FOREST INSECT AND DISEASE CONDITIONS IN ALBERTA, SASKATCHEWAN, MANITOBA, AND THE NORTHWEST TERRITORIES IN 1990 AND PREDICTIONS FOR 1991

H.F. Cerezke, F.J. Emond, and H.S. Gates

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1991

Forestry Canada's Northwest Region is responsible for fulfilling the federal role in forestry research, regional development, and technology transfer in Alberta, Saskatchewan, Manitoba, and the Northwest Territories. The main objectives are research and regional development in support of improved forest management for the economic, social, and environmental benefit of all Canadians. The Northwest Region also has responsibility for the implementation of federal–provincial forestry agreements within its three provinces and territory.

Regional activities are directed from the Northern Forestry Centre in Edmonton, Alberta, and there are district offices in Prince Albert, Saskatchewan, and Winnipeg, Manitoba. The Northwest Region is one of six regions and two national forestry institutes of Forestry Canada, which has its headquarters in Ottawa, Ontario.

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Cover photo:
Late instar larva of spruce budworm, *Choristoneura fumiferana* (Clem.).

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ABSTRACT

Forest pest conditions in Alberta, Saskatchewan, Manitoba, and the Northwest Territories during 1990 are summarized and some predictions of infestation status are given for 1991. Twelve major pests are discussed, and additional noteworthy insects, diseases, and tree damage agents are reported in a table. An updating of surveys for acid rain symptoms in permanently established ARNEWS (Acid Rain National Early Warning System) plots and pest damage incidence in young coniferous stands are also reported.

RÉSUMÉ

Le présent rapport résume l'état des populations de ravageurs et des maladies des arbres en Alberta, en Saskatchewan, au Manitoba et dans les Territoires du Nord-Ouest en 1990 et donne certaines prévisions des niveaux d'infestation pour 1991. Il examine 12 ravageurs d'importance et fait état, sous forme de tableau, de la situation d'autres insectes, de maladies et d'agents nuisibles dignes de mention. Il présente également une mise à jour sur les relevés des symptômes des pluies acides observés dans les placettes permanentes du DNARPA (Dispositif national d'alerte rapide pour les pluies acides) ainsi que des dégâts causés par les ravageurs dans les jaunes peuplements de conifères.

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INTRODUCTION

The Forest Insect and Disease Survey (FIDS) unit at the Northern Forestry Centre (NoFC) of Forestry Canada annually conducts general surveys to detect and monitor noteworthy forest insects and diseases, and other tree-damaging agents in Forestry Canada's Northwest Region (Manitoba, Saskatchewan, Alberta, Northwest Territories, and the Rocky Mountain national parks) (Fig. 1). The surveys include aerial mapping of pest infestations and various ground plot examinations to verify pest identifications, damage intensity, and host records. Much of this work is conducted in cooperation with a number of federal, provincial, municipal, academic, and industrial agencies:

- ☐ Agriculture Canada
- ☐ Alberta Agriculture
- ☐ Alberta Environment
- ☐ Alberta Forestry, Lands and Wildlife
- ☐ Canadian Parks Service
- ☐ Manitoba Agriculture
- ☐ Manitoba Natural Resources
- ☐ Northwest Territories Renewable Resources
- ☐ Saskatchewan Agriculture
- ☐ Saskatchewan Parks and Renewable Resources
- ☐ Forest industries
- ☐ Provincial parks
- ☐ Universities
- ☐ Urban parks departments

Figure 1. Forest districts and regional boundaries of the three prairie provinces and the Northwest Territories.

In addition, the collections of insect and disease species made during the surveys are maintained at NoFC and provide continuity for the historical records of the permanent insect collection, herbarium, and the national FIDSINFOBASE (the Forest Insect and Disease Survey Information system). These collections also contribute information that supports plant quarantine and forest research projects. The results of these regional pest surveys contribute to an annual review of national forest pest conditions. Other special surveys are conducted as part of a national program of acid rain monitoring, under the umbrella of ARNEWS (Acid Rain National Early Warning System).

This regional report summarizes the status of major forest insects and diseases and other tree-damaging agents within the three prairie provinces and the Northwest Territories in 1990, and forecasts expected trends for some of the pests and the damage they will cause in 1991. Special surveys are reported, such as those conducted in nurseries, seed orchards, and plantations. Other tree-damaging agents that affect shelterbelts and shade and ornamental trees are summarized in tabular form.

Information for this report is based largely on field observations, special collections, and records collected and assembled in 1990, from April to late October, by the five FIDS ranger staff assigned to the following jurisdictional areas:

- Mike Grandmaison: Manitoba
- Gary Still: Saskatchewan
- Craig Tidsbury: Northern Alberta and the Northwest Territories
- Howard Gates: Central and southern Alberta
- Jim Emond: National and provincial parks, urban areas, selected high-priority surveys, and tree pest extension diagnostics

In addition, personnel associated with the above-named federal, provincial, municipal, academic, and industrial agencies involved with tree and forest pests have cooperatively provided notes and reports on many of the pest species discussed in this publication and their efforts are hereby acknowledged with appreciation.

