. Small populations were recorded in stumps on Manson Creek Road, only one standing tree infested. Over 500 red lodgepole pine were recorded at Takla Lake south of old infestation.
1960	Scattered populations persist while infestations at the southeast end of Takla Lake subsided. The area of infestation was 11 200 ha, estimated volume killed 804 000 m <sup>3</sup> .
1961	Low levels of mortality were recorded with 20 red lodgepole pine at Tabor Lake and 5 at Upper Willow River. Populations were static at Takla Lake, slight increase at Bivouac Creek. Three new infestations were detected: Kloch Lake, 175 trees; Kuzkwa River, 730 trees; Tezzeron Lake, 64 trees. Volume loss for 1959-60 was 2630 m <sup>3</sup> .
1962	The number of currently attacked trees increased at Bivouac Creek near Takla Lake and on Kuzkwa River, North of Tezzeron Lake, where counts of 4000 and 2250 were recorded. Infestation remained at low levels near Tabor Lake (10 trees).
1963	There was a general increase in the number of red pines counted at Tezzeron Lake, Kuzkwa River, Bivouac Creek and Sakeniche River, some 1962-attacked trees were reattacked.
1964	There was increase of 17% in red trees in the Tezzeron-Takla lakes area.
1965	Current attack increased 27% due to 1964 attack in Tezzeron-Takla lakes area. Although low levels of 1965 attacks were due to heavy larval mortality. Damage for 1963-64 calculated at 37 700 m <sup>3</sup> of lodgepole pine killed over 3420 ha (6000 red trees counted).
1966	Low levels of attack noted with a decrease of 79% in currently attacked trees; Kuzkwa River, 220 red trees; Inzana Lake, 250 red trees. The total mortality over the past four years was 1963-64: 35 650 m <sup>3</sup> - 31 480 trees, 1964-65: 7 570 m <sup>3</sup> - 6690 trees.



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Year	Remarks
1967	There was a significant decrease in populations noted at Takla Lake, 660 red lodgepole pine.
1968	Continued decreases noted with over 100 red lodgepole pine noted at Takla Lake. Localized infestations noted in lodgepole pine and western white pine stands in the Canoe River Valley.
1969	The number of lodgepole pine attacked decreased.
1970-71	Populations were at low levels with only 300 red western white pine noted along Canoe River.
1972	Populations increased at Canoe River with 750 red western white pine recorded.
1973-74	No new attacks observed at Canoe River or in other areas of the region.
1975	Recently killed lodgepole pine were mapped in the Stuart-Takla lakes area: Whitefish Lake, 150 trees over 16 ha; Nancut Creek, 60 trees 6 ha; Takla Lake, 60 trees, 4 ha; Takla Landing, 20 trees, 2 ha; Wedge Mountain 10 trees on 1 ha.
1976	Current small infestations were located in the Fort St. James District: Stuart Lake, 50 red trees; Whitefish Lake, 50; Nancut Creek, 90; Cunningham Lake, 80; Takla Lake, 50; Chuchi Lake 140; Chuius Mtn. 120; Hatduatchl Creek 50; Pinchi lake 15 and north of Valemount at Swift Creek 150. Western white pine were killed along Canoe Arm at Ptarmigan Creek 100 trees; Hugh Allan Creek 75 and 30 at Buster Creek.
1977	The number of beetle-killed pine increased to 4100 trees, with the largest increase in western white pine along McNaughton Lake, 3200 red trees. Lodgepole pine were killed at Valemount, 500 trees; Whitefish Lake 50; Nancut, 30; Cunningham Lake, 55; Chuius Mtn., 75; Hatdudatehl Creek, 95; and eight other small (5-30) spots from Vanderhoof to Takla Lake.
1978	There was a general decrease in the number of red pine trees counted. Western white pine were killed along both sides of McNaughton Lake, 1445 trees. Lodgepole pine were killed at: Swift River, 200; Nevin-Horsey creeks, 125; Nation River, 50; Cunningham Lake, 30; Stuart Lake, 30; Tezzeron Lake, 25; Kazchek Lake, 75 and Tsayta Lake 25 trees.

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Year	Remarks
1979	An increase in red trees occurred with 4600 trees counted over 2200 ha. Western white pine were killed along McNaughton Lake, 2125 trees on 1418 ha. Lodgepole pine were killed at several locations; Swift Creek, 2155 trees on 575 ha; Nevin Creek, 28 trees on 64 ha; Ft. St. James, 30 trees on 32 ha; Tezzeron Lake 50 trees on 30 ha; Dem Lake, 100 trees on 64 ha; Leo Cr., 50 trees on 35 ha and Nation Lake, 125 trees on 60 ha.
1980	Infestation expanded with 8000 ha of mortality over 90 separate infestations. In the McNaughton Lake area, 4400 ha of white pine were attacked. Near Valemount at Swift Creek the beetle killed trees over 800 ha and north and west of Ft. St. James infestations totaled 2000 ha, mainly at Tachie River, Whitefish and Butterfield lakes.
1981	Infestations continued but area was down compared to 1980 because of logging and host depletion. A total of 2500 lodgepole and 3800 western white pine were killed over 900 ha, mainly from Valemount to Canoe Arm on McNaughton Lake and northwest of Prince George in the Takla and Tezzeron lakes area.  At Swift Creek lodgepole pine were killed over 125 ha; at Canoe Arm western white pine over 604 ha; Takla Lake lodgepole pine over 500 ha; Tezzeron-Trembleur lakes over 2000 ha and Purden Mountain over 10 ha of mortality.
1982	Outbreaks continued, killing 16,000 pine (9,140 lodgepole pine, 3 190 m <sup>3</sup> , 6 860 western white pine, 5 110 m <sup>3</sup> ) at Swift Creek, 4 600 trees; Ft. St. James, Takla Lake 4 540 trees; McNaughton Lake, 6 860 trees.
1983	The number of recently killed lodgepole pine and western white pine increased to over 18 000 in 1983: 15 400 over 520 ha along the east side of Canoe Arm; 2 620 trees over 200 ha near Trembleur Lake.
1984	Lodgepole pine mortality increased to 97 700 m <sup>3</sup> in 170 separate locations over 2 800 ha; 2 570 ha along the east side of Canoe Arm; 10 new infestations over 200 ha near Valemount: 225 ha in the Stewart-Trembleur lakes area; scattered attacks in the Blackwater River area.
1985	Lodgepole and western white pine mortality in the Prince George Region declined overall to 11 760 m <sup>3</sup> over 630 ha. The majority of the decline occurred on the east side of Canoe Arm in the McBride TSA.

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Year	Remarks
1986	Lodgepole pine mortality due to attacks by the mountain pine beetle decreased slightly to 9 000 m <sup>3</sup> over 1 225 ha. Most of the 440 infestations were near Fort St. James, southwest of Vanderhoof, and southwest of Prince George and southeast of Valemount.
1987	Mountain pine beetle killed 132 660 m <sup>3</sup> of lodgepole pine over 4 290 ha. Seventy-five percent of the volume killed in the region occurred in the Skeena-Sustut infestation in the Fort St. James District. Infestations along the northwest arm of Takla Lake and in TFL 42 accounted for the remaining 25%.
1988	Recorded lodgepole pine mortality decreased to 72 100 m <sup>3</sup> over 3 975 ha. Eighty percent of beetle-caused mortality was found in chronic infestations in the Fort St. James District. The area of beetle-killed trees increased slightly in the Prince George West and McBride districts while decreasing slightly in the Vanderhoof and Prince George East districts.
1989	Volume of lodgepole pine killed by mountain pine beetle decreased to 97 910 m <sup>3</sup> over 2 805 ha. Eighty-five percent of beetle caused mortality continued in the Fort St. James District. The area of mortality increased slightly in the McBride District while declining in the Vanderhoof and Prince George districts.
1990	The area of recorded lodgepole pine mortality due to attacks by the mountain pine beetle increased to 206 000 m <sup>3</sup> over approximately 7 875 ha. These figures are based solely on maps provided by the B.C.F.S. Much of this apparent large increase in area and subsequently volume can be attributed to differences in mapping techniques between Forestry Canada's FIDS unit, and the B.C. Forest Service.  Ninety-five percent of beetle caused mortality occurred in areas of chronic infestation in the Fort St. James Forest District in the Prince George TSA. Mortality increased slightly in the Prince George District, remained static in the McBride District, and declined in the Vanderhoof District.
1991	Recorded lodgepole pine mortality due to attacks by the mountain pine beetle increased to some 267 000 m <sup>3</sup> over more than 9300 ha. In the Fort St. James District pine mortality increased to over 8900 ha mostly along the north shores of Trembleur and the Northwest arm of Takla lakes, and northwest of Lovell cove. Mortality was mapped over 165 ha in the Prince George Forest District mostly south of Prince George



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Year	Remarks
1992	<p>city. An estimated 225 ha of beetle killed trees were recorded along McNaughton Lake in the McBride Forest District. Only 10 ha of attack were noted in the Vanderhoof Forest District.</p> <p>The area of lodgepole pine mortality due to attacks by the mountain pine beetle decreased to 8430 ha after three consecutive years of increase. Again over ninety percent of beetle caused mortality occurred in areas, mostly inaccessible, of chronic infestation in the Fort St. James District in the Prince George TSA. The actual area of attack decreased from 8900 ha to 8100 ha but the timber volume of trees killed increased slightly 293 000 m<sup>3</sup>, due to increased severity of attack. The same situation occurred in the McBride Forest District with a decrease in area to 150 ha but an increase in tree volume killed, 11 000 m<sup>3</sup>. Mortality increased slightly in the Prince George Forest District to 180 ha and remained static in the Vanderhoof Forest District with no recorded tree mortality.</p>
1993	<p>The area of recorded lodgepole pine mortality due to attacks by the mountain pine beetle increased to over 12 000 ha. Most of the mortality occurred in the Fort St. James District with increased attacks over 11 000 ha. The most dramatic increase was in the Vanderhoof District where 500 ha of attack was recorded up from only scattered individual attacks in 1992. In the McBride Forest District area of mortality increased to 400 ha and more than doubled in the Prince George Forest District.</p>
1994	<p>This beetle killed lodgepole pine over almost 17 000 ha the largest area ever recorded. Over eighty percent, 13 600 ha, of the beetle caused mortality occurred in areas of chronic infestation in the Fort St. James Forest District.</p>

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Douglas-fir beetle  
Dendroctonus pseudotsugae

This beetle is a major pest of Douglas-fir in the Prince George Forest Region. It is mainly confined to the Fraser, Blackwater, and Crooked river drainages around Prince George, Stuart-Tezzeron-Trembleur lakes north of Fort St. James, and in the McBride-Valemount area.

Attacks have been recorded since 1944 but were scattered and patchy until 1962-66 when over 12 000 m<sup>3</sup> were killed near Hixon, around Stuart Lake, and along Castle Creek near McBride. Infestations remained at low

levels until 1986 when populations began to expand and continued to increase until over 3650 ha of mortality was recorded in 1993. Almost half the area in 1993 was recorded in the Fort St. James Forest District.

