



FIDS REPORT

92-14

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**HISTORY OF IMPORTANT FOREST INSECTS
IN THE CARIBOO FOREST REGION
1913-1991**

R.D. Erickson
Forest Insect and Disease Survey
Revised 1992

Pacific and Yukon Region



Forest Insect and Disease Survey



Forestry Canada
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Introduction

This report is a history of the important forest insects in the Cariboo Forest Region since 1913. Information was compiled from Kamloops, Prince George and Cariboo Annual District Reports of the **Forest Insect and Disease Survey** prior to 1972, and from the Cariboo Regional reports from 1973 to date. Information from unpublished reports and a variety of published histories of insects in British Columbia was also used.

The Cariboo Region is 8.7 million ha in area; of this, 6.5 million ha are productive forest land. Tree species in the Region are: lodgepole pine, on 65% of the area; white spruce, 11%; Douglas-fir 17%; alpine fir 3% and western red cedar 1%. Western hemlock, white pine and ponderosa pine are minor species comprising less than 1% and deciduous species approximately 3%. Volume of mature timber is as follows:

lodgepole pine	442 494 000 m ³
white spruce	130 423 000 m ³
Douglas-fir	86 990 000 m ³
alpine fir	40 173 000 m ³
western red cedar	13 972 000 m ³
western hemlock	8 829 000 m ³
whitebark pine	318 000 m ³
deciduous spp.	15 035 000 m ³
<hr/>	
Total	739 221 000 m ³

Bark beetles have been the major cause of volume loss in the Cariboo Region. Mountain pine beetle is the most serious pest of mature pines in the region. Unlike spruce and Douglas-fir beetles, mountain pine beetle populations do not build up in windthrown trees and slash, they attack healthy pines. The largest epidemic ever recorded in Cariboo Forest Region occurred from 1974 to 1985, peaking in 1983 at 382 000 ha closely followed by 381 000 ha in 1984. Dead pine were mapped in all three TSA's, however over 90% of the infestation occurred in the Chilcotin part of Williams Lake TSA.

Douglas-fir beetle occurs throughout mature and overmature Douglas-fir stands in the Interior. Normally the beetle prefers to attack logs, windfalls, slash, and injured or weakened trees. Frequently, however, it infests single trees but more often groups of up to one hundred trees. Areas of chronic beetle attack in the region include near Williams Lake, the Narcosli Creek valley, on the plateau between 100 Mile House and the Fraser River, and along the Fraser River from the Gang Ranch to Quesnel.

Spruce beetle is the most destructive pest of mature spruce. Populations build up in windthrown trees and logging slash and when epidemic, living trees are attacked resulting in tree mortality. Outbreaks have occurred periodically in the eastern portion of the region in the Horsefly and Quesnel districts where most of the spruce stands occur. Dead spruce were mapped from 1962-66, peaking in 1965 at 12 050 ha in the eastern part of Quesnel TSA. Other infestations have occurred in the same area from 1969-71 (peaking in 1970 at 26 260 ha) and 1980-86 in the eastern part of Quesnel TSA, Bowron Provincial Park and the Horsefly River area, peaking in 1981 at 13 050 ha.

Western balsam bark beetle, in association with a wood-staining pathogen, kills alpine fir throughout British Columbia. Tree mortality has been recorded annually throughout the host range.

Defoliators have also seriously damaged conifer forests from time to time in the Region.

Two-year-cycle spruce budworm, a subalpine species, has frequently defoliated alpine fir and spruce stands. Periodic outbreaks have been reported since 1913 from Mahood Lake north to the regional boundary.

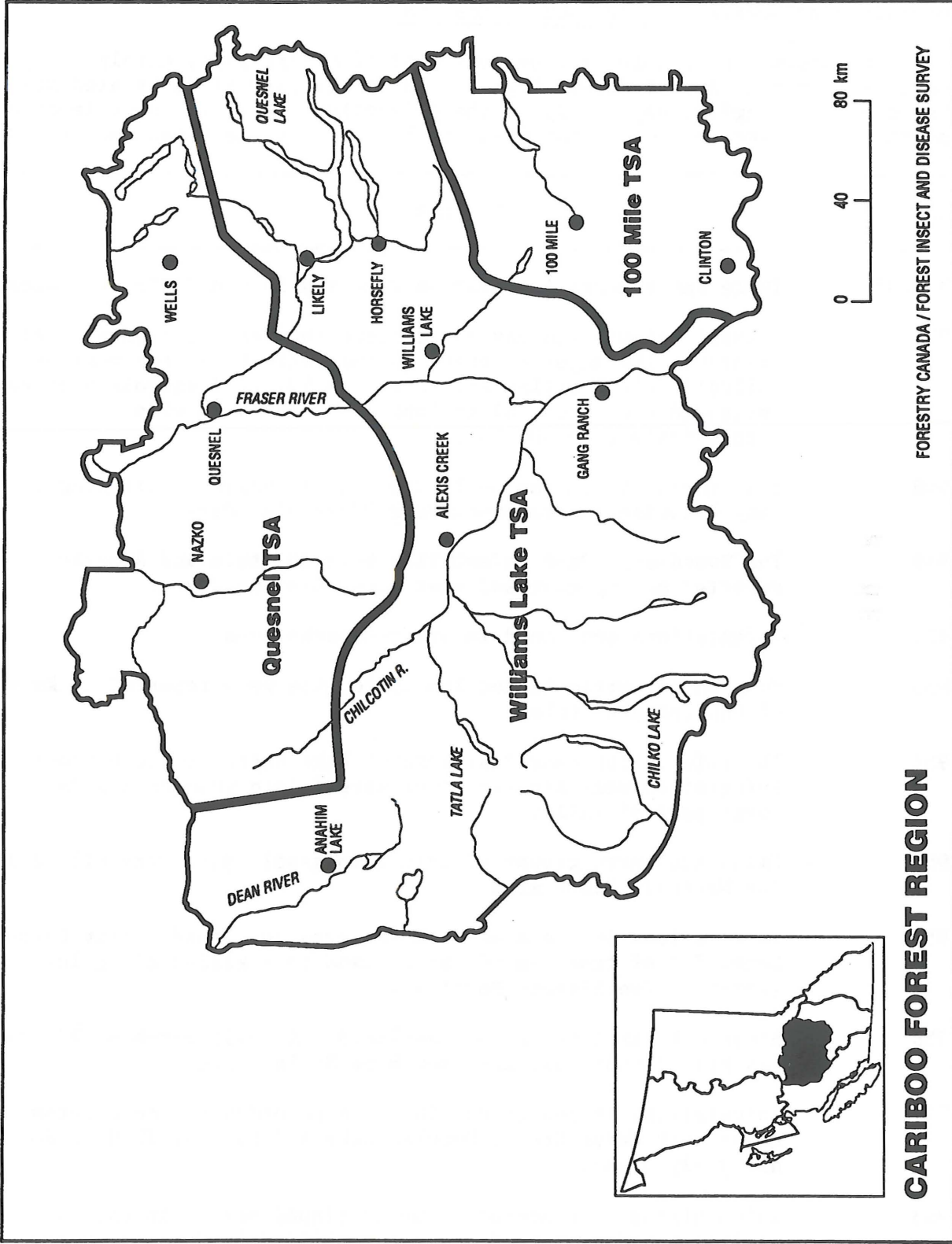
Western spruce budworm does not have a lengthy history of damage in the Cariboo Region, but has defoliated Douglas-fir and caused light tree mortality near Clinton, along the Fraser River near Big Bar Creek, near Mahood Lake and from Horsefly Lake to Quesnel Lake.

Western blackheaded budworm infestations occur less frequently in the region but it is capable of causing severe defoliation in wet belt areas.

Douglas-fir tussock moth, an important pest of Douglas-fir, is capable of sudden outbreaks with tree mortality as occurred in 1981 near Clinton.

Western hemlock looper has periodically defoliated overmature western hemlock-western red cedar stands near Quesnel Lake.

Other insects, though of minor importance, are reported here since they have potential to cause damage and are common in Cariboo forests.



CARIBOO FOREST REGION

Map 1

PINE PESTS

Mountain pine beetle, Dendroctonus ponderosae

Mountain pine beetle is a serious pest of mature pine, mainly lodgepole, in the Cariboo Forest Region. Infestations have devastated stands throughout the region, especially in the Chilcotin. It is the most important forest pest in the Cariboo. Completion of its' life cycle takes one year.

Year	Remarks
1930-35	There was a large infestation reported in the Tatla Lake area.
1936	A small infestation was noted along the Cariboo highway north of Clinton. The major outbreak in the Tatla Lake area west of Chilcotin River collapsed. Sixty to 90% of lodgepole pine was destroyed over area 161 km long by 40 to 64 km wide (approximately 65 000 ha).
1948	Tree mortality in the Bella Coola River valley, extending for many kilometers into Tweedsmuir Provincial Park.
1949	The Tweedsmuir Park infestation between Stuiie and Atnarko reported moving east and west along Atnarko River.
1951	Infestations continued in Stuiie-Atnarko area.
1953	Four ha of beetle killed lodgepole pine were reported 14 km west of Puntchesakut Lake.
1954	The infestation near Puntchesakut Lake decreased to 8 trees. Infestation near Atnarko River spread into younger stands in lower part of valley.
1955	Small scattered groups of mature lodgepole pine were killed in the Narcosli Creek area.
1956	Infestations in the Atnarko River area continued. Near Bowron Lake, 70% of trees in 60% pine stand were killed along lower slopes of Two Sisters Mountain.
1958	Atnarko River infestations declined. A small patch of 25 trees was killed near Joes Lake south of Springhouse.
1961	Infestations in ponderosa pine were recorded in the Clinton area; near Hayes Creek, Douglas Lake and east of 70 Mile House along Fly Creek.
1963	Infestations in ponderosa pine continued near Clinton. An estimated 840 m ³ of lodgepole pine killed in Narcosli Creek valley.

Year	Remarks
1964	There was a substantial increase in infestations. Approximately 10 000 recently killed trees counted in Cariboo area; highest numbers at Bull Mountain and Tyee Lake, Keithly Creek and west of Williams Lake to Alexis Creek; 10 ha infested at Cuisson Creek.
1965	Over 10 000 trees were mapped near Williams Lake; trees were killed near Cuisson Lake; 2000 over 121 ha south of Quesnel and 1000 over 323 ha northwest of Alexandria.
1966	Recently killed lodgepole pine were mapped at Bull Mountain, Tyee, and Cuisson lakes.
1967	Ponderosa pine were killed near Clinton. Recently killed lodgepole pine were mapped at Bull Mountain, 475 at Cuisson Lake, 1000 along Tingley Creek, 600 near Narcosli Creek and 120 near Eveline Creek.
1968	East of Williams Lake near the Williams Lake Airport there were 20 000 recently killed pine trees mapped; Bull Mountain, 10 000; Tyee Lake, 3000; and 2000 at Cariboo Lake.
1969	Infestation at Bull Mountain collapsed; highest numbers of recently killed lodgepole pine were 500 east of Williams Lake, and 2000 near Cariboo Lake.
1970	Thirty trees killed near Cuisson Lake.
1971	Few recently killed pine trees were recorded.
1972	Generally low populations in the region except near the north end of Cariboo Lake where 720 recently killed lodgepole pine were counted.
1973	Populations remained at low levels.
1974	Counts of recently killed trees increased to 9700 in the Region; Klinaklini River, 3650 trees; Cariboo Lake, 1500; Bald Mountain, 1150; Cariboo Lake - Ditch Creek 700; Tyee Lake, 700; Little River, 400; Beaveridge Lake, 250; Little Lake, 200 and Tinmuskit Creek 200.
1975	Infestations expanded 6 fold to 140 000 trees over 14 900 ha. Aerial surveys disclosed recently killed trees as follows: West Chilcotin, 74 500 trees; East Chilcotin, 18 450; Williams Lake, 14 600; Tyee Lake, 6700; Cariboo Lake, 6200; Dog Creek - Jesmond, 6905.
	Additional areas with from 100 - 600 recently killed lodgepole pine were scattered throughout the region.