Other contributors to this report at the Northern Forestry Centre were:

- Peter Amirault, Insect and Disease Specialist, Canada–Alberta Forest Resource Development Agreement (FRDA)
- Herb Cerezke, Head of FIDS; Entomologist
- Yasu Hiratsuka, Mycologist; disease diagnostics
- David Langor, Entomologist; insect collection maintenance and diagnostics
- Ken Mallett, Pathologist; disease diagnostics
- Paul Maruyama, Mycology Technician; disease diagnostics
- Colin Myrholm, Insect/Disease Technician
- Jan Volney, Project Leader for FIDS; Entomologist
- Daryl Williams, Forest Pest Biology Technician; insect diagnostics
- Andu Yohannes, Entomology Technician

SPRUCE BUDWORM
Choristoneura fumiferana (Clem.)

In the Northwest Region, spruce budworm infestations increased in size and intensity in several areas in northern Alberta and in the Northwest Territories in 1990 (Figs. 1, 2). The infestations covered a composite area of 260 540 ha, somewhat less than the 277 116 ha reported in 1989, and this reflects decreases in infestation in both Saskatchewan and Manitoba (Table 1). In these two provinces, most infestations occurred in the locations previously reported in 1989, while several new small infestations were observed in at least three locations, including the Cypress Hills in southwestern Saskatchewan.

Aerial spray programs for spruce budworm control and the protection of foliage were carried out by the provinces of Alberta and Manitoba, using the biological insecticide, *Bacillus thuringiensis* var. *kurstaki* (Bt) (Table 2). One of the areas treated in Alberta (about 700 ha) was established as the site of a cooperative research study by the Alberta Forest Service and Forestry Canada for the comparison

and evaluation of two Bt formulations developed to protect white spruce foliage, and for the examination of budworm-host interactions and sampling methodologies.

In **Alberta**, spruce budworm caused light-to-moderate defoliation at three locations southeast of Edmonton: near Millet (50 ha), in Big Knife Provincial Park (100 ha), and near Castor (200 ha). The infestation area (about 250 ha) reported in 1989 between Camrose and Donalda was only lightly defoliated this year. The infestation in Big Knife Provincial Park has persisted since 1982, when it was first detected.

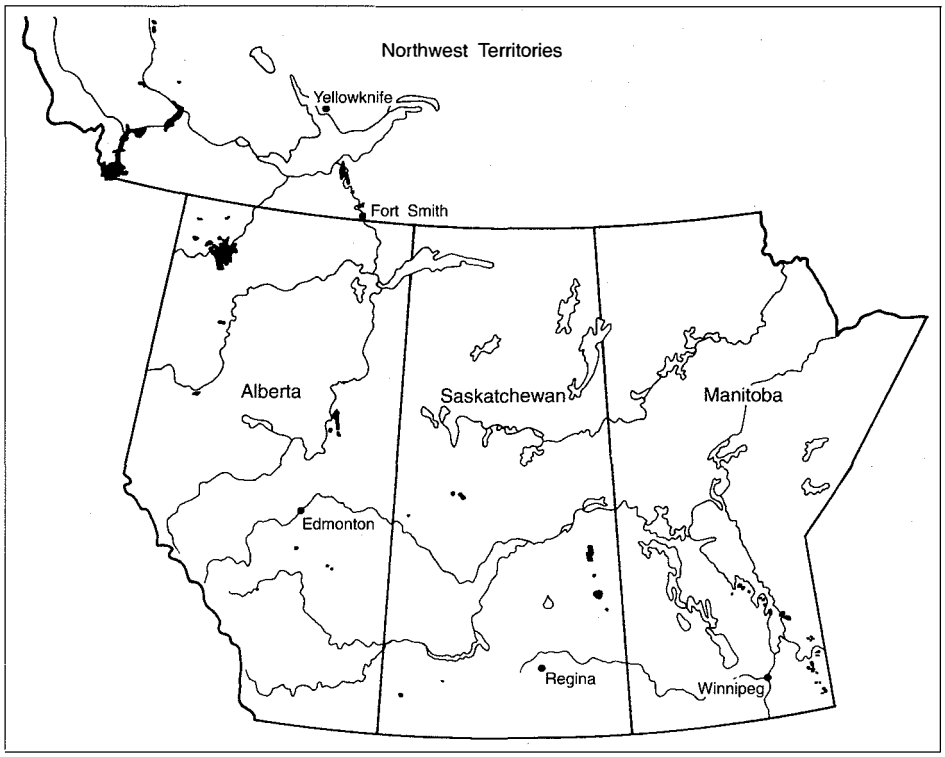

Figure 2. Areas of moderate-to-severe defoliation caused by the spruce budworm in 1990.

In the Lac La Biche Forest, an outbreak of infestation, now in its third year, increased the area of defoliation by nearly 300% in 1990 to 11 800 ha. Areas of moderate-to-severe defoliation now extend along the House River and are at two locations along the Athabasca River southwest of Fort McMurray.

In the Footner Lake Forest District, the infestation along the Chinchaga River, first mapped in 1987, expanded to affect an area now estimated at 95 000 ha with moderate-to-severe defoliation of white spruce forests. About 10 000 ha of this area consist of forests in the fourth consecutive year of severe defoliation; some top kill has occurred. High-value timber (estimated at 153 000 m^3) within the outbreak area is slated for early harvest as part of the budworm management strategy[1]. Three new outlying areas of defoliation (included in the above 95 000 ha) were mapped in 1990: they consist of 2 000 ha along the Amber River, 500 ha along the Hay River, and 600 ha along the Steen River.