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Year	Remarks
1944-46	Scattered attack was recorded at the northeast end of Pinchi Lake.
1947	Continued attacks reported on a few trees at Pinchi Lake plus scattered groups of trees northwest of Stuart Lake.
1948	Small patches of Douglas-fir were attacked on both sides of Stuart Lake from Fort St. James to Tachi River, plus some additional attacks on the slopes north of Pinchi Lake.
1949	All infestations subsided; no new red trees were reported.
1950	No activity reported.
1951	A few red trees noted in the Pinchi-Tezzeron lakes area and along the Fraser River south of Hixon.
1952	A few trees were attacked along the ridges between Pinchi and Tezzeron lakes.
1953	Small infestations reported at Pinchi and Tezzeron lakes and on Churchill Mountain.
1954	Light attacks found at Stuart Lake and Churchill Mountain.
1955-56	Twenty-five trees attacked at Summit Lake and fifteen attacked at Pinchi Lake.
1957	Endemic populations.
1958	Several hundred red trees at Stuart Lake, also several at Chilako River, Angusmac Creek, Isle Pierre Road, and south of Fort St. James.
1959	A slight decrease in trees attacked was noted with 175 dead trees on the south shore of Stuart Lake, mostly near Tachi village, 10 trees near Mapes.
1960	Noteworthy losses occurred in the Hixon and Stuart Lake areas.
1961	Dead trees were confined to the Red Rock-Ahbau Lake area with minor losses.
1962	A total of 1421 dead trees with an estimated volume of 3180 m <sup>3</sup> were mapped region-wide.

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Year	Remarks
1963	An estimated 1600 trees were killed southwest of Hixon and 700 in the Stuart Lake area.
1964	Another 584 trees were attacked in Stuart-Tezzeron lakes area.
1965	Infestations remained at a low level south of Prince George. In Stuart-Tezzeron lakes area, 804 red trees were mapped.
1966	Populations decreased with 450 trees killed over a 2-year period at Castle Creek (McBride); 30 red trees at Pinchi Lake.
1967	Continued decreases reported; Hugh Allen Creek, 126 red trees; Castle Creek decrease; scattered attack in Pinchi Lake area.
1968	No record in reports.
1969	Groups of red trees adjacent to logging or in seed blocks: Barney Creek, 45; Eaglet Lake, 50; Purden Lake, 20.
1970	Decline in attacks noted; Canoe River, 215 trees and Stuart-Tezzeron lakes, 100 trees.
1971	Further decline in attack.
1972	At Summit and Bear lakes 50 red trees were mapped and 25 trees at Teapot Mountain.
1973	Along the Canoe River; 200 red trees were observed at Foster Creek.
1974	Scattered attacks occurred at Bear Lake.
1975	Scattered single trees were killed in the Tete Jaune Cache area and north of Prince George near Bear Lake.
1976	Log decks were attacked 20 miles west of Punchaw Lake and approximately 300 red trees were noted over 12 ha along Barney Creek Road.
1977	Attacked log decks were observed north of Summit Lake and west of Punchaw Lake.
1978	A few small patches of 5-10 Douglas-fir trees were killed along Castle Creek near McBride.
1979-80	No tree mortality reported.



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Year	Remarks
1981	An estimated 200 recently killed trees were recorded in pockets of 5-10 trees at McLeod and Stuart Lakes, McGregor River and in the McBride area.
1982	Small numbers of dead trees noted in pockets in Bowron River area.
1983	An estimated 78 recently killed trees were recorded in 12 small pockets along the Blackwater River.
1984	The number of recently killed trees increased to 384 over 35 ha, centered around Blackwater Crossing.
1985	Attacks declined to 63 trees, due in part to a recently implemented trap-tree program.
1986	About 20 small groups of Douglas-fir veterans were killed over 75 ha in the Prince George District, mostly in the Averil and Eaglet lakes areas northeast of Prince George. Tree mortality declined in the Blackwater River Valley due to recent trap-tree and selective-tree removal.
1987	Over 250 trees were killed in 15 locations over 45 ha mostly in a new infestation just north of Cunningham Lake. The remaining infestations were scattered within the Prince George East District and ranged from 5 to 20 trees at Harvie Creek, along the McGregor River, north of Eaglet Lake, near the junction of Highway 16 east and Giscome Road, and north of Purden Lake.
1988	Over 250 red trees were mapped over 90 ha in groups of 1 to 20 trees along the Blackwater River, the Bobtail-Pelican Road, west of Gregg Creek, and the Butcher Flats to Chilako River area.
1989	Approximately 500 Douglas-fir trees were killed over 113 ha in 200 small scattered patches over the southwestern portion of the Prince George District, and in the Fort St. James District.
1990	Mortality due to beetle attacks was mapped by the B.C. Forest Service over 800 ha in scattered groups of 1 to 40 trees from the Bobtail Lake area southeast to Punchaw, and the Blackwater River area from the Nazko River to the Fraser River. Scattered mortality was also recorded in the Baldy Hughes area and along the Telegraph Range.

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Year	Remarks
1991	Mortality due to attacks by the Douglas-fir bark beetle almost doubled to over 1500 ha. Over 720 ha was recorded in the Prince George Forest District, in 250 small, scattered infestations of mostly light mortality. The largest increase in beetle-caused Douglas-fir mortality occurred in the McBride Forest District with over 600 ha of mostly moderate mortality recorded.
1992	Area of attack more than doubled to over 3425 ha. Almost half the damage, 1400 ha, was recorded in the McBride Forest District with an estimated 19 000 m <sup>3</sup> killed in 33 mostly light infestations along McNaughton Lake. Volume loss in the Fort St. James District was 29 000 m <sup>3</sup> in 28 infestations over 900 ha. Infestation expansions also occurred in the Prince George Forest District where over 1125 ha in over 200 infestations was recorded with a volume loss of 21 000 m <sup>3</sup> .
1993	The area of mortality due to attacks by the Douglas-fir bark beetle increased for the eighth consecutive year to more than 3 650 ha. Expansions occurred in all Forest Districts where the beetle was mapped in 1992 except for the Prince George Forest District where there was a significant decrease. In the Fort St. James District beetle attacks doubled to almost 1800 ha. In the McBride District there was a slight increase to 1500 ha. Widely scattered single tree attacks in the Vanderhoof district coalesced into small but significant infestations. The area of attack decreased about two-thirds to 350 ha in the Prince George Forest District.
1994	Beetle attacks decreased to approximately 2 500 ha. Decreases occurred in all Forest Districts with active infestations except for the Prince George District where the area of attack increased to 1300 ha. Almost 500 ha of mortality was mapped just north of Fort St. James to Pinchi, and around Whitefish, Hatdudatehl and Inzana Lakes. In the Prince George Forest District most mortality occurred in chronic infestations in the Blackwater River, Naltesby Lake and Wansa Creek drainages. Approximately 730 ha of chronic infestations were mapped along McNaughton Lake in the Robson Valley District.

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Western balsam bark beetle-fungus  
Dryocoetes confusus

This beetle, in association with a fungus Ceratocystis dryocoetidis which is introduced into attacked trees, has killed large volumes of alpine fir in the Region during periodic outbreaks. Although early records are sketchy, there are records of damage as far back as 1923 in the Wells - Barkerville area.

From 1962 until 1965 widespread mortality was reported over more than 60 000 ha in the Fort St. James, Mackenzie and Prince George Forest districts.

Increases in balsam bark beetle caused mortality was again noted in 1978 and continued until 1989 mainly around Takla and Williston lakes. Over 35 000 ha of infested high elevation balsam was recorded in the Fort St. James Forest District in 1992.

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Year	Remarks
Prior to 1958	Intermittent reports of unspecified tree mortality.
1958	Small numbers of red trees reported at km 13 of the Nation River mine road.
1959-60	Not mentioned in reports.
1961	Approximately 150 red trees were mapped at Lazaroff, Nelson-Kenny lakes and Hixon areas. Extensive tree-kill in Stuart Lake area occurred prior to 1961, 90 890 m <sup>3</sup> over 8560 hectares. In the Pine Pass area, 27 500 dead trees were recorded over 2200 ha.
1962	At Upper Fraser, TFL 30, Purden and Willow River drainages, 4400 alpine fir trees were killed. Extensive mortality was also noted along Table River, Scovil Creek, Missinchinka River, and near Stuart Lake.
1963	Widespread infestations recorded in the; Upper Fraser River Valley, Tchentlo, Kloch, Airline, Humphrey Lakes, Takla Landing, Parsnip River from Arctic Lake to Anzac and Pine Pass.
1964	Few current attacks noted, but vast areas of previous attacks from the 1950's was recorded in the Purden and Willow river areas. Widespread old mortality over 58 720 ha, and current light mortality was active in Callazon-Clearwater lakes and Pine Pass areas.
1965	In the McBride area and along the Upper Fraser River tributaries, 6000 red trees were counted. Cumulative mortality from 1962-64 was estimated at 110 205 m <sup>3</sup> loss over 34 600 hectares. Scattered infestations were noted at Azouzetta and at km 235 of the Alaska Highway.
1966	Mortality, 1200 trees, was recorded north and east of the Morkill River with scattered attack seen in the Upper Slim Creek, McGregor, Raush and Canoe rivers.



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Year	Remarks
1967	Continued scattered damage was found in the McKale, Jaselle, Slim and Kenneth creek drainages, severe at Burden and Scovil creeks and light attack at Stuart, Tezzeron, Trembleur and Tchentlo lakes areas. Further reductions in attack were noted at Pine Pass.
1968	Widely scattered red trees were recorded in the mountainous area in the eastern portion of the region, Dome Creek and McBride areas most severe. Infestations were also noted at Burden, Morfee, McLeod, Takla and Trembleur lakes.
1969	Widespread attacks on the east side of Rocky Mountain trench in Missinchinka River and Mugaha Creek areas. Severe attacks seen in Willow River and Fraser river drainages.
1970	From 1968 to 1970, 14 600 red trees were counted throughout Pine Pass and along Dome, McKale and Thursday creeks.
1971-72	Approximately 2200 red trees counted throughout region.
1973	Reduced levels of attack noted throughout the region.
1974	Slight increase to 230 recently killed alpine fir trees seen at Moose Lake and Pine Pass.
1975	Slight increase in number of trees to 460; Moose Lake 150; Slim Creek headwaters 85; Link Lake 35; Garbitt Creek 110; Bennett Creek 40 and George Mountain 40.
1976-77	Dead trees mapped in the Pine Pass area, 180 in 1976 and 100 in 1977.
1978	There was an increase in tree mortality but numbers are not available. Areas of tree mortality were: Pine Pass 250 ha; Everett Creek 250 ha; Kuyakuz Mtn. 200 ha; Limestone Ridge 100 ha and 100 trees at Moose Lake.
1979	A further increase in area of alpine fir mortality mapped to 3800 ha. Moderate mortality (6-30% of alpine fir affected) over 800 ha at Boling Peak and 200 ha along Takla Lake. Tree mortality was mapped over 2800 ha northwest of Van Decar Creek near Middle River.
1980	Mortality continued at widespread locations, Bivouac Creek 715 ha; Pyramid Peak near Takla Lake 2266 ha and 85 ha at Emerald Ridge in Mt. Robson Park.