Year	Remarks
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1976 The estimated number of killed trees decreased to 84 560, however, the area increased to 15 815 ha, as follows:

Location	No. of trees	Area (ha)
Chilko PSYU	52 920	6970
Stum "	8350	1860
Narcosli "	350	60
Special Sale Area	25	5
Quesnel L.	2475	1730
Williams Lake	8625	1540
Big Bar	10 315	3390
Tweedsmuir Park	1500	260
TOTAL	84 560	15 815

1977 Infestations continue; 45 965 trees over 17 580 ha.

Location	No. of trees	Volume (m ³)	Area (ha)
Chilko PSYU	33 070	12 897	12 220
Stum	4275	2650	1390
Narcosli	10	6	10
Special Sale Area	100	18	30
Quesnel L.	1000	730	540
Williams Lake	1100	748	1280
Big Bar	5910	4081	1860
Tweedsmuir Park	500	130	250
TOTAL	45 965	21 260	17 580

1978 Infestations increased to 863 470 trees killed over 31 240 ha

Location	No. of trees	Volume (m ³)	Area (ha)
Chilko PSYU	830 400	328 856	20 500
Stum	12 100	7502	4470
SSA	40	25	20
Quesnel L.	6300	4600	1500
Williams Lake	5700	3875	1090
Big Bar	8800	5984	3580
Tweedsmuir Park	130	50	60
TOTAL	863 470	350 892	31 220

Year	Remarks
1979	There was a decrease in the number of recently killed trees to 72 985 over 31 000 ha.

Location	No. of trees	Volume (m ³)
Chilko	45 535	17 758
Stum	6035	3741
SSA	1475	914
Quesnel L.	8330	6080
Williams Lake	6930	4712
Big Bar	4680	3182

TOTAL	72 985	36 387
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1980 The number of trees killed over the large area infested precluded counting of trees and in 1980, an estimate of the number of trees killed was derived from cruising at 18 locations and sketch mapping the area during aerial survey.

Mountain pine beetle killed an estimated five million trees or an estimated 2 650 000 m³ over 63 510 ha.

Location	Area infested (ha)
Williams Lake	3950
Cariboo L.	3620
Riske Creek	7725
Dog Creek-Jesmond	6745
Puntzi Lake-Klinaklini	38 630
Chilko-Talayoko lakes	2840

TOTAL	63 510
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Overwintering mortality of mountain pine beetle broods averaged 93% at 7 locations sampled throughout the infestation.

Year	Remarks		
1981	The area of recently killed pine continued to expand to 72 452 ha.		
	TSA	Supply Block	Area infested (ha)
	Williams Lake	Anahim	11 860
		Tatla	21 276
		Chilcotin	3454
		Kloakut	2660
		Chezacut	2740
		Springhouse	5767
		Gaspard	10 409
		Churn	4096
		Palmer Lake	323
		Cariboo	4662
	100 Mile House	Loon	177
		Meadow	4940
		Holden	89
	TOTAL		72 452

Overwintering mortality of broods was low.

1982	Increased to 221 835 ha; 13.6 million m ³ killed. Largest increases were in Williams Lake TSA.		
	Location	Area (ha)	Volume (m ³)
	Williams Lake TSA	213 405	13 999 000
	Quesnel TSA	165	6685
	100 Mile TSA	4270	164 200
	Bowron Provincial Park	285	11 525
	Tweedsmuir " "	2560	163 840
	DND Military Block	1150	47 230
	TOTAL		221 835 13 592 480

Overwintering mortality averaged 57% at 8 locations.

Year	Remarks
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1983 Mortality of lodgepole pine caused by mountain pine beetle expanded about twofold. Recently killed trees were mapped over about 382 000 ha.

Location	Area (ha)	Volume (m ³)
Williams Lake TSA	346 580	19 406 160
Quesnel TSA	12 730	693 945
100 Mile TSA	22 560	1 418 600
Total	381 870	21 518 705

Overwintering mortality was low, the "R" values calculated indicated increasing populations.

Infestations occurred mainly in the Williams Lake TSA, in the western supply blocks (SBs) of the Chilcotin. Spread of the epidemic was eastward in the Kloakut block and northward in the Chezakut and Palmer Lake blocks. Infestations increased slightly in the Cariboo Lake area and along the west side of Bowron Provincial Park to near Wells. Current attack averaged 32% of stems per hectare at 14 locations.

1984 Infestations were mapped over 381 385 ha, similar to 1983. Infestations intensified between Chilko Lake and Big Creek north to Clusko River and from Churn Creek west of the Fraser, to Gaspard Creek and northward from the Clusko River and Palmer Lake area to Nazko.

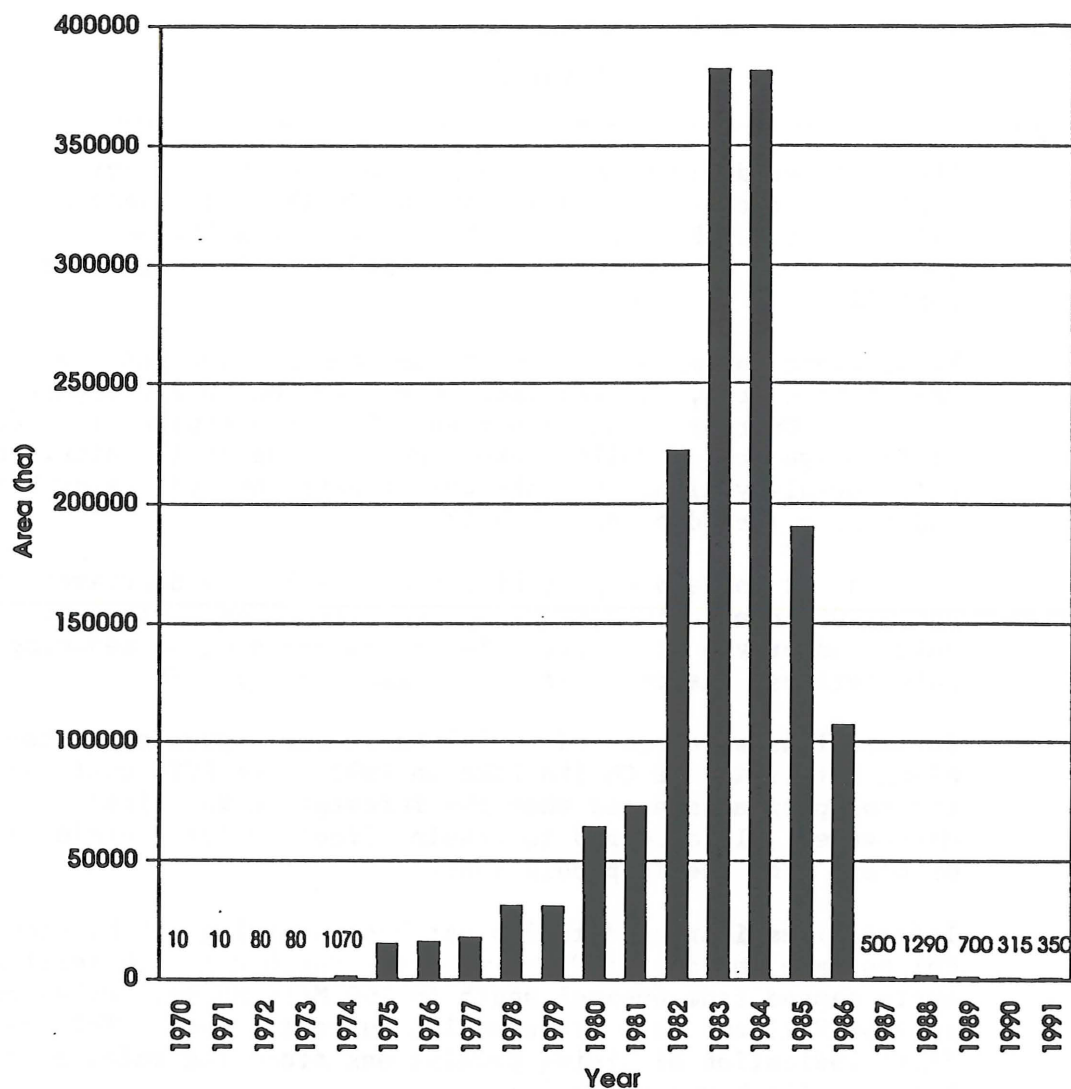
Location	Area (ha)	Volume (m ³)
Williams Lake TSA	361 575	7 233 165
Quesnel TSA	7 430	148 635
100 Mile House TSA	5 960	119 275
DND Riske Cr.	240	4 800
Tweedsmuir Prov. Park	4 530	90 615
Bowron Lakes Prov. Park	1 650	33 000
Total	381 385	7 629 490

Current attack averaged 24% at 19 locations. Overwintering mortality was estimated at about 50% however the "R" values indicated an increasing population.

Year	Remarks
1987	The major epidemic of mountain pine beetle in the region collapsed, except at Franklyn Arm on Chilko Lake where pine were killed over 500 ha. This is the first increasing population located since the epidemic was stopped by cold temperatures in 1984-85.
1988	Populations increased for the second consecutive year in the Chilko Lake area, killing trees over 1290 ha in 230 separate patches. Current attack averaged 13% at one cruise strip done at Franklyn Arm on Chilko Lake. Many of the small patches of pine mortality along the lake were treated by BCFS using MSMA and single tree disposal techniques.
1989	The area of lodgepole pine killed by the beetle decreased to 720 ha in 206 infestations along Chilko Lake. The control program, which had proven to be effective in maintaining or reducing the infestations, was continued at Chilko Lake by BCFS.
1990	Infestations were reduced to 315 ha in 155 separate patches along both sides of Chilko Lake in 1990. The BCFS continued the control program started when the infestation was first discovered. It appeared to remain effective for containing mountain pine beetle populations.
1991	Infestations increased to 295 patches totalling 350 ha along Chilko Lake, mainly at Franklyn Arm. There were 120 small new spots mapped from Quesnel south to 100 Mile House. Prism curses east of Williams Lake averaged 11% current attack. This was the first indication of rising populations since the infestation at Franklyn Arm began in 1987.

Table 1. Area of lodgepole pine killed by mountain pine beetle, Cariboo Forest Region, 1983-91

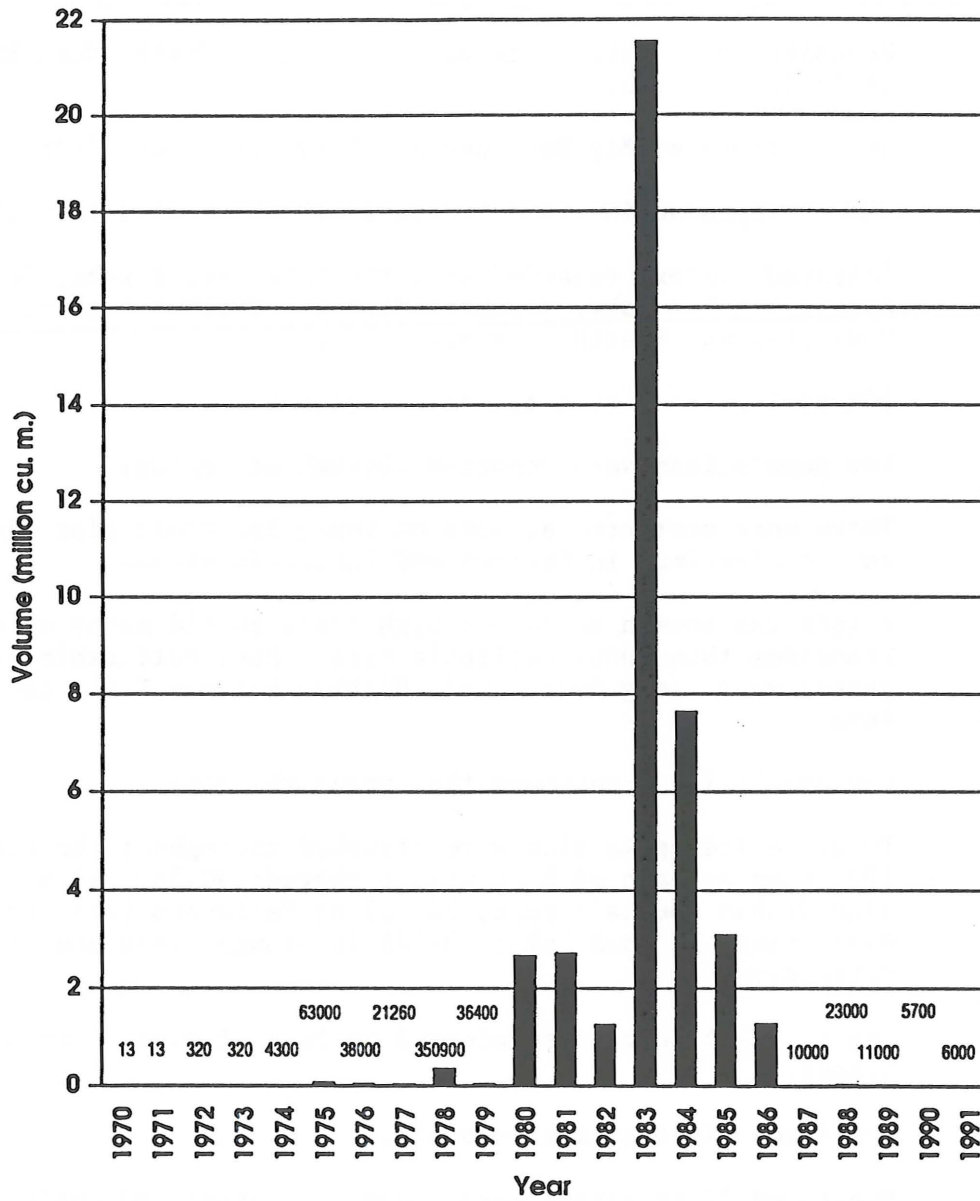
Year	Area(ha) and location					
	Timber Sale Area			DND	Provincial Parks	
	Williams Lake	Quesnel	100 Mile House	Riske Creek	Tweeds.	Bowron
1983	346 580	12 730	22 560	0	0	0
1984	361 575	7 430	5 960	240	4 530	1 650
1985	161 035	13 540	7 820	910	5 300	870
1986	82 775	20 405	3 765	285	0	270
1987	500	0	0	0	0	0
1988	1 290	0	0	0	0	0
1989	720	0	0	0	0	0
1990	315	0	0	0	0	0
1991	265	25	60	0	0	0