The oldest infestation persisting in the northern spruce forests affects about 1 000 ha near Eaglesham in the Grande Prairie Forest District. Although its initial year of onset is unknown, this outbreak area is estimated to be undergoing the sixth or seventh consecutive year of defoliation, based on present stand conditions. Top kill is now

Table 1. Summary of spruce budworm defoliation in the Northwest Region, sketch-mapped from aerial and ground surveys in 1989 and 1990

	Area of defoliation (ha)		
Location	1989	1990	Change
Alberta	85 850	109 150	+23 300
Saskatchewan	34 650	18 780	-15 870
Manitoba	58 016	18 985	-39 031
Northwest Territories	98 600	113 625	+15 025
Totals	277 116	260 540	-16 576

[1] Personal communication from H. Ono, Manager, Insects and Disease, Alberta Forestry, Lands and Wildlife, October 1990.

Table 2. Summary of spruce budworm infestation areas treated in commercial forests in Alberta and Manitoba in 1990 with aerial applications of *Bacillus thuringiensis* var. *kurstaki*

Location	Area treated (ha)	Host species	Bt product	Application rate	Dosage
Alberta					
Chinchaga River	9 240	White spruce	Futura-XLV^R	30 BIU/ha[a]	0.9 l/ha
Eaglesham	1 111	White spruce	Futura-XLV^R	30 BIU/ha[a]	0.9 l/ha
Hawk Hills:					
Block 1	500	White spruce	Futura-XLV^R	30 BIU/ha[a]	0.9 l/ha
Block 2	200	White spruce	Futura "O"^{R}	30 BIU/ha[a]	0.9 l/ha
Manitoba					
Abitibi-Price F.M.L.	3 050	White spruce-balsam fir	Futura-XLV^R	30 BIU/ha[a]	0.9 l/ha
	1 312	White spruce-balsam fir	Futura-XLV^R	20 BIU/ha[b]	1.35 l/ha

[a]Indicates one application.
[b]Indicates two applications.

extensive throughout the outbreak area, radial stem growth has been drastically reduced, and up to 25% mortality was estimated on a portion of the outbreak area[2].

An outbreak area, which was first reported in 1989 in the Peace River Forest District at Hawk Hills, intensified in 1990, and more than 1 000 ha suffered moderate-to-severe defoliation. This stand is easily accessible, has relatively uniform forest stand characteristics, and supports a high spruce budworm population in the early stage of outbreak development. For these reasons, this site was selected in 1990 for a cooperative research trial to test Bt spray efficacy and to obtain information on the biology of the budworm and its host. Two treatment blocks, each with four monitoring plots, were established and aerially treated with two different Bt products: one block was sprayed on 500 ha with a high-potency formulation, Futura-XLV^R, and the other block was sprayed on 200 ha with an experimental ultra-high-potency formulation, Futura "O"^{R}. A third control block was untreated. The results are being assessed on the basis of pre- and post-spray larval, pupal and egg-mass density counts, male moth captures in pheromone-baited traps, and defoliation estimates. These results are being summarized in a separate report.

Egg-mass density surveys were conducted at all four northern outbreak areas in Alberta by Alberta Forest Service and Forestry Canada personnel, and indications are that moderate-to-severe levels of defoliation can be expected again in 1991 at all locations (Table 3).

In **Saskatchewan**, the total area of forests moderately-to-severely defoliated by the spruce budworm declined to 18 780 ha from the 34 650 ha reported in 1989 (Table 1). Most of the decline occurred in two long-established outbreak areas, Red Earth and Porcupine Hills, where trees have sustained severe defoliation within portions of these areas since 1982. Much of the reduction reported in 1990, however, was due to on-going salvage logging.

The 1990 surveys indicated that 9 100 ha of white spruce-balsam fir forests were affected with moderate-to-severe defoliation in the Red Earth area, while 4 900 ha were similarly defoliated in five stands of white spruce-balsam fir between Usherville and Reserve. Several new areas where moderate-to-severe defoliation of spruce occurred, totaling about 220 ha, were found in farm woodlots near Norquay and near Prairie River in east-central Saskatchewan. Another new infestation of

[2]Personal communication from H. Ono, Manager, Insects and Disease, Alberta Forestry, Lands and Wildlife, detailing information in an Alberta Forest Service survey, October 1990.

Table 3. Results of surveys for spruce budworm defoliation, egg-mass densities, and male moths captured in pheromone traps in 1990, and predicted defoliation levels expected in 1991 in the Northwest Region