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Year	Remarks
1981	Up to 5% of the alpine fir were killed in white spruce-alpine fir stands over 315 ha at various locations in the Takla Lake area; Frypan Creek 125 ha; Lovell Cove 100 ha; West Landing 40 ha and on the southside of Tsayta Lake 50 ha.
1982	Mortality increased to 24 000 trees over 8300 ha mainly in Stuart-Takla-Germansen lakes areas.
1983	The number of killed trees decreased to 3 000. The largest infestation contained 2 000 trees over 230 ha southwest of Tumuch Lake.
1984	The number of recently killed trees increased to 6 260, mostly along Takla and Williston lakes.
1985	A total of 5 240 red trees were mapped over an area of 4 600 ha along Takla and Williston lakes.
1986	Over 7 000 trees were killed in 160 separate infestations over an area of 3 000 ha, mostly in the Takla mountains.
1987	An increase to 10 600 trees over 6 125 ha: Takla Lake, 2 050 ha; Manson Creek, 600 ha; Missinka River, 260 ha; Herrick Creek, 740 ha.
1988	Alpine fir mortality was scattered in 54 infestations over 1220 ha, mostly northwest of Fort St. James. Significantly reduced aerial surveys, particularly over previously infested stands east of Prince George and Mackenzie, were a major factor in any apparent decline in area.
1989	More than 80 separate areas totaling 3 900 ha containing alpine fir recently killed by the beetle were mapped in the region; this threefold increase is largely due to expanded aerial surveys. Most mortality occurred in chronically infested areas east of Prince George and in new areas northwest of Fort St. James.
1990	Only 35 ha of recent mortality were recorded during limited aerial surveys in 1990. This decrease is strictly a reflection of reduced aerial surveys, rather than an abrupt decline in beetle populations.
1991	Approximately 6900 ha of alpine fir was killed mostly in the northern portion of the region. Light mortality was mapped over 4200 ha in the Fort St. James District. More than 1700 ha were recorded along both sides of Bear Lake and

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Year	Remarks
	between Forester Lake and Katsberg Creek. In the Mackenzie district almost 2400 ha of light to moderate mortality were mapped with an estimated 960 ha bordered by Nation Bay, Manson Arm and Mt. Bisson. In the McBride district almost 300 ha of scattered severe mortality in over 60 infestations were noted.
1992	Beetle-caused tree mortality increased over fivefold to over 40 000 ha. The majority of the damage occurred in the Fort St. James Forest District with 35 000 ha. Almost half the area was mapped in 15 infestations along the east side of the Bait Range. In the Mackenzie Forest District mortality was reported over a wide area, however no actual area figures are available due to lack of aerial mapping. In the McBride Forest District more than 1200 ha of mortality were recorded.
1993	Balsam bark beetle caused alpine fir tree mortality decreased slightly to approximately 30 000 ha. The majority of the mortality again occurred in the Fort St. James Forest district with light mortality mapped over 25 000 ha, 80% of which was mapped in 90 infestations in the Takla Lake area.
1994	Alpine fir trees were killed over 33 000 ha mostly in the Fort St. James Forest district with light mortality mapped over 32 000 ha. Approximately 12 000 ha were recorded in 26 infestations along the eastside of Takla Lake from Takla Narrows north to Elmore Creek. Further to the north over 9 000 ha were reported along the Skeena, Sustut, Mosque and Omineca Rivers. Over 10 000 ha were recorded northwest of Salmon Lake and in the Nation River-Nation Lakes drainages.

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Northern spruce engraver beetle  
Ips perturbatus

This beetle is usually considered to be a secondary bark which invade weakened trees or slash but attacks on living trees is not unusual. Large broods develop because of an abundance of suitable host material. Windfall and non-lethal spruce beetle trap trees that are felled partially in the open to facilitate removal, provide an excellent source of host material. Top kill and mortality of white spruce has been reported from 1965-68, 1984-88 and 1991-92.



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Year	Remarks
1957-60	A large population attacked windthrown white spruce in Stone Creek Valley.
1961	Heavily infested white spruce blowdown in upper Willow River Valley and in log decks in the Parsnip River Valley.
1962	Log decks along upper Fraser River were heavily infested.
1963-64	Common in slash and in log decks in Prince George Forest District.
1965-67	Attacked and killed the upper crowns of numerous white spruce in the Prince George Forest District which had been lightly attacked by spruce beetle.
1968	Large populations in Willow River Valley killed 200 white spruce on the edges of leave strips.
1969-70	No records.
1971	Heavily infested log decks were noted at Bear Lake and infested windfalls and log decks in the Willow River Valley.
1972-74	Severely infested windfalls and trap trees noted throughout the region.
1975	No records.
1976	Moderate populations in blowdown trees and decked logs along the Bowron, Tumuch and Naver Roads.
1977-83	Endemic populations.
1984	Engraver beetles attacked and killed the upper crowns of at least 3 000 mature white spruce in TFL 23 near Pass Lake and Walker Creek, and more than 300 trees in the Bowron River Valley near Haggen Creek.
1985	The upper crowns of an estimated 4 000 mature white spruce were attacked in scattered patches for 25 km along the southwest side of the Torpy and west Torpy rivers. In addition to the new attacks, most of those trees top-killed in 1984 were reattacked farther down the boles.
1986	Approximately 800 trees were attacked, mainly along Otter and Captain creeks and in the Torpy River area.

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Year	Remarks
1987	Only 20 current engraver beetle attacks were detected in the Parsnip River drainage.
1988	In the fourth year of declining populations, only 15 current engraver beetle attacks, mainly along Herrick Creek.
1989	Not reported.
1990	Large numbers of suitable host material consisting of both windfall, and non-lethal spruce beetle trap trees were attacked from the Stony Lake area, to well north of Mackenzie, and to a lesser degree, in the Carbon Creek area west of Hudson Hope.
1991	Populations of this engraver beetle continued to increase, top killing scattered single standing white spruce over large areas east of Summit Lake in the Prince George Forest District and west of Takla Lake in the Fort St. James Forest District. The top third of the infested trees were killed in the Averil, Olsson, Ankwil and Kwanika creeks drainages and along the Torpy River. Although this pest is normally a secondary bark beetle, the attacks on living trees were not unexpected as population build-ups were noted last year.
1992	This engraver beetle continued to kill the top third of white spruce trees mostly in the Prince George Forest District. Scattered single standing white spruce were top killed throughout the Averil Creek, Olsson Creek, and the Torpy, McGregor, and Parsnip river drainages. The dead tops caused by the beetle were often found next to dead and dying spruce beetle infested trees.
1993-94	No infestation areas were noted in 1993 or 1994.

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Ambrosia beetle  
Trypodendron lineatum

Populations of this beetle vary with weather and the amount of overwintering windfall, log decks or slash. Unless sawmills utilize logs or log piles immediately after the winter logging is completed, usually prior to mid-May, logs will be infested. Lumber from infested logs is degraded and banned for export due to quarantine laws.

Records of ambrosia beetle attack in the Prince George Region are only available from 1950.

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Year	Remarks
1950-54	Low populations.
1955	At the south end of Takla Lake the lower trunks of lodgepole pine were attacked after being killed by mountain pine beetle.
1956	Low populations.
1957	White spruce was attacked at Fort Nelson and along Haines Road.
1958-61	Endemic populations.
1962	Varied attacks at many areas from Upper Fraser to Pine Pass, up to 25 entrance holes per 900 cm <sup>2</sup> . At Eaglet Lake Mill 28 316 m <sup>3</sup> of logs were infested and 14 150 m <sup>3</sup> at McGregor.
1963	Attack levels similar to 1962 with up to 25 entrance holes per 900 cm <sup>2</sup> of stem at Eaglet Lake and Pine Pass. .
1964	Same areas as in 1963 infested plus the Willow and Naver river areas; up to 118 entrance holes per 900 cm <sup>2</sup> of stem. Most of the attack was in log decks and fresh windthrown white spruce.
1965	Widespread attacks from Prince George to Pine Pass, increases were noted at Valemount, Vanderhoof, Finlay Forks, and Summit and Bear lakes area.
1966	Endemic populations.
1967	Light attack on log in decks at Mackenzie.
1968-70	Endemic populations.
1971	Moderate attacks in log decks at Ferguson Lake Sawmills, Bear and Penney lakes.
1972	Light attacks in log decks at Northwood Sawmill at Upper Fraser.
1973-75	Endemic populations.
1976	Beetles degraded white spruce logs in a 32 ha blowdown area at Thursday Creek southeast of Prince George; 30 entrance holes/900 cm <sup>2</sup> of stem on 30% of the trees. Attacks also noted on blowdown trees along the Bowron River, Tumuch Lake and Bowron Coal roads.



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Year	Remarks
1977-82	Endemic populations.
1983-93	Widespread scattered attacks in log decks and mountain pine beetle and Douglas-fir beetle attacked trees.
1994	Widespread infestations in log decks and mountain pine beetle killed trees. Also widespread throughout the western hemlock looper infestation in the Robson Valley. In some areas up to 25% of the defoliated western hemlock has been infested by ambrosia beetle.

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CONIFEROUS TREE DEFOLIATORS

Eastern spruce budworm  
Choristoneura fumiferana

Damage attributable to the spruce budworm was first noted in the Smith River region of the Liard River in 1957, at which time a light to moderate population was found extending from 782 kilometre to 848 on the Alaska Highway. This population persisted and in 1962 another infestation broke out near Kledo River, from 528 kilometre to 560 Alaska Highway. In 1964 and 1965, several infestations coalesced throughout most of the Nelson and Liard river drainages, causing light to moderate damage. This population remained until 1969 when it decreased throughout most of the area except for along the Liard River Valley, and in the Fort Nelson area at kilometre 395. This was an extension of a large infestation in western Alberta and Northwest Territories.

Repeated defoliation is believed to have resulted in the mortality of some spruce along the Smith River Valley.

A population decline occurred again in 1970 but moderate to severe defoliation occurred annually in the Fireside-Liard Hotsprings area of the Liard River Valley until 1974 followed by light to moderate defoliation in 1975 and 1976 in the Liard River Valley which declined in 1977.

Defoliation has been recorded in the Fort Nelson Forest District since 1984 with almost 400 000 ha mapped in 1990. Infestations expanded into the Fort St. John Forest District in 1992.

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Year	Remarks
1956	No record of damage in reports.
1957	Light to moderate defoliation was noted on the Alaska Highway near Smith River on white spruce, alpine fir, eastern larch and lodgepole pine.
1958	Populations decreased.
1959	Defoliation noted and egg surveys conducted with 90-900 egg masses per 100 sq. ft. of foliage from km 794 to 860.
1960	Defoliation similar to 1959 with up to 90% current foliage eaten, increased number of egg masses noted.
1961	There was a decrease in area of defoliation, although egg mass counts increased at perimeter of the infestation.
1962	Severe defoliation of white spruce and some eastern larch was mapped over 390 km <sup>2</sup> .

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Year	Remarks
1963	Populations remained at high levels, with severe defoliation noted along Rabbit, Grayling, Liard and Kledo rivers.
1964	Population expanded throughout most of the Nelson, Liard, Fontas, Kledo and Smith rivers, from valley bottoms to 600 m elevation. Tree mortality reported resulting from spruce beetle attacks on weakened defoliated trees.
1965	Light to moderate defoliation in same areas as in 1964 from km 374 to km 554 on the Alaska Highway and from km 790 to 861.
1966	Light to moderate defoliation in same areas as 1965 with considerable decline in the severity of attack. Defoliation noted in the Fontas, Fort Nelson, Liard, Muskwa rivers and Kotcho Lake.
1967	There was an increase in extent and intensity of defoliation south and east of Fort Nelson and at km 864 near Liard Hot Springs. Moderate to severe in Fontas, Sikanni Chief, Muskwa, Prophet, Fort Nelson and Liard river valleys (km 395-547, km 790-860) generally 20-80% defoliation in upper crowns.
1968	Most severe defoliation was recorded south and southeast of Fort Nelson and at km 864, Liard Hotsprings.
1969	Populations decreased, larval mortality resulted in a reduction of defoliation in most areas:  Alaska Hwy. km 800-845 - moderate to heavy; " " km 395 - light; " " Smith R - repeated defoliation, some tree mortality.
1970	Population decline, moderate defoliation at km 395 and km 810-864 on the Alaska Highway.
1971	Populations increased with 100+ larvae per beating sample. Moderate to severe defoliation of upper crowns was recorded over 13 000 ha in the Liard Hotsprings-Fireside area.
1972	Similar to 1971 damage, with slight decrease in populations, light to moderate defoliation.
1973	Similar to 1972 with slight increase in larval numbers, moderate to severe defoliation.