Total area with pine killed by mountain pine beetle, Cariboo Forest Region.

Table 2. Volume (m³) of lodgepole pine killed by mountain pine beetle, Cariboo Forest Region, 1983-91

Year	Timber Sale Area			DND Riske Creek	Provincial Parks	
	Williams Lake	Quesnel	100 Mile House		Tweeds.	Bowron
1983	19 406 160	693 945	1 418 600	0	0	0
1984	7 233 165	148 635	119 275	4 800	90 615	33 000
1985	2 673 730	204 130	68 960	12 050	105 780	11 310
1986	952 635	291 990	26 090	3 375	0	2 835
1987	10 000	0	0	0	0	0
1988	23 000	0	0	0	0	0
1989	11 000	0	0	0	0	0
1990	5 700	0	0	0	0	0
1991	4 500	500	1 000	0	0	0



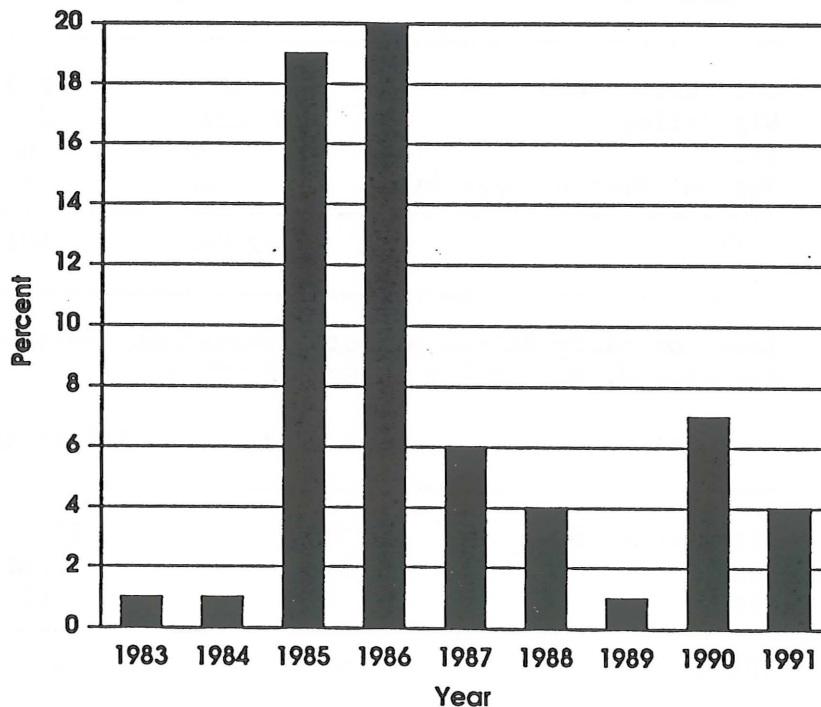
Total volume of pine killed by mountain pine beetle, Cariboo Forest Region.

Lodgepole pine terminal weevil, Pissodes terminalis

The preferred host of this weevil is lodgepole pine, but it does attack western white pine and occasionally ponderosa pine. It is common throughout the Cariboo Region causing leader mortality in young pine.

Year	Remarks
1962	Roadside trees were attacked along Alexis Creek, Dean River and at Tatla Junction.
1963	10% of trees at Big Bar Lake and Dean River were infested.
1964	30% of reproduction infested in an old burn at Big Creek.
1965	Infested leaders recorded at Horse Lake, Young Lake, 70 Mile House, Big Bar Lake, Jesmond, Mile 104 Cariboo Highway, Gustafsen and Fletcher lakes.
1966	29% of leaders were attacked at Tatla Lake.
1967-71	Low populations were reported throughout region.
1972	There were scattered attacks on young lodgepole pine along roads and in clearings in Cariboo and Chilcotin areas.
1973	Attack was common on 3-10 m high trees in old burns or along roadsides throughout Chilcotin area. Most noticeable areas of damage were along Bella Coola Highway between Tatla Lake and Anahim.
1974-78	Low populations continued throughout the region.
1979	Immature lodgepole pine were attacked throughout the Region. 100 trees at each of 8 locations showed: 30-36% infested along Alex Graham Mountain road, 26% along Tatlayoko Lake road; 10% Eagle Lake; 2% Bosk Lake; 10-12% in Slough Creek and 6% near Swift River.
1980	One to 9% of terminals infested in four of sixteen natural stands.
1981-82	Scattered light attack recorded.
1983	Scattered light attack were found throughout lodgepole pine stands.
1984	The most common pest found in young stand surveys was pine terminal weevil, infesting up to 6% of terminals. However, there was no current attack recorded.
1985	The number of terminals attacked increased to an average 19% current attack along Big Creek and Palmer Lake roads.

Year	Remarks
1986	Current attack along Big Creek and Palmer Lake roads was reduced to an average 9%. Elsewhere in the Chilcotin, 28% of regeneration pine were attacked near Nimpo Lake, 16% along Chezacut Lake road and 30% near Twan Creek.
1987	Current attack at four long term study plots near Big Creek, Raven, Chezacut and Nimpo lakes declined to an average 6%.
1988	There was a further decline in the number of terminals attacked to an average 4% current attack at eight locations in the western portion of the district.
1989	Attacks on pine terminals were light throughout the range of lodgepole pine in the region.
1990	Low populations continued throughout the region except for near Kloakut Lake where an average 7.5% of terminals were attacked on BCFS research plots.
1991	Low populations continued, averaging 4% of leaders currently attacked in parts of the Chilcotin near Nimpo Lake and along the Chezacut Road. The same rate of attack was reported at Pigeon Creek and Green Lake.



Average percent of pine terminals attacked by pine terminal weevil, Cariboo Forest Region.

SPRUCE PESTS

Spruce beetle, Dendroctonus rufipennis

In British Columbia spruce beetle usually has a 2-year life cycle. Some populations or parts thereof may mature in one to three years depending on geographical location, elevation and variations in the mean temperature of the spring and summer months. Infestations can occur anywhere mature spruce is growing.

Year	Remarks
1932	Occasional healthy spruce trees were attacked near Stanley in a spruce budworm infested area.
1933	Currently attacked trees were recorded in spruce budworm infestations south of Jack of Clubs Lake.
1962	100 mature spruce heavily infested near Hush Lake and 15 miles east of Quesnel in areas surrounded by wind-felled trees. Populations were in one year cycle.
1963	Severe current attack was mapped near Hush and Kenny lakes in Cottonwood PSYU, moderate attack near Wingdam and light attack eastward to Trigillus Creek. Heavy attack near Willow River area in Big Valley PSYU.

Location	Area (ha)	Volume (m ³)
Cottonwood PSYU	3652	247 436
Big Valley	6512	239 680
TFL 5	792	60 060
Quesnel Special Sale Area	1098	46 928
TOTAL	12 054	594 104

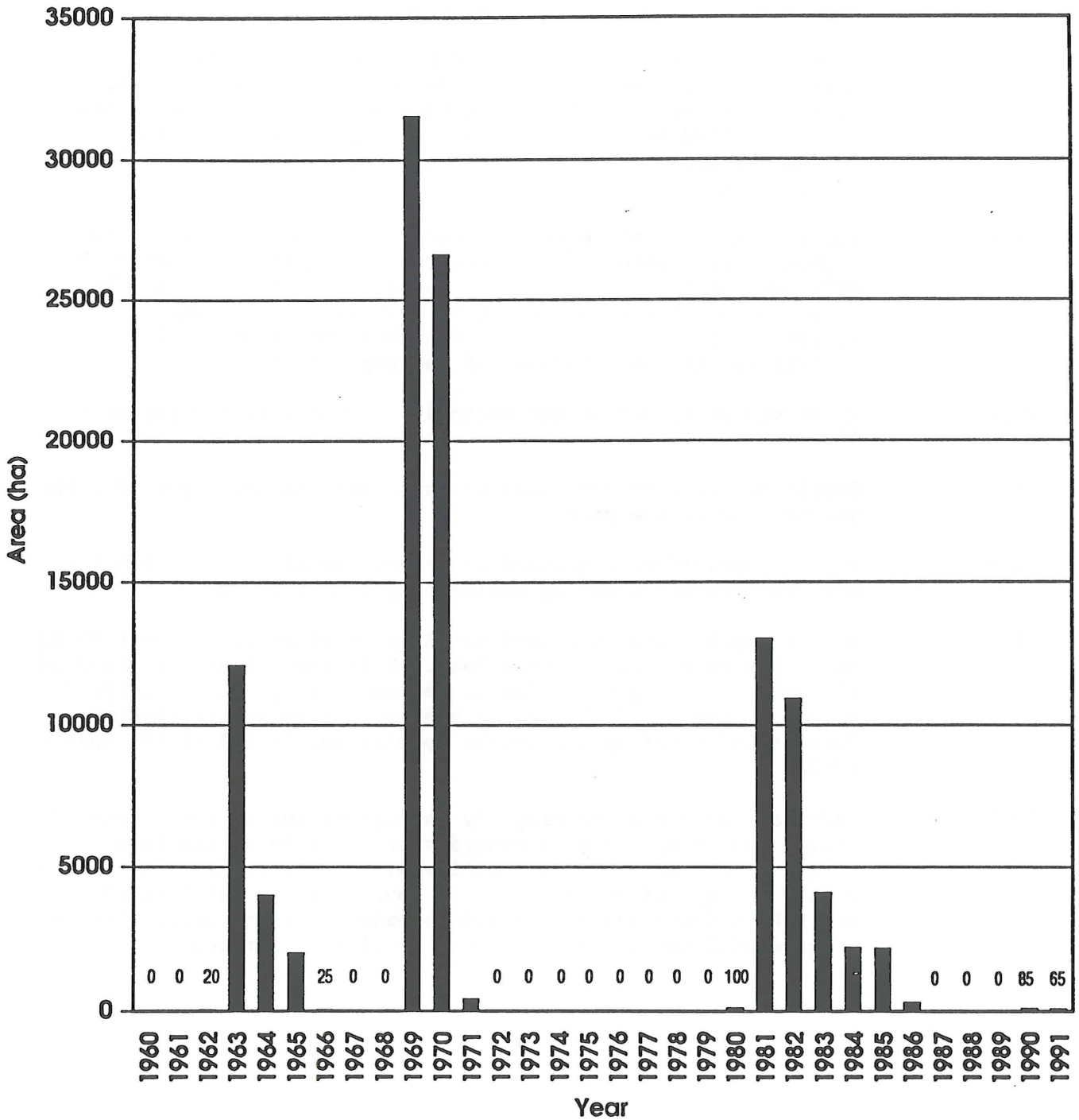
1964 Tree mortality decreased but infestations continued in Cottonwood, Big Valley PSYUs and TFL 5.