Location	Average defoliation 1990 (%)	Avg. no. egg masses per 10 m^2 of foliage	Average no. moths per trap	Predicted defoliation for 1991[a]
Alberta				
Eaglesham (Bt treated)	72[b]	335[b] (170)[bd]	--[c]	Moderate-severe
Chinchaga(Bt treated)	93[b]	305[b] (310)[b]	--	Moderate-severe
Chinchaga (Untreated)	77[b]	244[b] --	--	Moderate-severe
House River	100[b]	516[b] (48)[b]	--	Severe
Hawk Hills:				
(Untreated)	100	399 (235)[b]	1 621	Severe
Block 1 (Bt treated)	87	133 --	698	Moderate-severe
Block 2 (Bt treated)	92	188 --	578	Moderate-severe
Saskatchewan				
Delaronde Lake	98[e]	293[e]	--	Severe
Taggart Lake	88[e]	168[e]	--	Moderate-severe
Manitoba				
Birds Hill Provincial Park	17	11 (12)	114	Light
Spruce Woods Provincial Forest	25	76 (55)	322	Moderate
Red Deer River	0.2	0 (0)	57	Nil
Duck Mountain Provincial Park	1.7	0 (0)	8	Nil
Riding Mountain National Park	0.3	0 (0)	6	Nil
Northwest Angle Provincial Park	0.4	0 (25)	9	Nil
Whiteshell Provincial Park	22	218 (349)	643	Severe
Wanipigow	21	77 (268)	509	Moderate
Hecla Island Provincial Park	9	36 (22)	37	Moderate
Lac Ste. George	0.7	0 (8)	0	Nil
Rocky Lake	0.8	12 (0)	49	Light
Simonhouse	1.7	0 (0)	30	Nil
Pisew Falls	0.2	0 (4)	6	Nil
Northwest Territories				
Fort Liard: Site 1	--	123[f] --	--	Moderate-severe
Fort Liard: Site 2	--	279[f] --	--	Severe

[a]Based on egg-mass densities where Light = <25% defoliation (1-15 egg masses), Moderate = 26-50% defoliation (50-100 egg masses), and Severe = >50% defoliation (200+ egg masses).
[b]Data collected by Alberta Forest Service.
[c]No data collected.
[d]Values in brackets are for 1989.
[e]Data collected by Weyerhaeuser Canada Ltd., Saskatchewan Division.
[f]Spruce foliage collected by Northwest Territories Renewable Resources.

moderate defoliation affected more than 50 ha of white spruce in the west block of Cypress Hills Provincial Park.

Three infestations that were reported for the first time in 1989 continued in 1990 with moderate-to-severe defoliation of the white spruce-balsam fir stands near Big River, at Taggart Lake (2 500 ha) and Delaronde Lake (2 000 ha), and in a small area (10 ha) west of St. Walburg. The Taggart and Delaronde lake infestations are within the forest management area of Weyerhaeuser Canada Ltd., Saskatchewan Division, whose staff conducted ground surveys in late 1990 for spruce budworm egg-mass densities, bud damage, and defoliation. Based on the egg-mass densities, defoliation in 1991 is expected to be severe at Taggart Lake, and moderate-to-severe at Delaronde Lake (Table 3).

In **Manitoba**, spruce budworm infestation areas of white spruce-balsam fir forests in the eastern part of the province decreased in size in 1990 to about 18 985 ha, and sustained moderate-to-severe defoliation. The areas affected occurred within the Abitibi-Price Forest Management Licence (F.M.L.), and in Nopiming, Whiteshell, and Hecla Island provincial parks. Some increases in infestation were noted in the Grindstone, Black Island, and Spruce Woods Provincial Forest areas, and in Birds Hill Provincial Park.

An aerial spray program was implemented by Manitoba Natural Resources over a total area of 5 674 ha. Spraying 1 312 ha of this area occurred over provincial park high-use recreational areas, the remainder of the sprayed area consisted of commercial forests of the Abitibi-Price F.M.L. The areas treated with Bt are indicated in Table 2. Manitoba Natural Resources also conducted egg-mass surveys[3] in August and September of 1990, in the Abitibi-Price F.M.L. and in Nopiming and Whiteshell provincial parks. Moderate defoliation is predicted for all surveyed areas in 1991, including Falcon, Westhawk, Dorothy, Bird, Booster, Flanders, Manigotogan, Long, and Beresford lakes.

Spruce budworm pheromone traps were placed at 13 fixed sampling locations (3 traps per location) for the sixth consecutive year to record trends in the numbers of male moths trapped. Mid-crown foliage samples were also collected from the same locations for the estimation of egg-mass densities and prediction of the levels of defoliation expected in 1991. The results are summarized in Table 3, and suggest that moderate or severe defoliation will occur in the Spruce Woods Provincial Forest, in Whiteshell Provincial Park, at Wanipigow, and in Hecla Island Provincial Park.

In the **Northwest Territories**, there was some expansion of infested areas, compared to the 98 600 ha reported in 1989 (Table 1; Fig. 2). New infestations were also mapped along the Mackenzie River between Fort Simpson and Fort Norman (4 500 ha), and an additional 325 ha of light-to-moderate defoliation occurred between Camsell Bend and Bulmer Lake. The main infestation, which has persisted since 1982, extends along the Liard River between Fort Simpson and the British Columbia border; in 1990 it included about 97 800 ha of white spruce forests with moderate-to-severe defoliation. This area increased in size and intensity in 1990 and is part of a larger outbreak area extending into parts of the Yukon Territory and the Fort Nelson Forest District of British Columbia, where the increase from 1989 was more than 300%.

In the Slave River outbreak areas, defoliation occurred in three infestations covering a total area of 11 000 ha: 6 200 ha of this area were rated light-to-moderate, and 4 800 ha were rated moderate-to-severe (Fig. 2).

In 1990, spruce foliage samples for egg-mass density estimates were collected at two locations in the Liard River infestation by Northwest Territories Renewable Resources personnel. Moderate-to-severe defoliation is forecast at both locations in 1991.