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Year	Remarks
1974	Decrease in defoliation levels possibly due to the cool wet spring, resulting in slow development of larvae and an increase in tree growth.
1975	In the Liard River Valley between Fireside and Liard Hot Springs and average 40% of the current growth of white spruce was defoliated.
1976	Defoliation was light in the Liard River to Fireside area and populations declined. Beating samples declined to 35 larvae/sample from 124 in 1975.
1977	Population decreased particularly in the Liard and Smith rivers area. Repeated severe defoliation caused top-kill which averaged 1.2 m on 27% of the trees.
1978-82	Populations remained low in the Liard-Smith river drainages and other areas.
1983	Endemic populations; no defoliation reported.
1984	Budworm lightly defoliated 7 500 ha of mainly spruce trees between mile 790 and 863 of the Alaska Highway. This is the first recorded defoliation since 1977. Defoliation of new growth on white spruce and alpine fir at Liard Hot Springs averaged 35 larva with a high of 75.
1985	A new infestation reported at the junction of the Fort Liard Highway and the Fort Nelson River; north towards the Northwest Territories border, no area figures were recorded. No defoliation was noted along the Alaska Highway.
1986	Infestation expanded to 94 000 ha of lightly to moderately defoliated white spruce and alpine fir. Defoliation was recorded north and west of Fort Nelson and Liard river valleys to the Yukon and Northwest territories border. Pockets of mostly light defoliation occurred west of Fort Nelson in the Coal River Valley and near Liard Hot Springs.
1987	Defoliation of current foliage of alpine fir and white spruce was light to moderate over 59 400 ha along the Fort Nelson and Liard river valleys. Light defoliation occurred for the second consecutive year between Coal and Smith rivers, near Liard Hot Springs and Kledo Creek west of Fort Nelson.

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Year	Remarks
1988	Current foliage of white spruce and alpine fir was lightly defoliated over 36 000 ha in 130 separate infestations north and west of Fort Nelson, a decline of 40% from 1987. The decline was mostly in the Fort Nelson River Valley and at Kledo Creek, although the understory was severely defoliated. Defoliation declined to a lesser extent in the Coal and Smith River areas and at Liard Hot Springs.
1989	Current foliage of white spruce and alpine fir was defoliated over 123 750 ha in more than 200 separate patches north and west of Fort Nelson. This is more than three times the area affected in 1988. Defoliation again extended in the Northwest and Yukon territories and occurred for the fifth consecutive year in some areas around Fort Nelson. Defoliation was severe over about 10% of the area, mostly from Nelson Forks to the territories boundary. Lightly and moderately defoliated stands occurred equally over most of the remaining areas from Coal River east to Smith River and Liard Hot Springs, south of Fort Nelson at the Muskwa River, and north to the Beaver River drainage.
1990	Current and some older foliage of white spruce and alpine fir were defoliated over 398 150 ha in more than 228 separate patches north and west of Fort Nelson. Defoliation occurred for the sixth consecutive year in some areas northwest of Fort Nelson. Defoliation was severe over about 26% of the area, mostly from Nelson Forks to the territories boundary. Lightly and moderately defoliated stands occurred over 32 and 42%, respectively, of the remaining area from Steamboat Mountain east to Kledo Creek, south of Fort Nelson in the Muskwa River drainage, along the Prophet River from Fort Nelson to south of Jackfish Lake, and north to the Beaver River drainage.
1991	Populations in the Fort Nelson area decreased for the first time in three years to 245 000 ha, in this the eighth consecutive year of the current outbreak. Damage was recorded from Fort Nelson to the Northwest Territories border and west to the Coal River area, but was less severe and more scattered. Most moderate defoliation occurred near Liard Hot Springs and the largest are of damage was along the Fort Nelson River between Klua and Cridland creeks.
1992	The area of recorded defoliation in the Fort Nelson and Fort St. John districts declined by 46% to 139 000 ha of light defoliation in mainly white spruce stands. Damage was mapped in many of the same areas as in 1991 and expanded into the

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Year	Remarks
	Fort St. John Forest District where 6500 ha of light defoliation was recorded. The largest area of defoliation was along the Fort Nelson river between Klua Creek and the Snake River.
1993	The area of recorded white spruce and alpine fir defoliation increased over 20% to 169 500 ha of mainly light feeding in the Fort Nelson and Fort St. John forest districts. Damage was mapped in many of the same area as in 1992 from Fort Nelson to the Northwest Territories, west to the Coal River area, and near Liard Hot Springs. The largest area of defoliation was again along the Fort Nelson River.
1994	Budworm populations increased slightly for the second consecutive year in this the eleventh year of the current outbreak. The area of white spruce and alpine fir defoliation increased to 173 000 ha up from 169 000 ha of mainly light feeding in the Fort Nelson and Fort St. John forest districts. Severe defoliation was last reported in 1990 when over 28 000 ha were observed during aerial surveys.

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Two-year-cycle spruce budworm  
Choristoneura biennis

Infestations of two-year-cycle spruce budworm were recorded in the Wells-Barkerville area prior to 1930. The budworm was believed to be one-year-cycle until that time, after which two-year-cycle was recognized and accepted. At this time it is believed that there is a "on-cycle" population where the main feeding by mature larvae occur during even years and a "off-cycle" population where mature larvae feed during odd years. The "on-cycle" population appears to occur south of 54° latitude.

From 1950 to 1964, the largest outbreaks ever recorded occurred in the Prince George Region from Strathnaver to McGregor River and from McBride to Finlay Forks. This infestation caused severe top-defoliation of mature overstory white spruce trees, and some mortality of understory alpine fir, until 1963 when the infestation collapsed.

In 1974 an increase in numbers of larvae as well as light to moderate defoliation of white spruce was found on the southern edge of the Region in the Bowron Lakes region.

Defoliation occurred in the Holmes River Valley and in the Bowron River Valley between 1978-81 and in the Upper Willow River Valley in 1982.



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Year	Remarks
1947	Over 235 km <sup>2</sup> of defoliation was reported along Clearwater Creek. Small areas of defoliation were reported along the Peace River.
1948-49	Endemic populations.
1950	Severe widespread damage northwest of Indian Lake to Narrow Lake and in the Fraser, Parsnip, Crooked, Torpy and lower Nation river drainages.
1951	Population increases were noted in the Crooked River and Summit Lake drainages. Light to moderate infestations were recorded between Pinchi Lake and the Nation River. Damage to understory white spruce and alpine fir trees was noted on both sides of Fraser River at Penny and Ptarmigan Creeks.
1952	Damage not as conspicuous as in 1950 possibly due a cold and wet June. Populations high in Crooked and Pack River valleys but decreased in the Pine Pass area. North of Sinclair Mills, populations same as in 1950. Moderate to severe defoliation of alpine fir and white spruce was noted between km 132 and Manson Creek road and in the upper Pine and Willow rivers drainages.
1953	Defoliation noted along the Nation River and in the Bowron Lakes and Barkerville areas.
1954	Over 600 000 ha of defoliation recorded along the western slopes of Rocky Mountains from Parsnip River headwaters to Peace Pass. Most of the defoliation was between 900 and 1500 metres. Light to moderate defoliation recorded north of Fort St. James.
1955	Light defoliation noted north of Sinclair Mills and in the vicinity of Bowron Lakes.
1956	Over 14 000 ha of mostly light defoliation recorded in the Pine Pass and Davie Lake areas.
1957	Decreased levels of defoliation, main populations centered around Lynx Creek and in the Tudyah and Davie lakes area.
1958	Further decreases in populations noted with light to moderate defoliation at Takla Lake and in the Pine Pass area.
1959	Continued defoliation in the Takla and Trembleur lakes area with increases noted in area and intensity in Fraser and Willow River valleys.

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Year	Remarks
1960	Over 3 000 000 ha of infestation was recorded in the region. In the Prince George Forest District damage was reported in the Willow, Naver and, Ahbau river drainages. Defoliation occurred along the Dore, Sovereign and Swift river valleys in the McBride Forest District. In the northern part of the region feeding was recorded from Cunningham Lake to Summit Lake and north to Bear Lake and Finaly Forks.
1961	Infestations continued in the Willow, Naver and Ahbau river valleys with moderate damage on overstory trees and severe defoliation on understory trees over 300 000 ha.
1962	Light to moderate defoliation recorded over 455 000 ha in the McGregor, McBride, Willow, Mischinsinlika and Nation river drainages.
1963	Decreasing populations were noted in the Willow and Naver rivers areas and around Pine Pass. Moderate defoliation at higher elevations of mostly alpine fir along the McGregor and Torpy rivers.
1964	General decline noted with small dispersed light defoliation noted over 5000 ha in the Pine Pass and Willow River areas.
1965	No damage reported.
1966-72	No defoliation recorded and very few larvae found.
1973-74	Endemic populations.
1975	Low populations persisted throughout the Region. Pheromone baited traps attracted up to an average of 31 male moths per trap at Pine Pass and Beaver Creek.
1976	Larval populations increased slightly to an average of 1-3 larvae per positive sample from white spruce and alpine fir in the Willow and Bowron river drainages.
	Light to moderate defoliation occurred in the Holmes River Valley from mile 19 to 25. Foliage samples contained an average of 135 egg masses per 10 m <sup>2</sup> of foliage which indicated moderate defoliation in 1977. The average number of male moths in pheromone traps increased to 77 per trap.

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Year	Remarks
1977	In the Holmes River Valley from km 32 to 37, beating samples yielded 200 early instar larvae and 95% of new shoots were damaged. At Tumuch Lake beatings yielded 6.5 larvae per positive beating slightly higher than the average of 4 in the Willow and Bowron river drainages. Elsewhere populations remained low. Pheromone traps attracted an average of 4 moths per trap, down from 77 in 1976.
1978	Light (6540 ha) and moderate (3280 ha) of current growth defoliation occurred mainly in the Holmes River, Red Pass and Bowron River areas. The number of larvae in three-tree beating samples increased to 12.5 per positive sample. Branch samples had 808 egg masses per 10 m <sup>2</sup> of foliage which indicated continuing populations for 1979. Pheromone traps caught an average of 32 moths per trap up from 4 in 1977.
1979	Light defoliation occurred over 76 747 ha in the Bowron, Willow, and Holmes river drainages, up from 9820 ha in 1978. Pheromone traps caught an average of 30 moths per trap.
1980	Defoliation covered 115 000 ha of mature spruce and alpine-fir; 16 625 ha light, 96 855 ha moderate and 1485 ha severe. Affected areas were mainly in the Bowron, Willow, and Holmes river drainages and in the Red Pass area of Robson Provincial. Park. Top stripping of severely defoliated trees averaged 1.3 m and 60% of buds were damaged. Samples of 10 trees at Holmes River averaged 167 egg masses per 10 m <sup>2</sup> of foliage which indicated a continuing population. Pheromone traps, only at Holmes River, attracted an average of 93 adults per trap. There were 15 traps which contained three concentrations of pheromone bait, 0.001%, 0.01% and 0.1% respectively.
1981	Defoliation declined to light in white spruce and alpine fir stands in the Bowron, Holmes and Willow river drainages. Only 4% of the buds were infested at five locations in the Bowron and Willow river drainages.  Pheromone traps were used to monitor male adult populations in 1981.
1982	Light defoliation occurred in patches totalling 200 ha in the Upper Willow River drainage adjacent to the outbreak area in the Cariboo Region.