Location	Area (ha)	Volume (m ³)
Cottonwood PSYU	824	21 321
Big Valley "	2456	6625
TFL 5	776	6236
TOTAL	4056	34 182

Year	Remarks															
1965	Infestations continued but reduced tree mortality was recorded in Cottonwood and Big Valley PSYUs and TFL 5.															
	<table border="1"><thead><tr><th>Location</th><th>Area (ha)</th><th>Volume (m³)</th></tr></thead><tbody><tr><td>Cottonwood</td><td>355</td><td>2811</td></tr><tr><td>Big Valley</td><td>1591</td><td>15 458</td></tr><tr><td>TFL 5</td><td>65</td><td>362</td></tr><tr><td>TOTAL</td><td>2011</td><td>18 631</td></tr></tbody></table>	Location	Area (ha)	Volume (m ³)	Cottonwood	355	2811	Big Valley	1591	15 458	TFL 5	65	362	TOTAL	2011	18 631
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	Beetle attack in 15 of 24 windfelled trees near 20 mile, Horsefly River Road. Bark sampling found 1 to .25 attacks per 900 cm ² . Light attack occurred on few standing trees nearby.															
1966	Approximately 375 m ³ of timber killed over 24 ha in Big Valley area.															
1968	Currently attacked trees were reported in the Cottonwood area.															
1969	The total area of recently killed spruce mapped was 31 500 ha. Aerial surveys showed more severe 1968 infestations in Cottonwood River area than was indicated by ground surveys. Resurgence of this pest followed the warm dry 1967 summer and abundant local windfall. Severe infestations were mapped over 12 726 ha in the Quesnel and Cariboo lakes area (cruise strip disclosed 80% tree mortality at Weaver Creek and 40% at Spanish Mountain).															
1970	Infestations expanded to 26 260 ha in the Quesnel and Cariboo lakes area. This increase was due mostly to late color change of 1968-attacked trees not counted in the 1969 aerial surveys. Populations of beetles in all areas were greatly reduced by an extremely cold 1968-69 winter.															
1971	Infestations declined in the Quesnel Lake area to 80 ha at Blackbear Creek, 40 ha at Spanish Lake, 242 ha at Abbot Creek and 40 ha at Tasse Lake. Total area and volume of spruce killed during the infestation was estimated at 402 ha and 1 019 520 m ³ respectively.															
1974	Trace population found near Quesnel Lake.															
1975	Low populations recorded in windthrown trees in the Bowron Lake area.															
1976	There were 1400 ha of spruce blowdown in Bowron Lake Provincial Park. Approximately 53% of the blowdown was attacked but only 36% contained established broods.															

Year	Remarks																		
1977	Brood development in blowdown in Bowron Lake Provincial Park was in a 2-year cycle. Further attack of blowdown and standing trees was predicted for 1978.																		
1978	No attack in standing spruce observed. Beetle populations in 1975 windthrow in Bowron Lake Provincial Park remained low.																		
1979	Low populations continue.																		
1980	Spruce beetle killed trees were mapped over a total 100 ha near Kruger Lake, Indian Lake, Big Valley, Towkuh and Two Bit creeks in Willow and Bowron drainages.																		
1981	Over 13 000 ha of beetle killed spruce were reported in Quesnel, Horsefly and 100 Mile Districts																		
	<table border="1"> <thead> <tr> <th>Location</th> <th>Volume (m³)</th> <th>Area (ha)</th> </tr> </thead> <tbody> <tr> <td>Bowron Lake Park</td> <td>345 806</td> <td>6202</td> </tr> <tr> <td>Quesnel TSA</td> <td>302 419</td> <td>4770</td> </tr> <tr> <td>Horsefly TSA</td> <td>38 112</td> <td>852</td> </tr> <tr> <td>100 Mile TSA</td> <td>137 242</td> <td>1226</td> </tr> <tr> <td>TOTAL</td> <td>823 579</td> <td>13 050</td> </tr> </tbody> </table>	Location	Volume (m ³)	Area (ha)	Bowron Lake Park	345 806	6202	Quesnel TSA	302 419	4770	Horsefly TSA	38 112	852	100 Mile TSA	137 242	1226	TOTAL	823 579	13 050
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1982	There were 10 885 ha of spruce infested with a total volume loss of 583 700 m ³ .																		
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100 Mile TSA	1330	65																	
Williams Lake TSA	63 270	1380																	
TOTAL	583 700	10 885																	
1983	The area of mature white spruce killed by spruce beetle decreased to 4100 ha, mostly in the eastern part of the Region including Bowron Park 830 ha; Bowron supply block (SB) 1280 ha, and 960 ha in the Cottonwood SB. Other infestations totalling 1025 ha occurred in the Bowron unregulated area 130 ha, Cunningham SB 190 ha, Cottonwood SB 190 ha, Canim SB 385 ha, and 130 ha in Upper Horsefly SB.																		

Year	Remarks
1984	There were 2200 ha of spruce mortality mapped in Bowron Provincial Park and about 1300 ha reported but not mapped by the BCFS, in the Big Valley-Ketchum Cr. area. Populations were non-threatening, based on brood examinations.
1985	Dead trees were mapped over 2160 ha, similar to 1984. Tree mortality continued in Bowron Provincial Park over 1020 ha. Elsewhere recently killed trees were mapped over 35 ha in the Canim SB; 1090 ha in the Cottonwood, Big Valley, Bowron and Cunningham SBs and 20 ha in the Cariboo, Upper Horsefly and Junction SBs.
1986	Recently killed spruce were mapped over 290 ha throughout the region. There were widely scattered small patches observed by BCFS over 50 ha at 10 different locations. An additional 240 ha were located in Bowron Provincial Park near Isaac Lake. Abnormally low temperatures in November and December, 1985, contributed to the reduction of the population.
1987	There was no recent spruce mortality recorded in the region in 1987.
1988	Beetle populations continued at low levels in the region for the second consecutive year.
1989	Beetle populations continued at endemic levels with no new tree mortality observed during aerial or ground surveys.
1990	Beetle populations increased slightly, killing spruce over 85 ha in 44 separate small infestations. Widespread blowdown occurred throughout the region on May 5, however surveys in the largest patch of spruce and alpine fir blowdown in Bowron Provincial Park, found small spruce beetle populations in 29% of the spruce felled.
1991	Infestations decreased slightly throughout the region. Recently killed mature spruce were mapped over 65 ha in 40 separate infestations, mainly in the Willow River-Barkerville-Bowron Lake area. Surveys of the blowdown in Bowron Provincial Park at Isaac Lake found 13% of the 1990 blowdown were attacked with an average 10.3 beetle galleries per m ² of bark surface.



Area of mature spruce containing recent mortality caused by spruce beetle, Cariboo Forest Region.

Two-year-cycle spruce budworm, Choristoneura biennis

Two-year-cycle spruce budworm is a native pest of spruce and alpine fir stands, causing light to severe defoliation periodically, in conjunction with its' life cycle. In the Cariboo Region, eggs of this pest are laid in even-numbered years and the larvae overwinter in the second instar. In odd numbered years they develop to the fourth instar and again overwinter. The following year they feed on both new and old needles and complete their 2-year life-cycle. Infestations have persisted from Willow River to Mahood Lake.

Year	Remarks
1913-14	Severe defoliation was reported near Barkerville along Willow and Bowron rivers on white spruce and alpine fir. A high percentage of young trees were not expected to survive. No further reports after 1914. The assumption was made that the infestation collapsed in 1915.
1921-25	The infestations reported in the Barkerville area and near Stanley increased in 1923 and again in 1924. No figures were available.
1926	Infestations began at Wingdam and increased in severity toward Barkerville and Richfield. Defoliation of alpine fir and white spruce was equally severe. Estimated 310 000 ha of severe defoliation.
1928	Defoliation in the Barkerville area continued.
1929	The outbreak near Barkerville had been more or less active since 1921, if not longer, and extended over 155 400 ha, mostly from 930-1 200 meters elevation. Mature alpine fir and white spruce were affected. The outbreak reached a peak in 1924 and for the greater part of the area, little serious damage resulted. However, on the south side of Lightning Creek and in the vicinity of Jack of Clubs Lake, there were a large number of recently killed alpine fir which had been attacked by western balsam bark beetle. Weather conditions were adverse in 1929.
1930	More defoliation than expected; no figures were available.
1932	Still epidemic, but declining populations; no figures were available.
1938	An outbreak was reported at Barkerville.
1939	This was a non-flight year, but the light defoliation continued in the Barkerville area from just west of Beaver Pass Creek to Cunningham Creek and from Meridian Mountain near Barkerville northward for approximately 29 km. Moderate defoliation occurred near Cunningham Creek and was 14 km wide in a north-south direction. Severe defoliation was reported over an area 1.8 km wide and 14 km long along Antler Creek.

Year	Remarks														
1940	There was widespread light defoliation in the vicinity of Barkerville. Severe defoliation occurred southeast of Barkerville near Cunningham and Antler creeks.														
1943	The outbreak near Barkerville continued.														
1946	Light defoliation was reported in the Barkerville-Richfield area between 930-1200 meters elevation.														
1952	Light defoliation was recorded near Wells and Bowron Lake.														
1954	Severe defoliation was recorded from Wells to Wingdam, and light defoliation near Barkerville.														
1956	A general decrease in populations occurred.														
1960	Light defoliation was reported in the Swift River Valley and moderate to severe defoliation along Cottonwood River.														
1962	Light defoliation was recorded along Cottonwood River.														
1964	Large areas of defoliation were reported at Sovereign Creek, 1500 ha of moderate defoliation; Tregillus Creek, 31 sq. km of light defoliation and east of Abbau Lake, 2000 ha of light defoliation.														
1972	No defoliation observed but a population increase was noted.														
1974	Defoliation increased to over 40 478 ha of light to severe.														
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1975	Open growing small trees were 100% defoliated and understory trees lost 20-80% of current years foliage near Horsefly and McKay rivers.														
1976	Light to moderate defoliation was mapped over 27 000 ha from Hendrix Creek to Bowron Lakes Provincial Park.														