[3] Unpublished report on forest pest conditions in Manitoba, 1990. Prepared by A. Richard Westwood, Manitoba Department of Natural Resources, for the 18th Annual Forest Pest Control Forum Meeting, November, 1990.

FOREST TENT CATERPILLAR
Malacosoma disstria Hbn.

A substantial decrease in population levels of the forest tent caterpillar and subsequent defoliation was evident in the Northwest Region in 1990. The forest tent caterpillar, however, continued to be one of the major defoliators of trembling aspen in the prairie provinces. Aerial and ground surveys indicated light-to-severe levels of defoliation of the aspen forests in a total land area of 4 394 164 ha, compared to 5 899 000 ha affected in 1989 (Fig. 3). In Alberta and Saskatchewan, however, the total areas of aspen forests defoliated by the forest tent caterpillar were estimated at only 20% (Table 4) of the actual land area mapped because most of the infestations were distributed over agricultural lands containing only a scattered mosaic of aspen forests.

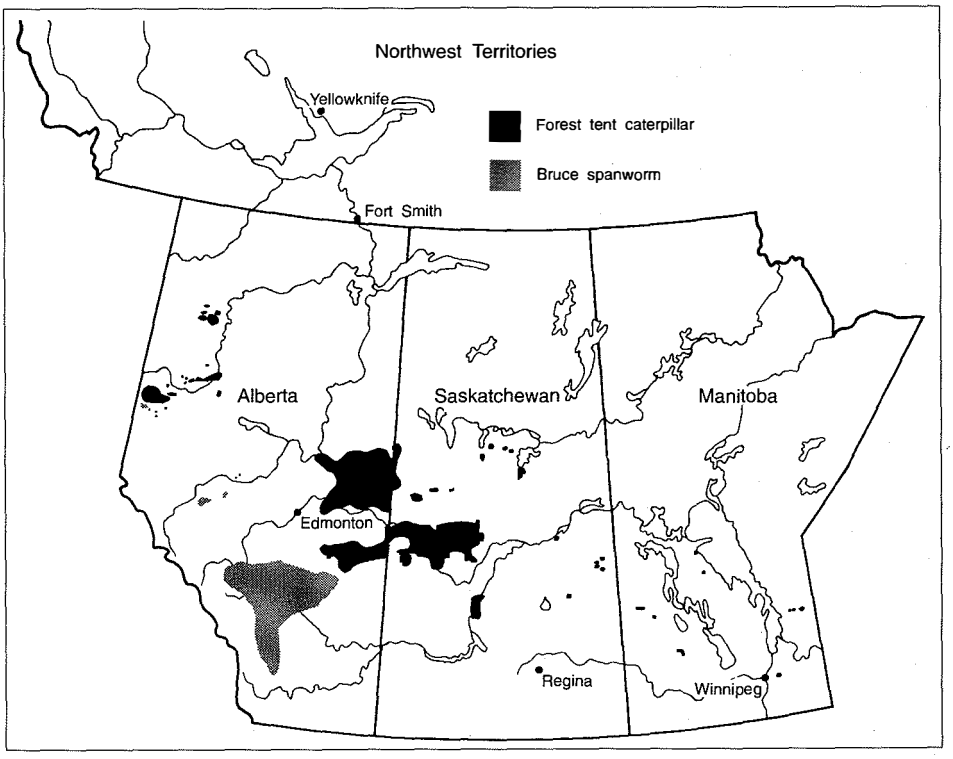

Figure 3. Areas of moderate-to-severe defoliation caused by the forest tent caterpillar, large aspen tortrix, Bruce spanworm, and other leaf rollers in 1990.

In **Alberta**, the total area of aspen forests with moderate-to-severe defoliation by the forest tent caterpillar in 1990 was estimated at 609 272 ha, compared to 1 179 800 ha in 1989 (Table 4). This significant decrease occurred over much of the previously reported outbreak area. The remaining infestation was composed of three separate areas (Fig. 3). The most extensive area of moderate-to-severe defoliation of aspen stands was located in the northeastern part of the province, between the North Saskatchewan River and Highway 55 and west from the Saskatchewan provincial border to Highway 831. The other infestation area where similar injury was reported was situated in east-central Alberta, in the general area between highways 12 and 16 and west from the Saskatchewan provincial border to Highway 854. The other sizable infestation was in the Grande Prairie-Peace River area of northwestern Alberta.

Aerial and ground spray control programs using Bt against the forest tent caterpillar were again undertaken in some counties and provincial parks in central Alberta to reduce foliage loss and the nuisance aspect of the caterpillars. Most of these programs achieved some degree of success.

Table 4. Summary of moderate-to-severe defoliation of trembling aspen by the forest tent caterpillar, Bruce spanworm, and large aspen tortrix in 1990

Province	Area of defoliation in 1989 (ha)	Area of defoliation in 1990 (ha)
Alberta	1 179 800[a]	609 272[a]
Saskatchewan	790 740[a]	260 922[a]
Manitoba	325 045	15 178
Totals	2 295 585	885 372

[a]Estimated as 20% of the total land area mapped.