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Year	Remarks
1983	An average 10% of the buds were destroyed on white spruce and alpine fir over an estimated 10 000 ha between km 57 and km 67 on the Bowron Forest Road. Adults and larvae collected in this area indicate an overlapping of generations.
1984	Light defoliation of white spruce and alpine fir occurred over 2 000 ha in two separate infestations in the Prince George TSA. Approximately 1 500 ha between km 58 and km 75 of the Bowron forest road and 500 ha in the upper reaches of Everett Creek was reported. High levels of disease, 16% infected by <u>Beauveria bassiana</u> and 15% infected by a nuclear polyhedrosis virus (NPV) were detected in the population.
1985	Trace defoliation of white spruce and alpine fir was recorded over a total of 580 ha: 300 ha over 2 areas on the west side of the Bowron River near km 100, and 280 ha over 3 areas in upper Everett Creek drainage.
1986	Defoliation was recorded over 15 670 ha, including 8 360 ha of light defoliation, 7 100 ha of moderate and 220 ha of severe. Damage was mapped along the Bowron River, near Tumuch Lake in the upper Willow River drainage and around Stony Lake.
1987	The infestation expanded to 20 320 ha. Trace defoliation was recorded in all areas during the off-cycle year of the two-year-cycle budworm. The increase in area occurred mostly along Morkill River and Dome Creek in the McBride and Prince George East districts, respectively.
1988	In the eastern and southeastern parts of the region, alpine fir and spruce were defoliated over 17 500 ha in the Everett and Ames creeks, Morkill River, and Stony Lake areas. Defoliation in 88 separate infestations by mature larvae was moderate over half the areas and light over the remainder.
1989	New shoots of alpine fir and white spruce east of Prince George were infested and lightly defoliated by immature larvae over about 4 200 ha along the Morkill River, Everett Creek and Tumuch Lake drainages and along the Bowron Coal Road.
1990	Defoliation of white spruce and alpine fir by mature larvae was mapped over 8 610 ha. Major declines occurred in previously infested stands included; the Bowron River area; Everett-Slim Creeks and the Tumuch Lake area; the Stony Lake area; and the Morkill River area. New areas of infestation were mapped in the Betty Wendle Creek and Milk River areas, southwest of McBride.

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Year	Remarks
1991	Defoliation of spruce-balsam stands in the Prince George Forest Region by mature 2-year-cycle budworm increased to almost 23 000 ha. Immature "on-cycle" populations lightly defoliated stands over 260 ha near McBride. Defoliation by mature "off-cycle" populations was mostly light over 15 000 ha along the Omineca River between Duckling and Ominicetla creeks and at Ankwill in the Fort St. James Forest District. In the Ospika and nearby Davis River drainages, north of Mackenzie, light defoliation occurred over 8000 ha.
1992	Defoliation of spruce-balsam stand by mature two-year-cycle budworm increased to 104 000. The Prince George, McBride, and Fort St. James Forest Districts had 58 000, 33 000, and 13 000 ha of defoliation respectively. Defoliation in the Mackenzie Forest District was estimated at 5000 ha however no budworm feeding was mapped from the air.
1993	Defoliation was down slightly from the previous year to 97 000 ha. Mostly light defoliation was mapped over 46 000 ha in the Mackenzie Forest District and 51 000 ha in the Fort St. James Forest District. The last feeding year by mature larvae occurred in these districts in 1991. In the Fort St. James District defoliated stands were recorded from Kloch Lake in the south to Ferriston Creek, a tributary of the Omineca River in the north. The largest areas of infestation occurred along Silver, fall, Ogden and Ominicetla creeks, and around Purvis, Tchentlo, Takatoot and Airline lakes. Budworm feeding in the Mackenzie Forest District was recorded from Germansen Landing in the southwest to the Ospika River drainage in the northeast.
1994	Two-year-cycle budworm defoliated spruce-balsam stands over 71 000 ha. Light defoliation was mapped over 44 500 ha in the Prince George Forest District, 18 500 ha in the Robson Valley Forest District and 8 000 ha in the Fort St. James Forest District. Defoliation in the Prince George and Robson Valley Forest Districts was caused by mature larvae and in the Fort St. James District by immature (off cycle) larvae.

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Western hemlock looper  
Lambdina fiscellaria lugubrosa

Prior to 1940, records of hemlock looper populations were not available, but since 1951 four outbreaks, one from 1952-56, 1963-64, 1982-84 and from 1991-94 were recorded. These infestations have mainly been located in the interior cedar hemlock biogeoclimatic zone from

McNaughton Lake in the McBride Forest District to Purden Lake in the Prince George Forest District. Western hemlock and western red cedar are the preferred hosts.

Extensive tree mortality was recorded in the 1950's and again in the 1990's.

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Year	Remarks
1950	Endemic populations.
1951-52	Slight increase in populations noted.
1953	Population increases continued with larvae present in 43 collections, highest numbers southwest of McBride in a hemlock-cedar stand.
1954-56	Overmature western hemlock, white spruce and alpine fir were defoliated in 1954 at Eaglet Mountain and near Giscome, east of Prince George. Light to severe defoliation of western hemlock and western red cedar increased, with small patches of light to moderate at defoliation at Giscome, Eaglet Lake, Lunate Creek, Slim Creek and around Penny. Some polyhedral virus was found to be infecting larval populations.
1955	Infestations continued with defoliation recorded over about 48 000 ha, south of McBride the average was over 100 larvae per beating sample.
1956-57	Populations decreased with only a few larvae found in the McBride area.
1958	Low populations with small numbers of larvae found in southern part of Region.
1959-62	Not mentioned in 1959 report, endemic levels between 1960 and 1962.
1963	Increased populations noted with large moth flights seen at Giscome, Sinclair Mills, Summit and Bear Lakes.
1964	Populations continued to increase at Aleza, Summit and Kerry lakes, and near Giscome and Hansard.
1965	Populations collapsed in winter of 1964-65.
1966-74	Generally low populations with slight annual fluctuations.
1975-77	Populations declined to endemic levels.



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Year	Remarks
1978	Populations increased slightly from Dome Creek to Goat River, with an average of 3.5 larvae per positive beating.
1979-81	Low populations persisted with no defoliation recorded.
1982	Increase in number of larvae per positive beating sample from 0 to 3.4 on western hemlock and 0 to 2.7 on white spruce.
1983	Twelve separate areas of defoliation were mapped in the McBride TSA over a total of 845 ha.
1984-90	Endemic levels throughout host range.
1991	Up to 100% defoliation of mature western hemlock and western red cedar was recorded over approximately 200 ha southeast of McBride along Hankins Creek. This infestation occurred in the moist mild interior cedar hemlock biogeoclimatic zone partially up slope from the valley floor. Understory Douglas-fir was also completely defoliated along with undergrown herbaceous plants.
1992	<p>Defoliation of mature to overmature western hemlock, western redcedar and Douglas-fir increased to over 28 000 ha in 77 infestations in the Prince George and McBride Forest districts. Eighty percent of the area was severely defoliated, with the loss of most or all foliage on more than 50% of the trees.</p> <p>In the Prince George Forest District the area of defoliation covered approximately 17 500 ha in 53 infestations in the southeastern portion of the district in the ICHvk2 biogeoclimatic subzone. Defoliation in the McBride TSA was recorded over 11 500 ha in 24 infestations from the western district boundary, ICHwk3 biogeoclimatic subzone, to the Golden Forest District, ICHmm subzone.</p>
1993	<p>Defoliation of mature to overmature western hemlock and western redcedar stands, by the western hemlock looper increased to over 43 000 ha in 108 infestations. More than 70% of the defoliation occurred in the Prince George Forest District, with the remainder in the McBride Forest District.</p> <p>Eighty-five percent of the area was severely defoliated, with the loss of most or all foliage on more than 50% of the trees. Mortality after 2 years of defoliation was relatively light, with 5%, 6% and 11% of the western hemlock, western redcedar and white spruce killed respectively.</p>

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Year	Remarks
1994	Successive years of defoliation has killed about 40% of mainly old growth western hemlock and western red cedar over 35 000 ha. Current defoliation was mapped over 5000 ha. In the Prince George TSA, tree mortality occurred over 22 000 ha from Purden Lake to Walker Creek. The largest areas of mortality were in the Torpy River and Walker Creek drainages. Approximately 14 000 ha of damage was noted in the McBride TSA mostly between Ptarmigan and Catfish creeks and around LaSalle Lakes.

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Black army cutworm  
Actebia fennica

Black army cutworm was first recorded in the Prince George Region in 1973 when larvae severely defoliated conifer seedlings at Bearcub Creek, Dog Creek, Naver Road and Canoe River.

In 1974 populations increased east of Prince George, but damage to seedlings was light. In 1978, a single infestation defoliated seedlings at Chuchi Lake north of Fort St. James. The population collapsed in 1979 and remained low in 1980 and 1981. In 1982, planted seedlings were severely defoliated in four areas near Prince George, Ft. St. James and McBride. Black army cutworm infestations occur on areas planted after slash burning before a sufficient supply of ground cover has been established. In 1983-85 over 70 000 seedlings were killed in the Prince George Forest Region.

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Year	Remarks
1973	White spruce and lodgepole pine seedlings were severely defoliated at Bearcub Creek, Dog Creek, km 26 Naver Road and Canoe River. An average of 16 pupae were collected per 900 cm <sup>2</sup> duff sample from 20 locations at Bearcub Creek and Naver Road areas.
1974	Numerous larvae were collected in new outbreaks at Purden Mountain, Carpet Lake road and Ptarmigan Creek but no seedlings were damaged.

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Year	Remarks
1975-77	Low populations.
1978	An outbreak severely damaged seedlings over 12 ha at Chuchi Lake north of Fort St. James.
1979	The population at Fort St. James collapsed, no evidence of feeding or larvae.
1980-81	Low populations.
1982	Newly planted conifer seedlings were severely defoliated in 20-60 ha areas at McLeod Lake and near Ft. St. James and McBride.
1983	Larval populations and seedling mortality increased dramatically in the region, with over 70 000 white spruce seedlings killed at Takatoot Lake north of Fort St. James, East Canoe road south of Valemount, Bill's Creek northeast of Bear Lake, and Stony Lake south of Prince George. Seedlings were 10-80% defoliated at Willowy Creek, Kalder Lake and Pass Lake.
1984	Cutworm completely defoliated 30-40% of the white spruce seedlings over 50 ha and lightly defoliated less than 5% of the seedlings in two plantations near Weedon Lake. As many as 20 000 of the severely defoliated seedlings could be killed.
1985	More than 3 000 lodgepole pine seedlings were killed over an area of approximately 3 ha near Indianpoint Creek in the Bowron Valley. High cutworm populations were reported at Kiwa Creek in the McBride TSA.
1986	Larvae totally defoliated an estimated 10 000 lodgepole pine seedlings over 10 ha in the Bowron River Valley and 60% of the white spruce seedlings over 10 ha near Haggen Creek.
1987	Populations of black army cutworm completely collapsed in the Prince George Region following several years of high levels.
1988	Douglas-fir and white spruce seedlings were severely defoliated over 30 ha at East Twin Creek. Light damage was reported at Leo Creek, the Muskeg River and along the east side of Canoe Arm.
1989	No defoliation of coniferous seedlings or herbaceous material was recorded.



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Year	Remarks
1990	No defoliation of coniferous seedlings was observed or reported but light defoliation of herbaceous material was recorded at one location near Weedon Lake and trace defoliation near Alford Creek.
1991	Light feeding was noted on white spruce over 2 ha at George Creek and moderate feeding of herbaceous material over 20 ha at the same location. Moderate feeding of herbaceous material was also noted over 20 ha at a site near Hambone Lake. Multipher pheromone traps caught an average of 138 (range 24-320) adults a decrease from the average 220 (range 0-770) adults caught in 1990.
1992	Light feeding of spruce plantations was noted at several locations in the Robson Valley. An average of 347 (range 24-320) adults were trapped in pheromone traps.
1993	Light feeding of spruce and pine plantations was noted at several locations in the Prince George Forest District. For the first time black army cutworm was found in British Columbia on the eastside of the Rockies, at a site in the Murray River Drainage south of Tumbler Ridge.
1994	Light feeding of pine seedlings was noted over a small area at the site of the 1992 Stoner Fire south of Prince George.