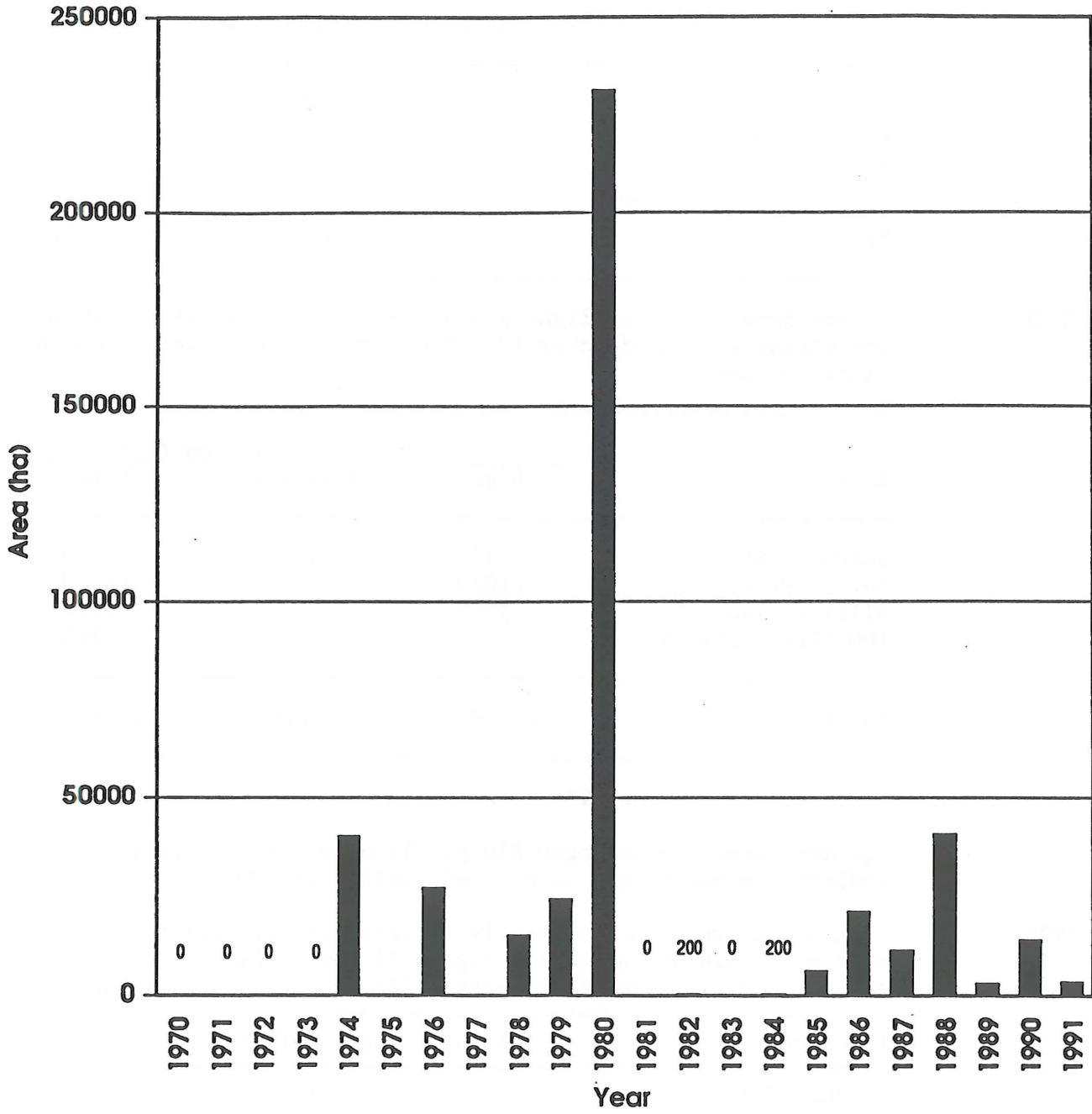
Year	Remarks														
1977	Moderate to high population of presumably early instar larvae caused light defoliation of alpine fir along McKay River and in the Hendrix Lake area.														
1978	Light to severe defoliation was recorded over 15 095 ha from Hendrix Creek to Bowron Lake Park but generally lighter than in 1976. Severe defoliation was mapped over 3800 ha in McKay River Valley; light defoliation over 3000 ha from Hendrix Lake to Bosk Lake; 575 ha northwest of Crooked Lake; 2300 ha along Matthew River; 3070 ha in Bowron Lake park and 2350 ha in the Grain Creek valley.														
1979	More severe than normal defoliation in the "off" year throughout the eastern portion of the region where 24 200 ha of light defoliation was recorded. Up to 50% defoliation of 1979 growth of alpine fir and spruce was found at some locations.														
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1980	231 000 ha of alpine fir and spruce defoliated between Hendrix Lake and Bowron Lake Park. Defoliation was generally light but patches of severe defoliation were mapped at the headwaters of Horsefly, McKay, Matthew and Little rivers. Larval parasitism and disease were reported in infestations for the first time. There was also a decrease in the number of egg masses which indicates a possible decreased population in 1981.														
1981	A few mined buds recorded in the McKay River area, otherwise low populations throughout 1980 infestation area.														
1982	There were 200 ha of trace defoliation of current growth mapped near Willow River; no defoliation in stands defoliated in 1980.														
1983	Low populations were recorded during the immature larval stage of the spruce budworm life cycle. Infested bud counts ranged from 3-37% along the Willow River.														

Year	Remarks
1984	Low populations continued but 50% of current years foliage was defoliated over 200 ha in the Big Valley Creek and Willow River areas.
1985	There was light upper crown defoliation mapped over 5940 ha from Horsefly Mountain to Quesnel Lake and Willow River. Infested bud counts in May were as high as 70% along the upper Willow River area and near Big Valley Creek.
1986	Populations increased and defoliated spruce and alpine fir were mapped over 21 000 ha, up fourfold from 1985. Severe defoliation was mapped over 900 ha near Willow River and Big Valley Creek; moderate defoliation over 5850 ha along Betty Wendle Creek, Matthew River and near Grain Creek, and light defoliation over 14 250 ha from Little River near Cariboo Lake south to Deception Creek near Hendrix Lake. Egg mass sampling at six locations averaged 228 egg masses per 10 m ² of foliage indicating light to severe defoliation in 1988.
1987	Immature larvae lightly defoliated spruce-alpine fir stands over 11 200 ha near Big Valley and Grain creeks, Willow and Mackay rivers, and near Hendrix Lake. Populations were mixed with western spruce budworm in the Bosk-Hendrix lakes area.
1988	Populations increased markedly, lightly and moderately defoliating spruce-alpine fir stands over 40 500 ha in the eastern part of the region.

Location	Area of defoliation(ha)		
	Light	Moderate	Total
Quesnel TSA	21 200	400	21 600
Williams Lake TSA	11 630	1 260	12 890
100 Mile House TSA	5 800	210	6 010
Total	38 630	1 870	40 500

Egg mass samples averaged 226 per 10 m² of foliage, indicating moderate to severe defoliation in 1990.

Year	Remarks																											
1989	There were only 2790 ha of light defoliation mapped, mainly in the Willow River area, and near Quesnel and Hendrix lakes.																											
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	¹ Included in Quesnel TSA total.																											
	Egg mass sampling averaged 210 per 10 m ² of foliage which indicated moderate and severe defoliation in 1992.																											
1991	Immature budworm larvae lightly to severely defoliated the current growth of spruce and alpine fir over 3245 ha in 43 separate infestations from Barkerville south to Quesnel Lake.																											
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Area of spruce-alpine fir forest defoliated by two-year cycle budworm, Cariboo Forest Region.

Spruce weevil, Pissodes strobi

The preferred host of spruce weevil is Engelmann and white spruce but it also attacks lodgepole pine occasionally. This weevil is common in plantations and other open areas such as road right-of-ways, causing topkill of younger trees.

Year	Remarks
1957	There were 15 trees infested at Big Lake; 40% of 54 trees examined were infested at Horsefly Lake.
1958-62	Not reported
1963	Over 8% of regeneration Engelmann spruce examined were attacked in Horsefly Bay area.
1964	Nearly 10% of Engelmann spruce reproduction examined were attacked in Horsefly Bay area.
1965-76	Sporadic minor attacks recorded.
1977-81	No damage was reported.
1982	Over 48% of 3 m high trees in 1968 plantation near Quesnel Lake were attacked: 8% in 1982, 30% prior to 1982.
1983-88	Low weevil populations continue.
1989	Populations increased along Horsefly River and in the eastern part of the region causing terminal mortality on 40% of spruce regeneration at Walker Creek near Horsefly River.
1990	The infestation continued along Walker Creek causing an average 9% mortality of spruce terminals. Elsewhere populations continued at low levels.
1991	Damage to Engelmann spruce continued in the eastern part of the region causing an average 13% terminal mortality in stands examined along Horsefly River and Quesnel Lake. Regenerated cutblocks attacked near Mitchell Bay (15%) and Whiffle Lake (20%), both near Quesnel Lake, were the most severely infested.

DOUGLAS-FIR PESTS

Douglas-fir beetle, Dendroctonus pseudotsugae

The Douglas-fir beetle, native to British Columbia and one of the most important pests of the Cariboo Region, has a one-year life-cycle. Although there is considerable overlapping in the emergence and attack periods of the two broods, there are definite spring and summer flights producing one brood each. Douglas-fir beetle is a very destructive insect, capable of killing many mature trees.

Year	Remarks
1946	Reports show 10% of Douglas-fir trees killed over 808 ha near Horsefly Lake.
1949	Small outbreak reported south of Likely
1950	Scattered, recently killed trees noted along the Fraser River from Cottonwood to Blackwater rivers. Indications were that attacks had occurred in this area for a number of years.
1951	A few recently killed trees were noted along the Fraser River from Quesnel to Hixon.
1952	Populations increased in the Quesnel District west of the Fraser River in patches of up to 16 ha. Dead trees were located at: Bouchie Creek 10 trees, Canim Lake 160 trees, Alexandria 10 trees and 20 trees at Narcosli Creek.
1953	An estimated 1000 recently killed trees were reported on the east side of the Fraser River north of Cottonwood Canyon. Scattered attacks occurred on both sides of the Fraser from Narcosli Creek to Alexandria and for 32 km north of Williams Lake.
1954	Moderate to heavy attacks were recorded from Lac la Hache north to Soda Creek. Numbers of recently killed trees increased south of Quesnel on the west side of the Fraser River but decreased on the east side.
1955	Infestations increased to 6000 recently killed trees near Narcosli Creek and 400 in the vicinity of Marguerite. Active infestations occurred near 100 Mile House, Lac la Hache, Timothy Lake, Canim Lake road, and from Williams Lake to Macalister.
1956	The number of recently killed trees increased to 25 100. There were 10 600 recently killed trees in the Narcosli valley and scattered groups around Macalister and Marguerite. There was a total of 6200 recently killed trees reported from Williams Lake to 100 Mile House; the main areas being Macalister to Williams Lake, 1600; San Jose to Lac La Hache, 4500; 100 Mile House, 2200. April studies showed up to 64% beetle mortality due to low winter temperatures.