In **Saskatchewan**, the extent of moderate-to-severe trembling aspen defoliation was significantly reduced. In 1990, a total land area of 1 304 611 ha was mapped (Fig. 3); of this 260 922 ha was estimated to be actual defoliated aspen forest area (Table 4). As mapped, the outbreak area was located between Lloydminster and Unity in the west, and Shell Lake and Glaslyn in the east. Moderate-to-severe defoliation continued to occur in the Cold Lake area, between the Beaver and Martineau rivers and east to Lac des Isles. Other widely scattered areas of similar defoliation were reported in the vicinities of Loon, Makwa, Doré and Smoothstone lakes and near Steele Narrows. The previously reported infestations present in east-central Saskatchewan in 1989 collapsed in 1990.

In **Manitoba**, a marked decrease of trembling aspen defoliation was evident in 1990. Moderate-to-severe injury was reported over a total of 15 178 ha of aspen forest, compared to the 325 045 ha reported in 1989 (Table 4; Fig. 3). The population collapsed during 1990, and only localized pockets of moderate-to-severe damage remained; these were located in the Jenpeg Road and Devil's Lake areas. Similar defoliation was also noted in the St. George-Fisher Bay area and near Camperville.

Egg-band surveys were conducted in the three prairie provinces in the fall of 1990 to predict defoliation levels in 1991. The results (Fig. 4) suggest a trend toward the continuing decrease of forest tent caterpillar populations in 1991.

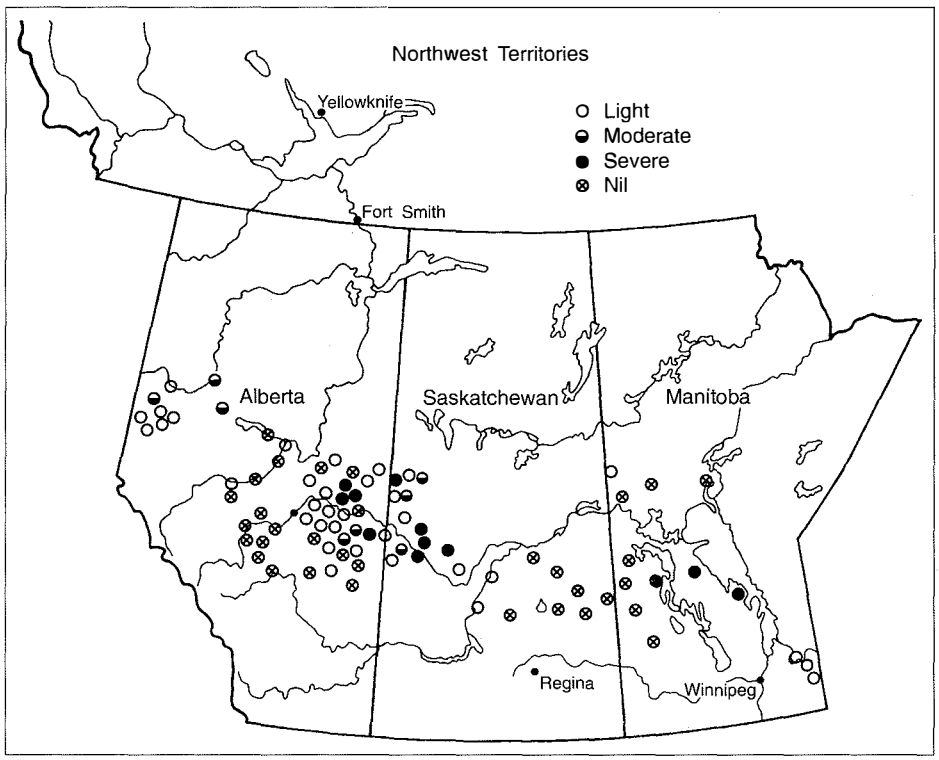

Figure 4. Predicted 1991 defoliation of aspen by the forest tent caterpillar, based on egg-band surveys.

LARGE ASPEN TORTRIX
Choristoneura conflictana (Wlk.)

In **Alberta**, the large aspen tortrix was reported in many areas of the province in 1990. It was present in many of the trembling aspen stands, including those where the forest tent caterpillar and the Bruce spanworm were the primary defoliators. Moderate-to-severe defoliation was reported south of Grande Prairie in the Twin Lakes area, north of Manning near Keg River, and in the Watt Mountain area west of High Level. Light-to-moderate defoliation was noted in aspen stands in the general area of Calgary, north and south of Turner Valley, near Drumheller, and in the Cypress Hills.

In Saskatchewan, significant light-to-moderate defoliation of trembling aspen was reported along the north boundary of Prince Albert National Park, and west of Montreal Lake in the Thunder Hills. Widely scattered pockets of similar defoliation were noted in the eastern part of the province, south of Hudson Bay and between Saskatoon and Outlook. Low population levels were reported throughout most of the forest tent caterpillar infestation areas.

In **Manitoba**, large aspen tortrix infestations declined slightly in 1990. Moderate-to-severe defoliation was reported in trembling aspen stands in Duck Mountain Provincial Park and in Riding Mountain National Park, where a combined total of 15 540 ha of aspen was affected in comparison with the 18 650 ha reported in 1989. Low population levels were noted in Birds Hill and Porcupine Mountain provincial parks, in the areas of Reed, Simonhouse, and Rocky lakes, and near Flin Flon, Pelican Rapids, and Benito.