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Conifer sawflies  
Neodiprion spp.

Commonly found on most coniferous trees in the Region they occasionally lightly defoliate western hemlock in the Upper Fraser River Valley.

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Year	Remarks
1952	Common in small numbers on white spruce in the Fort Fraser area.
1953-54	Endemic populations.
1955	Light defoliation of western hemlock was recorded near Sinclair Mills and Eaglet Mtn (139 and 128 larvae per collection).
1956-57	Endemic populations.

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Year	Remarks
1958	Light defoliation of western hemlock was recorded near Sinclair Mills and common on spruce and Douglas-fir in the western part of the Region.
1959-60	Endemic populations.
1961-62	Common in the region with 60% of coniferous collections containing larvae.
1963-65	Moderate populations with larvae common around McGregor, up to 140 larvae per/sample were collected on western hemlock near Sinclair Mills in 1965.
1966-70	Not mentioned in reports.
1971-74	Low populations, except in 1974 near McBride where moderate populations caused light defoliation of western hemlock at Dore River, McKale Creek and on the lower slopes of Teare Mountain.
1975	Populations increased with up to 60% defoliation of conifers reported from Bowron River to McBride in tributary valleys of the Fraser River. Average number of larvae per positive sample was 37.7, up from 13.2 in 1974, and 8.2 in 1973.
1976	High populations persisted with light to moderate defoliation, up to 60%, from Hungary Creek to Tete Jaune Cache. An average of 482 larvae per positive sample was collected in the infestation area.
1977	There was a large increase to 64 000 ha of moderate to severe defoliation between Hungary and Slim creeks. An average of 656 larvae per three-tree beating in the infestation area.
1978	Populations declined sharply with only light defoliation reported east of Prince George to McBride. There was an average of 290 larvae per positive beating within the infestation area.
1979-82	The population collapsed in 1979 and remained low up to 1982.
1983-84	Endemic levels noted throughout the host range.
1985	Trace to light defoliation of western hemlock occurred over 500 ha in the Dore River Valley.
1986-94	Endemic levels throughout host range.

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Larch sawfly  
Pristiphora erichsonii

The larch sawfly, introduced from Europe, is a serious pest of both eastern and western larch. This pest has severely defoliated eastern larch in the Prince George Region west of Prince George, in Monkman Pass east of Prince George and along the Alaska Highway.

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Year	Remarks
1953	Endemic populations.
1954	Light to moderate defoliation of eastern larch in swamps north of Cluculz Lake.
1955	Scattered light defoliation of larch was reported north of Pantage Lake. Decreased populations at Cluculz Lake with little defoliation evident.
1956-61	Endemic populations.
1962	Increased populations were recorded at Tamarack and Cluculz lakes, along the Alaska Highway between km 256 and 448 and in the Beatton River, Wildmare Lake and Bisset Creek drainages.
1963	Increased populations were noted in the same areas as 1962 and extended into the Monkman Pass, Hart and Alaska highway areas.
1964	No reports in the southern portion of the Alaska Highway but slight increases noted at km 875 and a northwest spread was predicted.
1965	Up to 100% defoliation noted along Beatton River road and in the Monkman Pass area.
1966	Slight increase in populatioesn along the Alaska Highway between km 395-422, with light to moderate defoliation reported. Light defoliation reported southwest of Dawson Creek to Hudson Hope.
1967	Light defoliation reported around Fort Nelson, Hudson Hope and Chetwynd.
1968	Population declines reported with light defoliation in parts of Fort Nelson River drainage.
1969-74	Endemic populations.



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Year	Remarks
1975-76	Common in eastern larch stands throughout the region. A large number of overwintering cocoons found in duff samples near Tamarack Lake.
1977	High populations continued with 95% defoliation of conifers reported over 1600 ha in the Bednesti-Tatuk lakes area and light defoliation, less than 30%, in the Peace, Monkman and Liard rivers area. Duff samples indicated a continuing population.
1978	An estimated 2500 ha of moderate to severe defoliation recorded from Bednesti Lake to Tatuk Lake.
1979-82	Populations collapsed throughout the region.
1983-94	Endemic populations levels noted throughout host range.

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Western blackheaded budworm  
Acleris gloverana

This insect has caused severe defoliation of a variety of coniferous trees in coastal areas of B.C. but has not been known to cause significant damage in the Prince George Region. It is common and widely distributed. Previous upward trends in population were recorded from 1953 to 1955, from 1966 to 1969 and from 1973 to 1974. Although white spruce and alpine fir were the preferred hosts, alpine fir was the most heavily defoliated.

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Year	Remarks
1947-50	Endemic populations.
1951	Light defoliation of white spruce and alpine fir noted from Fort St. James to Nation River.
1952	Larvae common in beating samples from Fort St. James to the Nation River but no defoliation recorded.
1953	Common throughout the region with the largest collection of 44 larvae found north of Fort St. James.
1954	Decreased populations reported with 16 larvae found on white spruce near Aleza Lake.

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Year	Remarks
1955	Evenly distributed low populations with the largest collection containing 9 larvae.
1956-62	Low populations found in most of the region, 15 and 18 larvae per sample were collected on white spruce from kilometre 275 of the Alaska Highway.
1963-66	A small annual increase was noted with larvae common in small numbers.
1967	Further increases noted with light defoliation of conifers recorded.
1968	Moderate to severe defoliation recorded at West Twin Creek and Goat River and light defoliation in Torpy and McGregor river valleys.
1969	Infestations collapsed and endemic populations continued for 1970-72.
1973	Populations levels quadrupled with small numbers common in the McLeod and Uslika lakes area and along the Bowron River.
1974	Light defoliation of alpine fir visible in McLeod Lake-Pine Pass areas.
1975	Populations declined with only trace defoliation in the Pine Pass area. Beatings averaged four larvae per positive sample (range 7-55), at Tudyah Lake, Pine Pass, Bowron, McGregor and Nelson rivers.
1976-81	Population continued at low levels with average of 2.4 to 2.7 larvae per positive sample in 1976 and 1977 and little change between 1978 and 1981, east and north of Prince George.
1982	Increase in average number of larvae per positive beating sample to 6, maximum 15 in the McLeod Lake area.
1983-87	Endemic levels.
1988	Blackheaded budworm infested an average 10% of the buds on 100% of the white spruce and alpine fir in the Germansen Landing-Discovery Creek-Uslika Lake area north of Fort St. James.
1989-94	Endemic levels throughout host range.

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Green-headed spruce sawfly  
Pikonema alaskensis

This sawfly commonly occurs on spruce but seldom causes noteworthy damage. Occasionally it may become epidemic in dense plantations of white spruce.

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Year	Remarks
1960	Common in very small numbers throughout the Region.
1961	Slight increase in population reported.
1962-74	Low populations persisted with minor fluctuations: decrease in north and south, increase in west in 1965; general decline with common occurrence in north and a large population at km 960, Alaska Hwy in 1967; an infestation on ornamentals in Peace River area in 1968 and a slight increase in 1972.
1975-82	Fluctuations continued with a slight increase in number of larvae reported in 1975; 18% of collections positive, average of 3.2 larvae per collection in 1976; 29% of collections positive, average of 1.5 larvae per collection in 1977; 50% of collections positive, average of 2.8 larvae per collection in 1978 and low populations continued up to 1982.
1983-94	Endemic populations throughout host range.

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Rusty Tussock Moth  
Orgyia antiqua badia

This tussock moth occurs throughout British Columbia and its hosts are many. This defoliator has been recorded in the Prince George Forest Region since the 1950's but reached epidemic levels only once. Outbreaks have occurred in small infestations of several hundred hectares in the southern regions of the province in the past.

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Year	Remarks
1950-1991	Endemic populations throughout the Prince George Forest Region.
1992	Defoliation of white spruce, alpine fir and lodgepole pine was recorded over 13 000 ha. Light defoliation was noted in the headwaters of Wichcika, East Seebach, Seebach, Olsson and Angusmac creek drainages. Over 1600 ha of moderate defoliation was recorded around Mt. Averil. All feeding occurred in the SBSf biogeoclimatic subzone.
1993-94	Populations collapsed to endemic levels.

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WOODY TISSUE FEEDERS

Spruce weevil  
Pissodes strobi

This insect is probably one of the most serious pests of 5-30 year old white spruce in the Prince George Region. It occurs throughout the Region, attacking and killing the terminal shoots of trees young spruce up to approximately 15 m tall. The weevil attacks are most severe in widely spaced, even-aged stands, such as plantations.

Damage has occurred annually with varying intensity.

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Year	Remarks
1949	A few scattered attacks were reported between Penny and Dome Creek.
1950	No records in report.
1951	Damaged leaders noted in open growing stands along the Fraser River Valley, particularly at Penny and the Goat River. An estimated 5% of the young white spruce were attacked at a stand at Reservoir Lake.
1952	An estimated 30% of the white spruce was infested for 3 kilometres at Pine River northwest of Azouzetta Lake.
1953-56	No records in reports.
1957	Dead terminals common from Penny to Snowshoe Creek, low levels in the other areas examined.
1958	Small numbers of attacked white spruce recorded at Mountview, Castle Creek, Swede Mountain, and near Summit Lake.
1959	Dead leaders common in surveys around the Willow River Valley and near Summit and Chief lakes.
1960	Approximately 29% of the trees surveyed in stands in the southern portion of the region were infested.
1961	Only 5% of the stems were attacked by the weevil at Sutherland River.
1962	In the southern portion of the region 5-10% of the spruce was attacked. No attacks were noted at Sutherland River.
1963	An estimated 15% of the leaders were currently attacked at Wansa Lake.

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Year	Remarks
1964	At Aleza Lake and Reservoir Lake up to 10% infested leaders recorded with 19% attack noted at Wansa Lake.
1965	Attacks at Wansa Lake increased with 22% of the leaders attacked.
1966	Light attacks noted throughout the southern portion of the Region.
1967	No record in reports.
1968	Incidence of attack was recorded at 0-5% at 20 plots surveyed, 100 trees were examined at each plot.
1969-74	Low populations with periodic fluctuations: less than 5% at Aleza Lake in 1972 and 1973; and an average 2% incidence of attack throughout seven 100 tree plots in 1974.
1975-76	Low populations; up to 2% of trees attacked in 100 tree plots at Aleza Lake, Fishhook Lake, Willow and Chuchinka rivers and occasional roadside trees infested.
1977	Increase in damage, with 12% and 30% of the trees attacked at two locations along the McGregor River. Near Hixon, 5% and 20% attack was recorded at two locations. Cumulative attack was noted on more than 50% of the trees at Limestone Creek north of Prince George.
1978	Generally low populations with continued damage noted at Hixon and McGregor.
1979	Damage is common in the Hixon area with 30% of regeneration attacked at Genevieve Lake.
1980	At Aleza, Davie, and Yardley lakes, spruce plantations were attacked, 18%, 12% and 8% respectively.
1981-82	An average of 7% of the trees were attacked at two locations in 1981 and 11% at 16 locations in 1982.
1983	No records of weevil attack.
1984	An estimated 1% of the white spruce was attacked in a natural stand at Vama Vama Creek.
1985	At Hungary Creek, 20% of white spruce were attacked. New attacks were also common in roadside white spruce along West Twin Creek.