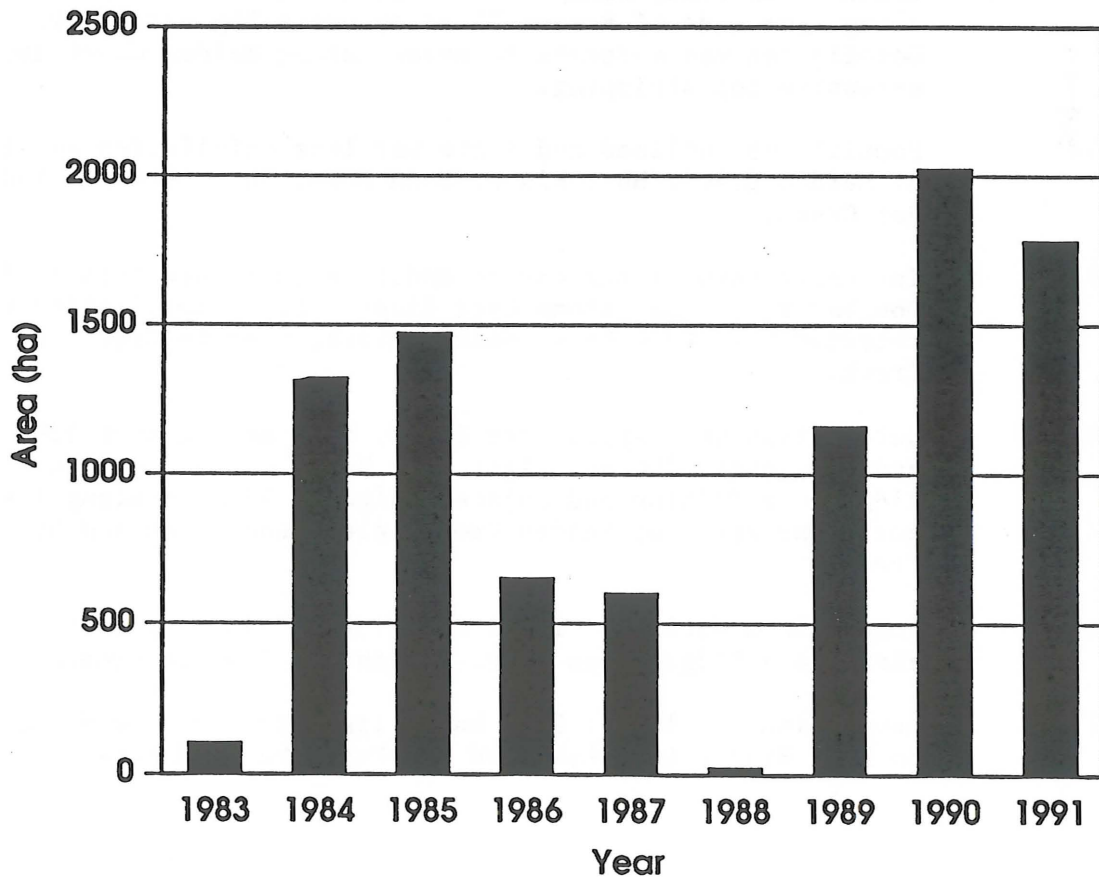
Year	Remarks
1957	The infestation intensity increased in the winter-damaged stands near Williams Lake. Highest concentrations of recently killed trees were mapped near Williams Lake, 1000 trees; Lac la Hache, 2600, and at 100 Mile House, 1150. At Lazaroff Lake an estimated 16 800 m ³ of beetle killed Douglas-fir timber was salvaged.
1958	An estimated 13 000 dead trees were reported near Lac la Hache and Williams Lake. At Lazaroff Lake, 6000 recently killed trees were reported.
1959	Infestations continued in the Cariboo and small groups of recently killed trees were scattered along the Fraser River.
1960	Largest infestation at Joes Lake-Springhouse, 4600 trees, and Riske Creek 1500. Narcosli Creek-Buck Ridge infestations increased to 1250 recently killed trees. Overwintering beetle mortality was 22% at Lac La Hache, 40% at 100 Mile House and 32% near Williams Lake.
1961	Over 14 000 recently killed trees were mapped in the Cariboo. Unusually dry conditions caused many currently-attacked trees to drop their needles by August.
1962	There were 1700 recently killed trees reported in the Chilcotin River area, 517 at Narcosli Creek and 360 from Australian to Marguerite.
1963	The highest numbers of recently killed trees (37 000), were mapped in the Chilcotin River area. Increases also occurred south of Quesnel and along the Fraser River; Whiteslanding Creek, 580; Cottonwood Canyon, 230; Narcosli Creek, 580; Twan Creek, 100 and Tingley Creek, 260. The total volume of timber killed in the Quesnel area was 6874 m ³ .
1964	There were 29 600 recently killed trees recorded in the Cariboo and Chilcotin; decreases occurred in the Quesnel area. The largest infestation was mapped in the Narcosli Creek valley where an estimated 1300 trees were killed.
1965	Approximately 26 000 recently killed trees were recorded in the Cariboo and Chilcotin areas; tree mortality caused by beetles remained the same in Narcosli Creek area.
1966	There was a marked decrease in infestations; the highest concentrations occurred from Clinton to Dog Creek and in Chilcotin River Valley (5000 trees).
1967	Infestations decreased; the largest numbers were 2900 in the Williams Lake-Lac la Hache and Gaspard-Chum creeks areas.

Year	Remarks																																				
1968	Largest numbers of recently killed trees were in the 1966 spring frost damaged stands in the Lac la Hache-Williams Lake area. There were 1000 recently killed trees from Lillooet along the Fraser River, to northeast of Williams Lake and west of Alexis Creek.																																				
1969	Approximately 10 000 recently killed trees were recorded along the Interior Plateau from Williams Lake south to Dog Creek. Overwintering beetle mortality was high.																																				
1970-71	Negligible populations.																																				
1972	Small groups of 5 to 10 recently killed Douglas-fir trees were noted throughout Cariboo-Chilcotin areas. In the Gang Ranch-Dog Creek-Gaspard Creek areas there were 470 trees counted.																																				
1973	Counts of dead trees increased to 1700.																																				
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1975	Numbers of recently killed trees decreased to 4700.			
	<u>Location</u>	<u>No. of trees</u>	<u>Location</u>	<u>No. of trees</u>
	Hawks Creek Valley	800	Lees Corner-Anahim	300
	San Jose River-Jones Cr	600	Dog Cr-China Gulch	300
	Meldrum Cr-Buckskin L.	600	Gaspard Cr-Churn L.	300
	Chimney-Felker lakes	500	Chilko Lake	200
	Williams Lake River	400	McLeese Lake	100
	Macalister	400	Other locations	200
			<u>Total</u>	<u>4700</u>
1976	Numbers of recently killed trees decreased to 250.			
	<u>Location</u>	<u>No. of trees</u>		
	Soda Creek and southward	150		
	McLeese Lake	30		
	Williams Lake to Dog Creek	60		
	Gang Ranch-Alexis Creek	10		
	<u>Total</u>	<u>250</u>		
1977	There were 600 recently killed trees counted; 350 near mill site on north side of Williams Lake and the remainder scattered throughout the region.			
1978	A total of 160 beetle killed trees near Beaver Creek, McLeese Lake, Soda Creek, Dog Creek and Gaspard Creek.			
1979	Over 500 beetle killed trees at: Meldrum Creek 56, Deserters Creek 20, Websters Creek 10, Narcosli Creek 55, Alexandria I.R. 20, Cuisson Lake 25, McLeese lake 20, Soda Creek 10, Canoe Creek 180, Big Bar 70, Stock Valley 10, and Hotnarko River 30.			
1980	Small groups of 2 to 10 recently killed trees were recorded near Soda Creek, McLeese Lake, Meldrum Creek, Springhouse, Dog Creek, Big Creek, Clinton and Hart Ridge.			
1981	Recently killed trees in widespread areas: Higginbottom-Grinder Crs. 185, Dog Creek 400, Gaspard Creek 60 and Word Creek 70. Williams Lake to McLeese lake 185, Military Block 100, Bonaparte River-Clinton 400.			

Year	Remarks										
1982	<p>Approximately 1400 trees were killed; concentrations of recently killed trees were recorded from Dog Creek and Empire Valley along the Fraser River north to the Military Block near Alexis Creek and to Alexandria.</p> <table border="1"><thead><tr><th>Location</th><th>No. of trees</th></tr></thead><tbody><tr><td>Williams Lake TSA</td><td>890</td></tr><tr><td>100 Mile House "</td><td>335</td></tr><tr><td>Quesnel "</td><td>175</td></tr><tr><td>TOTAL</td><td>1400</td></tr></tbody></table>	Location	No. of trees	Williams Lake TSA	890	100 Mile House "	335	Quesnel "	175	TOTAL	1400
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1983	<p>Tree mortality remained static, however BCFS aerial surveys recorded 18 800 ha of Douglas-fir beetle infestation in 1982 and 19 000 ha in 1983. Almost 75% of the total was mapped in the Williams Lake TSA.</p>										
1984	<p>The area of mature Douglas-fir mortality decreased greatly to 1 320 ha, probably due to a change in mapping technique. The most severe infestations occurred at: Dog Creek 450 ha, Meason Creek 130 ha, Sting Lake 130 ha, Brigham Creek 190 ha, Ross Gulch 65 ha, Chimney Lake 165, Military Block 124, and Canoe Creek 65 ha.</p>										
1985	<p>Infestations increased slightly in the same area attacked in 1985, killing Douglas-fir trees over 1 470 ha, mainly in scattered groups of 10-50 trees in Churn, Gaspard and Springhouse supply blocks.</p>										
1986	<p>The area of recently killed trees mapped declined to 650 ha, mainly in the Gaspard, Churn and Springhouse supply blocks.</p>										
1987	<p>Infestations mapped decreased to 590 ha of recently killed Douglas-fir, mainly in the area from Hwy 97 west to the Fraser River and as far north as Soda Creek.</p>										
1988	<p>A further reduction of Douglas-fir mortality by Douglas-fir beetle occurred when 20 ha was mapped mainly along the Fraser River.</p>										
1989	<p>A dramatic increase occurred in the number of Douglas-fir trees killed to 26 600 m³ over 1160 ha from north of Quesnel south along the Fraser to west of Clinton. Trees were recently killed in patches of 3-50 trees mainly in the Williams Lake TSA. Current attack averaged 29% of stems per hectare at 11 locations throughout the infestation, indicating a continuance of the infestation next year.</p>										

Year	Remarks
1990	The volume and area of Douglas-fir recently killed by Douglas-fir beetle increased to 46 460 m ³ over 2020 ha. The trees were mapped in the same areas as 1989, from the Blackwater River north of Quesnel, south along the Fraser River past Williams Lake to near Dog Creek and west to Alexis Creek and east to Horsefly. The average current attack was 13% at 18 plots throughout the infestation, indicating the possibility of more damage next year.
1991	The infestation continued throughout the region but with signs of a reduction in intensity. Trees were killed over 1780 ha in 2030 patches, mainly in the Williams Lake TSA (82%). Dead trees were mapped from north of Quesnel along the Blackwater River to the Fraser River and south through the center of the region from Williams Lake to Clinton, mainly in the IDF, SBS and SBSK1 and SBSK2 biogeoclimatic zones. The average current attack at 18 plots was 9% except in the DND Block near Riske Creek where the average was 17%.



Area of Douglas-fir forest which contained mortality caused by Douglas-fir beetle, Cariboo Forest Region.

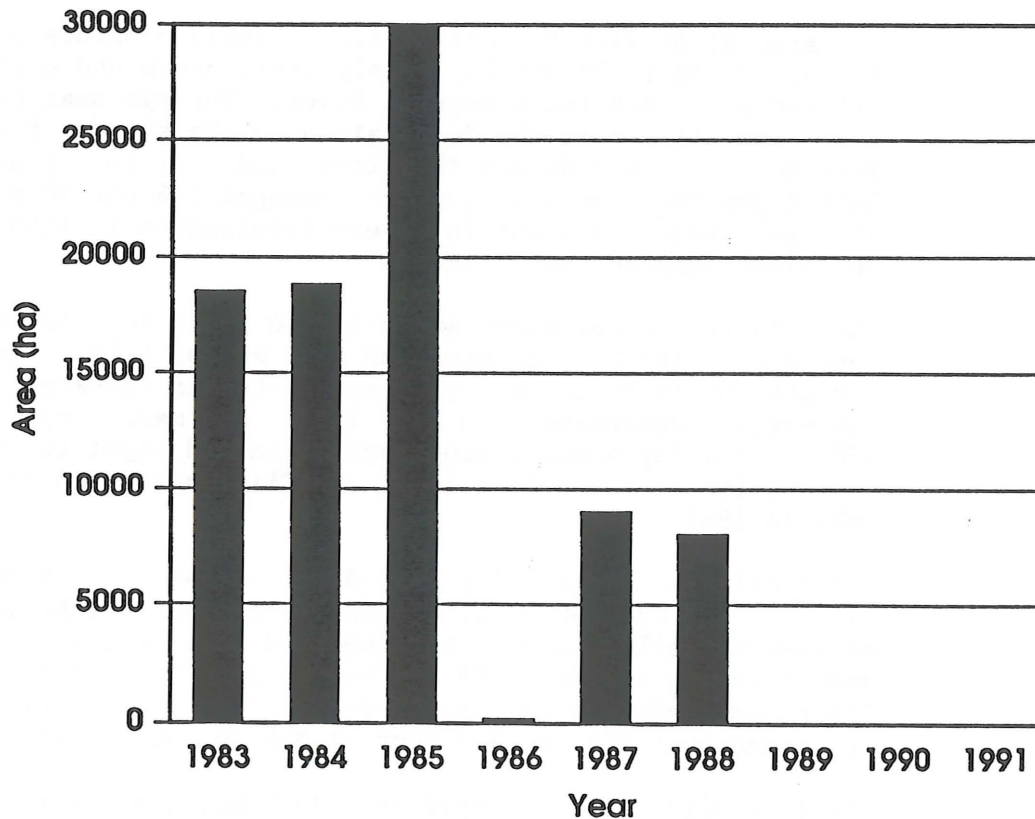
Western spruce budworm, Choristoneura occidentalis

The western spruce budworm is a defoliator of Douglas-fir. Prior to 1972, Douglas-fir defoliation caused by budworm was not found in the Cariboo Region. However since then, populations have been recorded in several years causing light to severe defoliation at scattered locations from Horsefly Lake to Clinton.