BRUCE SPANWORM *Operophtera bruceata* (Hulst)

Defoliation of trembling aspen forests and parklands by the Bruce spanworm increased significantly in many areas of **Alberta** in 1990. The largest area of moderate-to-severe defoliation was reported in the Claresholm-Rocky Mountain House-Castor triangle (Fig. 3). Within this general area, a total of 352 346 ha of aspen forest was defoliated. Other smaller areas of moderate-to-severe defoliation were evident in the following areas: Hinton-Obed (53 175 ha); north of Edson (13 257 ha); south and west of Grande Prairie (25 081 ha); Whitecourt (2 673 ha); and Manning-Keg River (72 872 ha). Scattered pockets of light-to-moderate defoliation were reported between Rimbey and Ponoka, and near Winfield, Buck Lake, Breton, and Warburg. Patches of light defoliation were observed east and west of Wetaskiwin and near Camrose.

In **Saskatchewan**, low populations of the Bruce spanworm were present in many of the areas where forest tent caterpillar infestations occurred (Fig. 3).

MOUNTAIN PINE BEETLE *Dendroctonus ponderosae* Hopk.

The Canadian Parks Service provided aircraft and assisted in aerial surveys of **Jasper**, **Banff**, **Kootenay**, and **Yoho** national parks to map and record mountain pine beetle (MPB) infestations. The survey over Jasper National Park included areas to the west in Mt. Robson Provincial Park, British Columbia, where previous MPB infestations and sanitation control cuttings had occurred in 1989. No recent lodgepole pine tree mortality observed at the time of the survey was attributed to this bark beetle.

Aerial and ground surveys were conducted in late 1990 by British Columbia provincial parks and forestry personnel in Mt. Robson Provincial Park. The surveys indicated that 8 pine trees had been recently killed by the MPB and 216 trees were attacked in 1990, all in the area of Shale Hill, about 46 km from the west gate of Jasper National Park. The beetle-infested pine will probably be cut and burned this winter.

The aerial survey of **Banff National Park** did not include its southern portion along the Spray Lakes Reservoir and Spray River where a few previous MPB infestations had occurred; the surveyed areas extended west and southwest of the town of Banff. No tree mortality was observed that was attributable to the MPB.

There was a general increase in pine recently killed by MPB in **Kootenay National Park,** mostly in the same areas as reported in 1989 (Fig. 5). In the area near Kootenay Crossing, several new infestations (an estimated 150 trees were killed) occurred within an area 4-6 km south of Hector Gorge, on the east side of the highway. Similarly, on the west side of the highway, between Kootenay Crossing and the confluence of Dolly Varden Creek and the Kootenay River, at least 10 new infestations were observed with an estimated total mortality of 100 trees. No infestations were noted east of the area between Mount Wardle and Split Peak. Three small infestations (about 10 dead trees in total) also occurred on the west side of the highway between Meadow and Nixon creeks.

The main areas of infestations with recent beetle-killed pine occurred in the following locations: along the lower west slopes of Selkirk, Daer,

and Harkin mountains to Dog Lake and Pitts Creek (more than 5 000 dead trees); between Pitts Creek and Cross River (at least 600 dead trees); adjacent to Kimpton Creek (more than 350 dead trees); and Redstreak Mountain (at least 2 000 dead trees). Other areas of numerous small patches of recently killed pine occurred adjacent to John McKay Creek, near Sinclair Pass, and between Settler's Road and the south end of the park. In the 1990 surveys, it was estimated that approximately 10 000 recently killed trees were located in the park-nearly a 200% increase in mortality over 1989. The increase may be attributed to the increased survival of overwintering larvae during 1988-89, and probably also to the increased migration of beetles into the park from adjacent outside infestations.