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Year	Remarks
1986	Only 5% of the spruce leaders were attacked at Hungary Creek and no new attacks were recorded at West Twin Creek. At Summit Lake and Anzac Camp 10% and 3% of the young spruce was attacked respectively.
1987	Scattered single or small groups of attacks on roadside regeneration were recorded along Highway 16 east of Hungary Creek to West Twin Creek.
1988	Current attack ranged from 2% of the white spruce at Vama Vama Creek to 55% at the Prince George Tree Improvement Station. Approximately 5% of the trees were infested at Fishhook Lake, Tacheeda Lakes, Anzac river and Chuchinka creeks.
1989	Current attack at five locations averaged 10%, range 2-40%. The highest incidence occurred at the Prince George Tree Improvement Station where 40% of the trees were infested.
1990	Spruce weevil populations were again active in scattered white spruce stands throughout the host range. Current attack averaged 12% (range 2-19%) in seven young stands from the Red Rock Seed Orchard south of Prince George, to Weston Bay on Williston Lake, north of Mackenzie. The Weston Bay infestation is the most northerly known infestation in the central interior.
1991	Current attacks averaged 4% (range 2-6%) in four young stands surveyed. Aside from these surveyed stands weevil attacks were widespread and often more severe in young stands throughout the southern half of the region.
1992	Weevil attacks were again observed in scattered white spruce stands throughout the region. However, infested stands were not surveyed so data on percentage of current attack is not available.
1993	A total of 15 susceptible spruce stands were surveyed in 8 different biogeoclimatic subzones to determine level of weevil attack. An average 13% (range 0-25%) of the white spruce were currently attacked by the spruce leader weevil in the 15 stands in 1993. Old attack (pre-93) was recorded on an average 9% (range 0-16%) of the stems and 3% of the trees had both old and new attacks.



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Year	Remarks
1994	A total of 18 sites were located in 9 different biogeoclimatic subzones in 5 different Forest Districts. Attacks varied widely between biogeoclimatic subzone and even between stands within subzones. An average 7% of the white spruce were currently attacked in the 18 stands. In the ten stands which have been surveyed for 2 consecutive years the level of current attack was 10% compared with 13% in 1993.

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Lodgepole pine terminal weevil  
Pissodes terminalis

This weevil has periodically infested lodgepole pine stands throughout the Region, but the damage has been very light. It prefers young, open growing trees.

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Year	Remarks
1963	No records in reports.
1964	An estimated 9% of 200 trees were infested along Kenny Dam road.
1965	Low population levels noted throughout western part of the Region.
1966	Minor attacks recorded throughout the Region with 12% of the pine infested on a 5 ha plot at Hixon.
1967	Near Moffat Lake, Prince George Forest District, about 50% of the young trees were infested in a an old 25-hectare burn.
1968	Twelve infested terminals were noted along Kenny Dam road.
1969-72	No record in reports.
1973	An isolated single attack was recorded on the Alaska Highway.
1974	An estimated 4-5 dead terminals/kilometre were recorded along Kenny Dam road.
1975-76	Low populations, 1-4% of the leaders were infested at Bear, Opatcho and Merton lakes and in the Wasi Creek-Oslinka River area.

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Year	Remarks
1977	Fewer attacks were recorded in the 1976 attacked areas.
1978-79	Light damage continued at Sinkut Mountain and Ospika River areas where 130 roadside trees were attacked along 1 kilometre of road.
1980-84	No infestations were recorded in the region.
1985	Common in the region with 40% of the natural regeneration attacked along Blackwater road and 50% of the natural regeneration infested for 2 km along the Bobtail access 400 road. Light damage, 1% infested leaders, in pine plantation along Naver access road.
1986-90	Endemic populations.
1991	This terminal weevil was found in 2 of 38 young lodgepole pine stands surveyed in the region with only 2% of the stems attacked.
1992	Approximately 3% of the stems were attacked in 1 of the 38 lodgepole pine stands surveyed in the region.
1993-94	No weevil attack was noted in young stand or other surveys in the Prince George Region.

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SUCKING INSECTS

Adelges cooleyi

Pineus spp

These gall formers are a pest of spruce and Douglas-fir throughout the forested area of the Region. Severe damage to white spruce deforms the current growth of both natural and plantation stands of young white spruce. The transformation of branch-tips into galls tends to inhibit linear growth. It is an important pest of young white spruce stands.

Severe attacks on Douglas-fir have caused needle losses which affect tree vigor and increment in young stands.

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Year	Remarks
1957	Common on white spruce throughout the southern part of the Region.
1958-61	No record in reports.
1962-65	Infestations were widespread on immature white spruce and abundant on Douglas-fir along Hart Highway, near Fraser Lake and the Yellowhead Pass area.
1966	Damage was noted on regeneration Douglas-fir and white spruce from Hixon south.
1967	Common in the Vanderhoof area.
1968-69	Endemic populations.
1970	Common throughout the Douglas-fir range with moderate attacks recorded on young white spruce.
1971-73	Galls were numerous and widespread on white spruce.
1974-79	Endemic populations.
1980	Two areas were severely infested in the Aleza Lake Experimental Forest with an average 90% of new shoots on spruce infested, at Wansa Lake 75% of current shoots were infested.
1981-82	Low populations throughout the Region.
1983-90	Common on white spruce throughout the region.
1991	Gall aphids were recorded in 24 of 34 white spruce stands where spruce was a major component of the stand. An average 34%, range (4-100%), of the trees were affected causing mostly minor or minimal damage.



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Year	Remarks
1992	Spruce gall adelgid was reported in 8 of 39 stands surveyed where white spruce was a major component of the stand. An average 55%, range (8-95%), of the trees were infested causing significant loss of current growth potential. <u>Pineus</u> spp. infested white spruce in 12 stands affecting an average 52% of the trees, (range 1-100%).
1993	Populations increased this year with adelgids found in 33 of the 41 managed stands surveyed that had spruce as a component of the stand. An average 26%, range (1-95%), of the trees were infested, with up to 80% of the new shoots deformed.
1994	The distribution of the adelgids decreased in 1993 with damage noted in 19 of the 38 spruce stands. Intensity of infestation increased with an average 32%, range (1-76%) of the trees infested.

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DECIDUOUS TREE DEFOLIATORS

Forest tent caterpillar  
Malacosoma disstria

Outbreaks of the forest tent caterpillar occurred repeatedly in extensive stands of trembling aspen and other deciduous hosts. Although total defoliation of these stands often occurs, the trees usually recover after the infestation has subsided. Infestations have been reported in the Prince George Forest Region every year from 1984 to 1994.

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Year	Remarks
1944	Outbreaks were recorded in the Cutbank and Peace River valleys. Trembling aspen and black cottonwood were also stripped for miles along river valleys in Pouce Coupe area.
1945	Severe defoliation was recorded at Taylor Flats along the Peace River and adjacent benchlands and the Kiskatinau River.
1946-47	No records in reports.
1948-50	Low populations recorded with some disease and parasitism in populations in the southern portion of the Region.
1951	Populations increased with localized infestations noted in the Prince George and McBride areas. High numbers of egg masses were collected at Rearguard, Woodpecker and Hixon.
1952	Infestations were noted along the Upper Fraser River at McBride, Dunster, Shere, Rearguard and Swiftwater.
1953	Severe defoliation occurred in Prince George, Hixon, and Strathnaver areas, with smaller increases occurring as far north as Salmon River. Isolated infestations were noted near Parsnip River bridge, Cluculz Lake, and Legrand to Mount Robson. Light defoliation was recorded in Prophet, Minaker and Muskwa River valleys. A polyhedral virus caused mortality of larvae at Beaverley.
1954	Severe defoliation was recorded from Prince George to Ahbau Lake and northward to the Salmon River. Infestations noted from McBride to Mt. Robson and spot infestations as far west as Cluculz Lake.
1955	Infestations collapsed, possibly due to egg mortality from a late frost.
1956	Endemic populations.

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Year	Remarks
1957	Moderate to severe defoliation was recorded from Croydon Station to Dunster, (60% defoliation).
1958	Population increases were noted in McBride-Tete Jaune Cache area.
1959	From 60 to 100% defoliation of aspen was recorded over 45 km <sup>2</sup> in McBride area.
1960	Infestations continued in the McBride area on both sides of Fraser River, light defoliation was also noted in the Canoe River Valley.
1961	Infestations increased in size and intensity from McBride to Valemount, McLennan River Valley and at the Peace River bridge.
1962	Infestations were mapped over 1025 km <sup>2</sup> in the Upper Fraser-Goat River-Mt. Robson; 80 km <sup>2</sup> of severe defoliation noted at Taylor and 80 km <sup>2</sup> at Peace River bridge.
1963	Populations subsided in most areas with some severe defoliation noted in the McBride-Valemount area.
1964	A further decrease in populations was noted with 13 km <sup>2</sup> of moderate defoliation noted north of McBride.
1965	Populations collapsed with no defoliation recorded.
1966-70	Endemic populations.
1971	Light defoliation was noted at Clauminchil Lake and around McBride.
1972	Light to moderate defoliation from mapped from Prince George to Strathnaver and McBride to Mt. Robson. Large numbers of large aspen tortrix found within tent caterpillar populations.
1973	Complete defoliation of aspen common from Prince George to Ahbau Lake and in the Robson Valley, scattered patches of defoliation were recorded west to Chilako River and north to Salmon Valley.
1974	Populations subsided, causing intermittent defoliation of aspen stands around Prince George and McBride. Suspected causes of populations collapse were a pupal virus and adverse weather conditions in May.



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Year	Remarks
1975	Defoliation increased to 100% over 4000 ha around McBride and in the McKale and Horsey creek drainages.
1976	Infestations increased to 6600 ha in the McBride area from McKale Creek to Tete Jaune Cache. Late larval and pupal collections contained nuclear polyhedrosis virus.
1977	Infestation increased to 30 400 ha in the McBride area from McKale Creek to Kiwa Creek and from Tete Jaune Cache to Valemount and Alpland in Mt. Robson Park.
1978	Defoliation subsided to 2100 ha from McBride to Horsey Creek and near Tete Jaune Cache.
1979	Population collapsed.
1980-82	Endemic populations.
1983	Populations increased with 485 ha defoliated in the Salmon River Valley, north of Prince George.
1984	Caterpillars caused 5420 ha of light to severe defoliation in the Salmon River Valley and 18 680 ha of light to severe defoliation between Dawson Creek and Fort St. John, including the Kiskatinaw and Peace River areas. Egg-mass surveys indicate continued defoliation in 1985.
1985	The infestation in the Salmon River Valley collapse, due primarily to NPV in the population. Infestations in the Peace River area increase to 56 390 ha of light to severe defoliation recorded from south of Pouce Coupe to the Fort St. John area. Egg-mass surveys indicate continued defoliation in the Peace River country in 1986.
1986	Infestations continue in the Peace River country with 91 700 ha of light to severe defoliation recorded from south of Tupper to Charlie Lake, and from the Alberta border to the Pine River area. Populations increase in the Salmon Valley, 580 ha of mainly light defoliation recorded. High larval populations noted in the Tabor Mountain area, but no visible defoliation. Egg mass surveys predict continuing defoliation in Peace River area in 1987. A cytoplasmic virus (CPV) was isolated from larval collections made in the Tabor Mountain area.