Year	Remarks
1974	Light defoliation was recorded at Kelly Lake near Clinton. Light population near Stuie but no defoliation.
1975	Light defoliation was recorded in small patches on Beckers Prairie near Riske Creek and at Kelly Lake.
1976	Light defoliation was reported near Kelly Lake. Small populations occurred in Douglas-fir stands throughout the southern portion of the Region.
1977	Infestations were mapped at Maiden Creek, Hart Ridge-Scottie Creek, Loon Lake, Bonaparte River, north side of Clinton and along west side of Fraser River opposite Big Bar Creek. Defoliation was moderate to severe along Maiden Creek causing extensive top stripping.
1978	Populations declined and there was less defoliation and top-kill at Maiden Creek, Hart Ridge, Loon Lake, Scottie Creek and Big Bar Creek.
1979	Increased populations caused moderate to severe defoliation of Douglas-fir stands along Hart Ridge. Light defoliation was recorded near Loon Lake, Maiden Creek, Scottie Creek and Big Bar Creek.
1980	Defoliation was mapped over 10 600 ha: severe over 3500 ha, moderate over 3300 and light over 3800; extending from Hart Ridge near Clinton and adjacent Highway 97 area along the ridge north and south of Maiden Creek, along Loon Lake and Scottie Creek.
1981	Populations declined; light defoliation was mapped over 5000 ha along Hart Ridge, Loon Lake, Maiden and Scottie Creeks.
1982	Populations declined; 2800 ha of light to moderate defoliation in Hart Ridge, Loon Lake and Big Bar Lake road areas.

Year	Remarks
1983	Budworm defoliated Douglas-fir forest over 18 500 ha in the southern part of the region. About 7900 ha were severely defoliated and 10 600 ha lightly defoliated southwest of Clinton along Hart Ridge, north of Loon Lake to Bonaparte River and south of Loon Creek along the north-facing ridge to Hwy 97. Egg mass sampling in the infestation averaged 200 egg masses per 10 m ² of foliage, indicating severe defoliation in 1984 at three locations and moderate at one in the Clinton area.
1984	Defoliation expanded over 18 800 ha of Douglas-fir forest in the Clinton area. Severe defoliation was mapped over 1790 ha near Loon Lake and along the Bonaparte River. Moderate defoliation was mapped over 12 140 ha near Wohleben Creek, south of Loon Lake, along Hart Ridge, and west of Clinton to Big Bar Lake and east to Chasm Creek. Light defoliation was recorded over 5870 ha near Tsilsalt Ridge. Egg mass sampling averaged 315 egg masses per 10 m ² of foliage at four locations indicating an increasing population and severe defoliation near Clinton in 1985.
1985	The area of Douglas-fir defoliated by western spruce budworm increased 25% to 29 500 ha, mainly west, north and northeast of Clinton and along the Bonaparte River. Surveys near Clinton to study the effects of the defoliation on the stands, found that tree mortality was 8% and that trees had lost four years of height growth. Egg mass surveys averaged 196 per 10 m ² of foliage, indicated light to severe defoliation in 1986 at six locations sampled near Clinton.
1986	The infestation collapsed and only 180 ha of defoliation were recorded in the Clinton area and near Mahood Lake. The decline was attributed to low winter temperatures in November 1985, and low spring temperatures in May, 1986. Egg mass samples averaged 176, indicating a continuing population and light to severe defoliation at three locations near Clinton and two at Mahood Lake in 1987.
1987	Defoliation of Douglas-fir by budworm increased to 9000 ha; mainly light over 6000 ha, and moderate over 3000 ha in patches between Horsefly and Quesnel lakes and near Mahood Lake. Egg mass sampling averaged 188 egg masses per 10 m ² of foliage, indicating moderate and severe defoliation in 1988 at two locations near Clinton and four at Mahood and Horsefly lakes.
1988	Light defoliation was mapped over 8000 ha, similar to 1987, mainly near Horsefly and Mahood lakes. Egg mass sampling averaged 150, indicating severe defoliation at Viewland Mountain and light at Likely in 1989.

Year	Remarks
1989	There was no defoliation of Douglas-fir mapped this year. The collapse was attributed to natural factors such as adverse weather, parasitism, predators and disease in the budworm population. Egg mass sampling averaged 10 egg masses per 10 m ² of foliage, indicating trace to light defoliation in 1990.
1990	There was no defoliation of Douglas-fir by western spruce budworm in the region for the second consecutive year and no larval population except at Cavanaugh Creek west of Clinton. Egg mass sampling at Cavanaugh Creek indicated light defoliation there in 1991.
1991	Trace defoliation was recorded at Cavanaugh Creek and low but increasing larval populations elsewhere, especially near Clinton. Egg mass sampling at Cavanaugh Creek indicated light defoliation in 1992.



Area of Douglas-fir defoliated by western spruce budworm, Cariboo Forest Region.

Douglas-fir tussock moth, Orgyia pseudotsugata

An important pest of Douglas-fir in the Clinton area, capable of sudden outbreaks which usually result in some tree mortality. The infested area in the Cariboo Forest Region is the northern limit of the distribution of tussock moth in BC.

Year	Remarks
1948	South of Clinton, 1600 ha of Douglas-fir were infested resulting in high tree mortality
1981	There was a sudden increase of populations and light defoliation occurred in the Maiden Creek, Loon Lake, Scottie Creek area, except for one severely defoliated patch approximately 1 ha in size, near Scottie Creek. Larvae began to show symptoms of nuclear polyhedral virus (NPV). By September larvae had spun cocoons but 80% did not pupate. Egg mass counts were low indicating a light population for 1982.
1982	Over 500 ha of Douglas-fir were severely defoliated south of Clinton near the regional border. Up to 250 virus-free larvae were collected per three-tree beating sample.
1983	There was severe defoliation of Douglas-fir at three locations totaling 170 ha south of Clinton near Three Mile Lake. However, there were no egg masses found in surveys in the fall.
1984	There was no defoliation or larvae collected in three-tree beating samples in the region. The complete collapse of the population was attributed to NPV.
1985-91	Low populations continued with only the occasional larva in standard three-tree beating samples in the southern part of the Cariboo Region.

ALPINE FIR PESTS

Western balsam bark beetle, Dryocoetes - Ceratocystis complex

The western balsam bark beetle, Dryocoetes confusus in association with a blue stain fungus, Ceratocystis dryocoetidis, kills large numbers of mature alpine fir. It is a chronic pest of high elevation stands throughout the region.

Year	Remarks
1923	Western balsam bark beetle was epidemic since 1922; a few alpine fir were attacked in the spruce budworm infestation near Stanley and south of Jack of Clubs Lake.
1929	From 25-50% of the alpine fir were killed over 1500 ha near Stanley and Jack of Clubs Lake. The trees were thought to have been weakened by repeated attacks of spruce budworm.
1930	Nearly 50% of alpine fir in a 2600 ha area were killed since 1925, in the Stanley-Wells area.
1931	Approximately 75% of alpine fir along the south side of Lightning Creek were killed from years of continued attack by western balsam bark beetle.
1933	A decline occurred, due probably to heavy blowdown in 1932 and absorption of existing populations.
1969	There were 599 recently killed trees located near Quesnel Lake.
1970-71	Scattered groups of 50-100 trees were reported around Quesnel lake.
1972	The largest group of dead trees was mapped near Bonaparte Lake, 300; Isaac Lake, 140; Hendrix Creek, 130 and Spanish Lake 110.
1974	Recently killed trees were reported at Moffat Lake, 500; Sovereign Creek, 400 and Buster Lake, 200.
1975	There was an increased incidence of tree mortality: Moffat Lake, 400; Molybdenite Creek, 300; Tisdall Lake, 200; Hen Ingram, Lake 200; Swift River, 100; and Spanish Lake, 50.
1976	Numbers of recently killed alpine fir trees decreased: Matthew River, 60; Sovereign Creek, 50; Swift River, 30; Antler Creek, 20.
1977	Over 750 recently killed alpine fir trees were mapped at Big Timothy Mountain, Matthew River, Ghost Lake, Cariboo River and Swift and Dean rivers.

Year	Remarks
1978	Populations increased; Segutlat Lake, 220; Klinaklini River, 220; Tatlayoko Lake, 170; Franklyn Arm-Chilko Lake, 550; and Matthew River, 150.
1979	Infestations decreased to 100 trees along the west side of Tatlayoko Lake.
1980	There was a decrease to scattered single trees throughout the region.
1981	There was increased occurrence of recently killed alpine fir east of Highway 97: Clinton Creek, 2 small groups of trees; West of Bowers Lake near Windy Mountain, 9 groups and near Timothy Mountain, 4 small and 1 large groups of trees.
1982	Over 5600 trees were killed; at the south end of Tatlayoko and Chilko lakes and in the southeast corner of Bowron Lake Provincial Park.
1983	The number of beetle killed alpine fir declined to 1125 trees. Dead trees were mapped along Franklyn Arm, Farrow, Cheshi, Edmond, Ottarasko and Nostetuko creeks, near the Lord River and at the south ends of Talayoko, Chilko and Taseko lakes. There were also red trees mapped in Bowron Provincial Park; 160 trees along the upper Cariboo River, 75 along Lanezi Lake and 220 along Betty Wendle Creek.
1984	There were 445 ha of recently killed alpine fir recorded throughout the region. Dead trees were mapped at: Chilko Lake, 25, Taseko Lake, 225, Tatlayoko Lake, 50, and at two locations in Bowron Prov. Park, 50 trees total.
1985	Areas of tree mortality occurred in small scattered groups of from 2 to 140 trees over 170 ha in four supply blocks in 100 Mile House TSA; over 80 ha in six supply blocks in Williams Lake TSA and over 200 ha in four supply blocks in Quesnel TSA.
1986	Dead trees were mapped over 970 ha in the eastern portion of the region. The largest area of tree mortality was located in the Hendrix Lake area along Big Timothy and Hendrix mountains, where over 500 trees were counted in 12 separate patches.
1987	The area of dead trees mapped increased dramatically to 16 000 ha, based mainly on aerial surveys done by BCFS. The damage was widespread throughout the region in 318 groups of red trees.
1988	There were 1200 ha containing 7321 m ³ of recently killed alpine fir mapped. Most, 730 ha, were located from Mitchell Lake to MacKay River. Other areas of recently killed trees were located near Betty Wendle Creek over 80 ha, Stikelan Pass near Chilko Lake over 170 ha, and above Yohetta Lake over 240 ha.

Year	Remarks
1989	Mortality of alpine fir was mapped over 2160 ha, 12 950 m ³ , in 70 separate infestations. There were 7650 trees recorded over 80 ha from Franklyn Arm to Tatlayoko Lake and near Taseko Lake; 700 trees were recorded over 410 ha near Hendrix Lake; 900 trees over 850 ha near Quesnel Lake and 50 trees over 50 ha in Bowron Provincial Park.
1990	There were 550 ha, 3240 m ³ , mapped throughout the region. The most severe damage was found over 180 ha along Franklyn Arm and from there to Tatlayoko Lake; over 160 ha near Hendrix Lake and on 40 ha in the MacKay River drainage.
1991	Mature alpine fir were killed over 860 ha, 5300 m ³ , in 75 separate infestations mainly near Chilko Lake and east to Taseko Lake and from Quesnel Lake to Bowron Provincial Park.

WESTERN HEMLOCK PESTS

Western blackheaded budworm, Acleris gloverana

Western blackheaded budworm is an important pest of western hemlock in the interior wet belt areas. The insect also defoliates Douglas-fir, spruce, alpine fir and occasionally lodgepole pine.

Year	Remarks
1967	Over 18 900 ha of western hemlock along Quesnel and Mitchell Lakes were moderately to severely defoliated.
1968	Infestations in Quesnel Lake area collapsed.
1973	Nearly 60% defoliation of current growth of alpine fir occurred between Wingdam and Beaver House Pass.
1974-82	No records of visible defoliation.
1983-84	Low populations continued.
1985	Populations increased and moderate defoliation of western hemlock was recorded over 4480 ha along Quesnel Lake; from Illahee Mtn. and Buckingham Lake to Summit Lake and Blue Lead Creek. Defoliation was also observed along Niagra Creek to Christian Lake. Egg surveys indicated low numbers of eggs and light defoliation in 1986.
1986	Populations of budworm collapsed due to abnormally low winter temperatures in 1985-86. The mean annual temperature was 3°C, down from the 30 year average of 4°C.
1987-91	Low populations continue with no reported defoliation.