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Year	Remarks
1987	Populations declined in the Peace River area and increased near Prince George. Only 17 025 ha were defoliated region-wide with 8 655 ha in the Peace River area and 8 370 ha in the Chief Lake and Tabor Mountain area, near Prince George. Egg-mass surveys predict continued defoliation in all areas in 1988.
1988	Populations continue to decline in the Peace River area while increasing near Prince George. A total of 48 315 ha of light to severe defoliation was recorded region-wide: 5 035 ha of mainly light to moderate defoliation in the Pouce Coupe and Farmington areas, south of the Peace River; and 43 280 ha of mainly moderate to severe defoliation in the Prince George area. Defoliation in the Prince George area was recorded in the Salmon Valley-Chief Lake area, the Cranbrook Hill area west of Prince George and north to the Giscome Rapids area on the Fraser River. Egg-mass surveys predict continuing high populations in and around Prince George and the Peace River country. Extremely high numbers of egg masses were found during the surveys. The number of egg masses from one 12-cm dbh aspen tree in the Chief Lake area was 339.
1989	A major increase in populations was recorded in and around Prince George while populations continued to decline in the Peace River area. Mainly moderate to severe defoliation was recorded over 108 290 ha region-wide: 103 225 ha in the Prince George area, and 4805 ha in the Pouce Coupe and Farmington areas. Additionally, 260 ha were defoliated in the Castle Creek area near McBride, the first recorded defoliation in this area since 1978. Defoliation in the Prince George area was recorded from Summit Lake to Pineview, and from Eaglet Lake to the Isle Pierre area. Egg-mass surveys again predict high populations in the Prince George area for 1990 while decreasing populations are predicted for the Peace River area.
1990	Populations increased, defoliating trembling aspen and, to a lesser extent, other deciduous trees in 250 infestations over 193 675 ha. Defoliation was moderate and severe around and within Prince George, in some areas for the fifth consecutive year. In the Peace River area, defoliation occurred over 35 600 ha in 70 separate areas from south of Pouce Coupe to Taylor and east to the Alberta border. The area of defoliated aspen near McBride increased to over 4450 ha.

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Year	Remarks
1991	<p>More than 92 000 ha of mainly trembling was defoliated. Tent caterpillar populations in the Prince George Forest District decreased after five consecutive years of increase. In the McBride Forest District the area and intensity of feeding increased by 45% to 6500 ha. Aspen defoliation in the Peace River area decreased to cover 4800 ha.</p>
1992	<p>The area of mainly trembling aspen defoliated by the forest tent caterpillar decreased to less than 21 000 ha. Populations in the Prince George Forest District decreased for the second consecutive year. For the first time in eight years no defoliation was recorded in the Peace River area. In the McBride Forest District the area of feeding increased for the second consecutive year by approximately 50% to 9700 ha.</p>
1993	<p>The area of mainly trembling aspen defoliated by the forest tent caterpillar increased to 40 000 ha. Populations in the Prince George Forest District increased to 22 000 ha, defoliating aspen from Prince George to Quesnel. The largest infestations and the majority of the area of attack was noted between the Prince George Airport and Stoner.</p>
	<p>In the McBride Forest District the area of feeding increased for the third consecutive year to over 16 000 ha of moderate and severe defoliation. The largest areas of defoliation occurred in the Dunster and Croydon areas with over 9 000 ha of severe defoliation. Several hundred hectares of severe defoliation was reported in the Dawson Creek Forest District south of Taylor.</p>
1994	<p>Forest tent caterpillar defoliated more than 41 000 ha of trembling aspen. In the Prince George Forest District defoliation occurred over nearly 33 000 ha. Severe defoliation occurred over 4500 ha along the Robson Valley. Almost 1500 ha of severe Defoliation was mapped in the Dawson Creek Forest District.</p>

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Northern tent caterpillar  
Malacosoma pluviale

The northern tent caterpillar occurs on willow and swamp birch throughout the Prince George Region. Since it feeds on low growing host material, small infestations may go unnoticed, especially on lake shores or swamp edges.

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Year	Remarks
1947	A outbreak was noted near Aleza Lake with severe defoliation of birch and willow in swampy areas.
1948-49	Not recorded in reports.
1950	Common in swamps throughout the region with over 40 ha, 12 km south of Stone Creek on Highway 97 defoliated.
1951	Small infestations continued at Stone Creek, Hixon, Cluculz Lake and Altezega Creek.
1952	Partial defoliation of birch and willow observed in swamps along the Crooked River Valley.
1953	Infestations subsided, with only one sample collected from willow near Fort Nelson.
1954	Endemic populations.
1955	Nine hectares of willow and birch were defoliated near Redrocky Lake.
1956-57	Endemic populations.
1958	Common on deciduous trees near Lazaroff Lake.
1959-61	Endemic populations.
1962-65	Severe defoliation of mostly birch occurred over more than 40 ha at Aleza Lake and over 10 ha at Newlands.
1966-68	Endemic populations.
1969	Willow and birch were lightly defoliated at Aleza Lake and Hansard.
1970-73	Endemic populations.
1974	Severe defoliation occurred on willow at Norman Lake.
1975-94	Endemic populations.

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Large aspen tortrix  
Choristoneura conflictana

The large aspen tortrix is commonly found in trembling aspen stands throughout the Region. Outbreaks often follow or are followed by forest tent caterpillar outbreaks. The most severe defoliation has occurred from Dawson Creek to Fort Nelson and in the Vanderhoof and Salmon River areas from 1953-58. From 1970-72 defoliation occurred in the Vanderhoof, Fort St. James, and McBride areas.

In 1978 patches of severe defoliation was reported east of Ft. St. John expanding along the Alaska Highway and the Peace River Valley in 1979.

About 38 800 ha were defoliated in 1980 in the Vanderhoof, Fraser-Stuart-Tezzeron lakes area, in the Peace, Ft. St. John, Ft. Nelson, and Liard River Valley. Defoliation continued in the same areas in 1981.

In 1982 populations and defoliation were greatly reduced. Light defoliation persisted in north eastern areas to Muncho Lake. From 1990 until 1993 severe defoliation covering up to 24 000 ha was reported along Williston Lake.

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Year	Remarks
1946	Outbreaks were recorded near Bear Lake on various deciduous trees and shrubs.
1947-52	Endemic populations.
1953	Light defoliation occurred at many scattered points along the Alaska Highway from Dawson Creek to Fort Nelson. Tortrix larvae were common in association with tent caterpillar from Hixon to Prince George.
1954	North of Vanderhoof, 80% defoliation of aspen occurred over scattered areas and along the Alaska Highway around Beatton.
1955-56	Light to severe defoliation was noted north of Vanderhoof, in the Salmon River valley and along the Alaska Highway.
1957	Feeding was again noted in the Salmon River Valley and around Pouce Coupe, Fort St. John, and Hudson Hope.
1958	Infestations continued in the Salmon River Valley.
1959	The Salmon River infestation collapsed.
1960-64	Small populations were recorded at Beatton River and along the Alaska Highway at km 16, 128 and 416.
1965-69	No records in reports.

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Year	Remarks
1970	Severe defoliation was recorded at 9 locations including: McBride, 1000 ha; Vanderhoof, 400 ha; Stuart-Pinchi lakes, 2 ha; and Fort St. James, 1600 ha.
1971	Approximately 2000 ha was defoliated in the McBride area and 6800 ha in the Vanderhoof Forest District.
1972	Populations declined with moderate defoliation noted from Fort Fraser to Prince George, Prince George to Ahbau Lake and at McBride.
1973	Populations collapsed although forest tent caterpillar populations increased in the same areas.
1974	Low populations levels were noted with 5 km of light defoliation recorded along Highway 97 near Groundbirch.
1975	Endemic populations.
1976	Moderate to severe defoliation of trembling aspen occurred on more than 160 ha near Dawson Creek and Fort St. John. Twig dieback was noted on 25% of the trees in some areas.
1977	Endemic populations, no defoliation recorded.
1978	Patches of severe defoliation occurred in stands east of Fort St. John. Pupal collections showed high levels of parasitism and disease.
1979	Severe defoliation was recorded along the Alaska Highway near Kledo Creek and light defoliation near Ft. St. John and along the bench lands above the Peace River near Dawson Creek.
1980	Light defoliation was mapped over 27 300 ha and moderate defoliation over 11 500 ha in the Vanderhoof area; along Fraser, Stuart and Tezzeron lakes. Defoliation was widespread east of Chetwynd along the bench lands above the Peace River to Fort St. John and near Dawson Creek. Patches of light defoliation were recorded along the Alaska Highway from Trutch to Ft. Nelson, west to Kledo Creek and along the Liard River near the B.C.-Yukon border.
1981	The outbreak continued with light to severe defoliation on 50-200 ha patches from Trutch to Muncho Lake, Liard River to Fireside, and in the Chetwynd-Fort St. John and Vanderhoof-Fraser Lake areas. Parasitism was at 75% in pupal and larval collections at Liard River.



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Year	Remarks
1982	Defoliation was greatly reduced with 20 ha patches of light defoliation recorded from Chetwynd to Muncho Lake.
1983-85	Endemic populations.
1986	Small patches of defoliation were reported near Wonowon. Severe defoliation and some top-kill were noted 20 km west of Fort Nelson. Aspen mortality totaling about 50 ha was located northeast of Summit Lake.
1987-88	Endemic populations.
1989	Patches of mostly light defoliation were widespread in northeastern British Columbia, along the Alaska Highway, between Fort St. John and Pink Mountain, and on Steamboat Mountain.
1990	Over 7365 ha of light to severe defoliation of trembling aspen was recorded during aerial surveys, from Mackenzie to Fort Ware in the Rocky Mountain Trench. Additionally, a large undetermined area of moderate to severe defoliation was observed during ground-based surveys along both sides of the Alaska Highway, from the Charlie Lake area north of Fort St. John to the Pink Mountain area, and for 50 km along the Alaska Highway in the Steamboat Mountain area, west of Fort Nelson. Defoliation was also noted in the Manson Creek area, northwest of Mackenzie.
1991	Populations increased for the third consecutive year defoliating aspen over more than 18 000 ha. The majority of the damage occurred along the east and west sides of Williston Lake from Mackenzie north to Finlay Reach.
1992	Populations increased defoliating aspen over more than 24 000 ha. All recorded defoliation occurred in 89 infestations in the Mackenzie Forest District.
1993	The tortrix defoliated trembling aspen over approximately 6000 ha, 3100 ha in the Mackenzie Forest District and 2900 ha in the Vanderhoof forest District.
1994	Defoliation of trembling aspen by the tortrix continued in the Nechako River Valley but collapsed in the the Mackenzie Forest District. Due to the high populations and lack of host material, feeding of current growth was also noted on white spruce.

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Bruce spanworm  
Operophtera bruceata

The Bruce spanworm is a leaf roller and defoliator of deciduous trees and has attacked trembling aspen throughout its host range in the Region. The most extensive infestations have occurred in the Peace River area and have remained at epidemic levels for up to five years.

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Year	Remarks
1956	No record in reports.
1957	Moderate to severe defoliation of trembling aspen recorded from Pine Pass to Pouce Coupe and north to km 152, Alaska Hwy.
1958	Moderate to severe defoliation of trembling aspen from Pine Pass to Beatton River with small scattered infestations as far north as Fort Nelson. Severe defoliation occurred at Little Prairie, East Pine, Hudson Hope, Dawson Creek, and Fort St. John.
1959	Severe defoliation was noted west of Dawson Creek on trembling aspen, black cottonwood and willow.
1960	The Pine Pass infestation collapsed. Larvae were collected in small numbers from alder and willow in Fraser Lake and Fort St. James areas.
1961-64	Endemic populations.
1965	Increased population levels were recorded at Pine Pass.
1966	Widespread defoliation was recorded northeast of Pine Pass.
1967	High populations were recorded in the Peace River Valley with the highest populations near Fort St. John.
1968-69	High populations again noted in the Peace River region.
1970-77	Endemic populations.
1978	Moderate defoliation between Dawson Creek and km 184 Alaska Highway.
1979	Severe defoliation of trembling aspen recorded in the Dawson Creek - Fort St. John area and north along the Alaska Highway to km 175.
1980-86	Endemic populations.