Western hemlock looper, Lambdina f. lugubrosa

Larvae have always been collected in three-tree beating samples throughout the wetter parts of the region east of Hwy 97, mainly in the over-mature western hemlock-western red cedar stands around Quesnel Lake and from there south to Mahood Lake. Visible defoliation has occurred only near Lynx Peninsula on Quesnel Lake, and east to Wells Gray Park.

Year	Remarks
1946	Defoliation of western hemlock and western red cedar was recorded over 10 square miles along the south shore of the eastern end of Quesnel Lake.
1983	Populations increased in standard FIDS three-tree beating collections to an average 122 larvae per sample in 98% of the samples, near Quesnel Lake on the Lynx Peninsula and north to Grain Creek. Trace defoliation was recorded in the area however no area was available. Parasitism and disease were low in the larval population.
1984	Western hemlock looper lightly to moderately defoliated 5000 ha of decadent hemlock-cedar stands on the north shore of Quesnel Lake. There was an average 185 larvae per three-tree beating sample in June and July. Larval and pupal parasitism averaged 12% (range 2-22%). Egg sampling, carried out by collecting old mans' beard and washing the samples to extract the eggs, found an average 43 eggs per 100 grams of lichen from 10 trees at Abbot Creek. The population was expected to continue in 1985 with moderate defoliation indicated.
1985	The western hemlock looper population collapsed, probably due to insect diseases such as nuclear polyhedral virus (NPV), and no defoliation was mapped. However, four patches totalling 640 ha failed to refoliate because of two successive years of defoliation.
1986-89	Low populations continued.
1990	Trace defoliation of western hemlock and western red cedar was visible on Lynx Peninsula indicating a rising population and more defoliation in 1991.
1991	Infestations increased to 5000 ha of light and 700 ha of moderate defoliation from Lynx Peninsula in Quesnel Lake east to Wells Gray Park. Parasitism of larvae by insect parasites was only 6%. Egg samples at three locations indicated light to severe defoliation at the areas sampled next year.

MULTIPLE HOST PESTS

Black army cutworm, Actebia fennica

Black army cutworm normally feeds on ground cover but when this is lacking it will defoliate seedlings in plantations.

Since it was first found in the Cariboo Region in 1980 in the Jack Fire area six miles south of Cottonwood House, high populations and defoliation of Douglas-fir, lodgepole pine and spruce seedlings has been recorded at several locations in the eastern part of the region.

Year	Remarks
1980	Douglas-fir seedlings were 50-100% defoliated over 10 ha in the Jack Fire area south of Cottonwood House.
1981-82	No recorded defoliation; active in other Regions.
1983	Low populations continue in the region.
1984	Black army cutworm lightly to moderately defoliated mostly Douglas-fir seedlings at a provenance trial site and two plantations near Mitchell Bay and Antoine Lake, the first time since 1980 near Cottonwood House. There was 50% seedling defoliation at Mitchell Bay but no mortality. At Antoine Lake, seedlings were lightly defoliated in scattered patches, mainly on southern exposures.
1985	Seventeen out of 32 recently burned logged blocks were infested, mainly in the eastern part of the region but defoliation was limited to ground cover. Planting was stopped at Rollie Creek near Cariboo River. There was less than 5% parasitism in larval samples. Trapping, using sticky traps, was carried out at 16 locations throughout the infestation. The average number of moths per trap averaged 19 (range 2-46). Douglas-fir seedlings were examined at five locations to determine the severity of the defoliation. The percent bud mortality averaged 56% (range 4-95%) at Cedar, Sellar and Rollie creeks and Boswell and Hen Ingram lakes.
1986	There was no noteworthy defoliation recorded in the region. Studies were conducted using soil samples to sample the cutworm larvae. The population was too small to be useful for the study since the average number of larvae per sample was <1. Sticky, baited traps were also used to try to predict the population size next year however the results were inconclusive.
1987	Small numbers of larvae were found near Victoria Creek east of Quesnel, however only fireweed was lightly defoliated.
1988	A small infestation was reported at Bootjack Lake west of Likely, where seedlings were 50-100% defoliated over 1 ha.

Year	Remarks
1989	There were no infestations reported in the region, however moth trapping was completed using sticky traps. An average 6-27 moths per trap were caught at three locations, indicating low numbers of cutworm, too few to cause damage to seedlings in 1990.
1990-91	Low populations continued. Multipher ^R traps caught 62 and 7 moths per trap each near the Horsefly River.

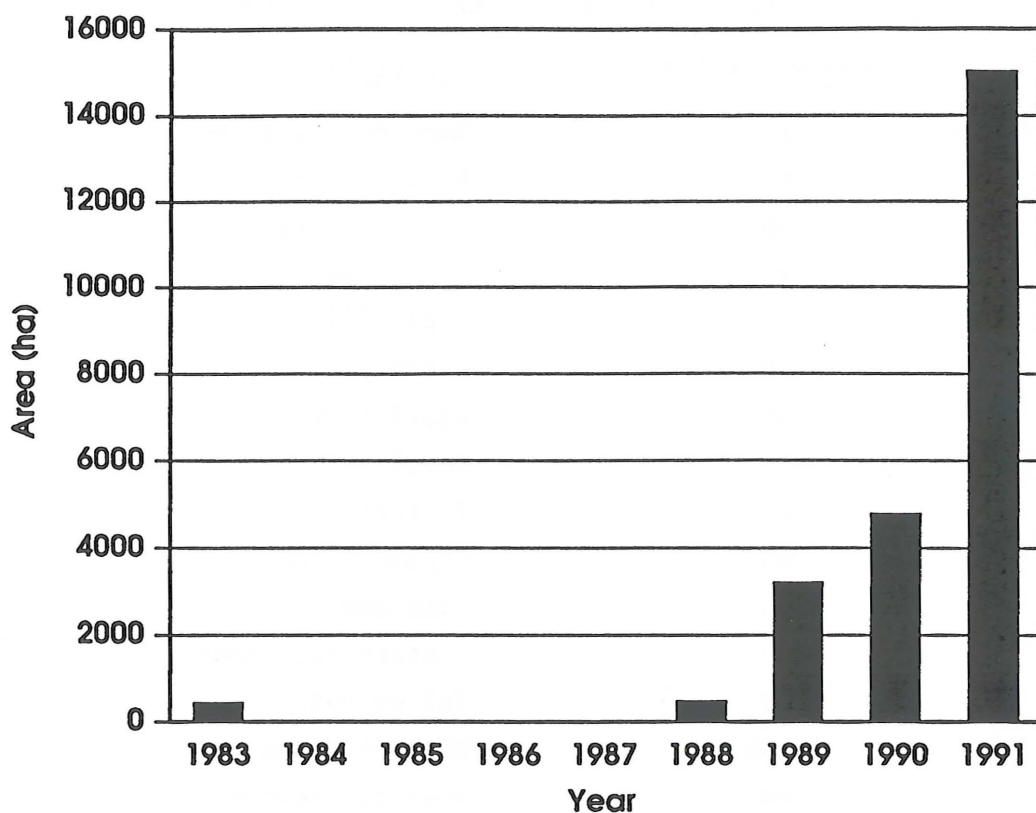
DECIDUOUS TREE PESTS

Forest tent caterpillar, Malacosoma disstria

Major infestations of this native pest have occurred in trembling aspen and other deciduous hosts throughout the northern, eastern and central parts of the region.

Year	Remarks
1937	There was a severe outbreak reported between Williams Lake and Quesnel.
1941	The outbreak continued at 100 Mile House, Soda Creek, Beaver Valley, Fraser River, Horsefly, Forest Grove. Severest defoliation occurred at Lac La Hache and in Beaver Valley.
1942-43	The outbreak continued in the Cariboo; larvae were so numerous on railway tracks between Lone Butte and Horsefly that a train was delayed for 2 hours.
1949	Over 40 ha of aspen, birch, willow, alder were 90% defoliated near Moose Heights. Parasitism was high and there was evidence of disease.
1950	The infestation at Moose Heights near Quesnel collapsed.
1951	There was a sharp increase in localized infestations. Severe defoliation was recorded in Cottonwood Canyon and near Ten Mile Lake.
1952	Severe defoliation of aspen in the vicinity of Beaver Creek and north to Cottonwood River; moderate to severe defoliation occurred along the west side of Fraser River from Quesnel north for 14 km and 19 km west of Bouchie Lake.
1953	The Quesnel infestation expanded north along the Fraser River for 128 km. Starvation from overcrowding occurred in the Quesnel area, and polyhedral disease was noted in some larvae.
1954	Infestations were recorded near Soda Creek, Williams Lake, Horsefly, east of Lac la Hache and over 5000 ha along Horsefly Lake. Severe defoliation also occurred along the Fraser River from Macalister to Prince George.
1955	All infestations collapsed.
1972	Severe defoliation of trembling aspen occurred over 3749 ha along the Fraser River near Quesnel. Severe defoliation was also recorded around Higdon Creek and Dragon Lake over 2068 ha; moderate defoliation over 1034 ha south of Cottonwood River and over 646 ha between Bouchie Lake and Moose Heights.

Year	Remarks
1973	Defoliation was recorded over 70 700 ha from Australian to Greening along Hwy. 97; for 32 km along the Wells-Barkerville road; 24 km along the Blackwater road, and for 9 km along the Nazko road.
1974-81	No recorded defoliation.
1982	Moderate and severe defoliation was recorded over 490 ha at Bonaparte and Bridge Lakes and east of Horsefly at Black Creek.
1983	Trembling aspen was severely defoliated over 400 ha east of Horsefly and over 10 ha near Forest Grove. The trees in the areas defoliated in 1982 sustained no permanent damage.
1984-87	Low populations continued throughout the region.
1988	Aspen was moderately to severely defoliated over 460 ha from Canim Lake to Green Lake, including Jim Creek; near Deka and Bridge lakes and south to the Bonaparte River and Green Lake.
1989	The area of defoliation increased to 3200 ha throughout the region. Aspen was moderately to severely defoliated near 108 Mile, south of Canim Lake, near Deka, Horse, Bridge, Egan and Green lakes. The most severe damage was mapped over 350 ha east of Deka Lake and over 330 ha along Jim Creek south of Canim Lake.
1990	The area of aspen defoliated expanded 50% to 4760 ha from Bridge Lake north to near Horsefly. Aspen stands south of Canim Lake were lightly to moderately defoliated over 1380 ha; near Horsefly new infestations covered 1250 ha. Other patches of poplar were defoliated east of Hendrix Lake over 480 ha. Willow and other shrubs were severely defoliated over 20 ha north of Barkerville in the Williams Creek Valley.
1991	The infestation expanded to 15 000 ha of light to severe defoliation from Bridge Lake to Quesnel in 155 separate patches. New infestations began along the Quesnel River from Quesnel to Beaver Creek. The largest increase in area defoliated was in the Horsely area. Egg mass sampling indicated a continuation of the outbreak. Parasitism average 34% by dipterous insects at four locations. Only 6% of the larvae were diseased.



Area of poplar defoliated by forest tent caterpillar, Cariboo Forest Region.

Fall webworm, Hyphantria cunea

Almost any deciduous tree or shrub will be attacked by this defoliator but the most common hosts are chokecherry, willow, trembling aspen, black cottonwood and rose. This insect, with its unsightly tents, is common in the southern portion of the Region and is not uncommon as far north as Williams Lake. No tree mortality has been attributed to this pest but it is a nuisance to home owners.

APPENDIX I. HOST TREE ABBREVIATIONS

<u>Abbreviations</u>	<u>Common Name</u>
eS	Engelmann spruce
wS	White spruce
bS	Black spruce
sS	Sitka spruce
a1F	Alpine fir
gF	Grand fir
aF	Amabilis fir
D	Douglas-fir
wL	Western larch
aL	Alpine larch
tL	Tamarack
wC	Western red cedar
yC	Yellow cedar
roJ	Rocky Mt. juniper
wH	Western hemlock
mH	Mountain hemlock
1P	Lodgepole pine
sP	Shore pine
pP	Ponderosa pine
wwP	Western white pine
wbP	Whitebark pine
tA	Trembling aspen
bPO	Balsam poplar
bCo	Black cottonwood
Al	Alder general
B	Birch general
M	Maple general
W	Willow general
O	Oak general