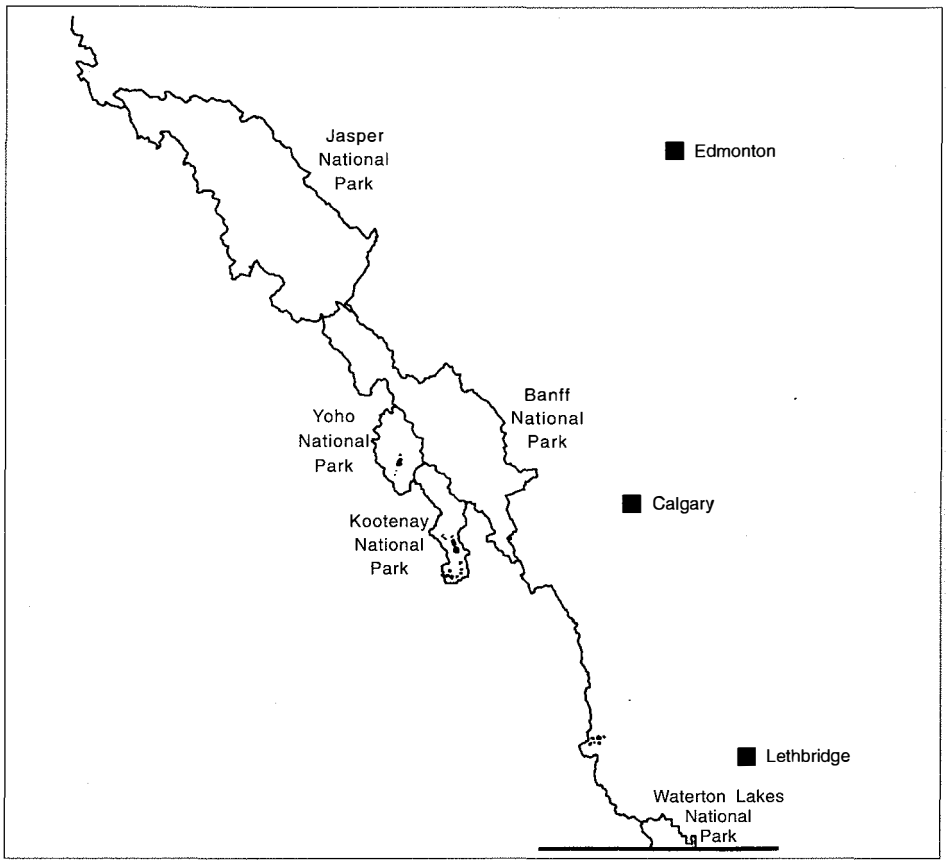

Figure 5. Areas of mountain pine beetle infestation in the Rocky Mountain national parks and southwestern Alberta in 1990.

In **Yoho National Park**, an estimated 110 pine were recently killed by the MPB in 1990 (a number similar to those reported annually since 1985). Five small areas of infestation with 30 newly killed trees occurred near Field, and the remaining dead trees were in small scattered patches between Emerald Lake and the Otterhead River, on the lower east slope of Mount King, and near the mouth of the Ottertail River.

In **Waterton Lakes National Park**, only ground surveys were conducted. No new dead or dying pine attributed to MPB were observed.

Elsewhere, in southern **Alberta** and southwestern **Saskatchewan**, provincial park staff and the Alberta Forest Service again deployed commercial semiochemical tree baits to detect and monitor endemic MPB populations. In the Cypress Hills, 100 tree baits were deployed at about 50 locations in the center and west blocks on the Saskatchewan side, while 199 were deployed at 67 locations on the Alberta side. No 1990 attacks were observed for the second consecutive year in Saskatchewan, while 14 attacks were found on 10 of the baited trees on the Alberta side, an increase from the 8 attacks reported last year. No aerial surveys were conducted this year over the Cypress Hills, but scattered blowdown continued to occur in the mature lodgepole pine forests of the area, providing a probable source for the maintenance of the endemic MPB population. Provincial park personnel in both provinces continued their policy of small-scale removal of the mature pine as part of a long-term strategy to change the age structure and distribution of the pine forests, and thereby reduce their vulnerabilty to the MPB.

Semiochemical tree baits were also deployed in the Crowsnest Pass corridor[4] to detect new infestations at or near the Alberta-British Columbia border. A total of 15 sites were baited (three baits at

[4]Personal communication from H. Ono, Manager, Insect and Disease, Alberta Forestry, Lands and Wildlife, October 1990.

each site). Most attacks occurred at 5 sites, with a total of 38 pine attacked, 19 of which received over 100 attacks each. The attacks were in the area between Blairmore and the British Columbia border. Twenty of the attacked trees were unbaited but adjacent to baited trees. An additional 27 baited and three adjacent unbaited trees were also attacked, but most of these had fewer than 20 attacks each. All the attacked trees have either been removed, or the individual galleries were destroyed. There appeared to be little successful egg laying and egg hatch.

Aerial surveys to detect new tree mortality were conducted by Alberta Forest Service staff in the Kananaskis and adjacent areas, but no new tree mortality attributable to MPB was observed. Two sites were baited, each with 3 baits; one site was located near the Upper Kananaskis Lake, the other near Smuts Creek. A total of 320 attacks were recorded at the sites: most occurred at the Smuts Creek site (an approximate 300% increase in attacks when compared to 1989). Most of the attacks appeared to be unsuccessful.

SPRUCE BEETLE *Dendroctonus rufipennis* (Kirby)

In **Alberta**, an aerial survey was conducted over residual blocks of mature white spruce in the Slave Lake Forest District (about 20 km northwest of Wabasca-Demarais) to map and record recent white spruce mortality caused by the spruce beetle. An estimated 300-400 trees had been killed in several patches throughout the area. A recent windfall of mature white spruce along the margins of residual cut blocks and an additional swath of dead trees across one of the blocks were believed to have provided the food source for a spruce beetle population buildup. A ground inspection revealed that most of the trees had died during the previous 2 to 4 years, and that there were few newly attacked trees in the residual block examined.

Spruce beetle populations were monitored with the use of semiochemical-baited traps in a mature white spruce forest in the Peace River Forest District about 50 km north of Manning. There was an increase in the number of captured beetles in comparison to the 1989 figures. This increase appeared to be related to the severe storm damage that occurred in the stand in early 1989, resulting in a large number of broken tops and stems. Most of the storm-damaged trees were attacked by the spruce beetle in 1990.

In **Manitoba**, several dead and dying 80-year-old planted white spruce were discovered in a plantation in the Turtle Mountains and in a mature white spruce farm shelterbelt in the southwestern part of the province. These trees had low populations of the spruce beetle present around the root collar base, and although the spruce beetle did not appear to be the main cause of mortality, the presence of the beetle probably hastened the trees' decline.

YELLOWHEADED SPRUCE SAWFLY *Pikonema alaskensis* (Roh.)

The yellowheaded spruce sawfly continues to be the most important defoliator of Colorado and white spruce plantings in urban centers, shelterbelts, and some nurseries and plantations, as well as roadside spruce regeneration in many areas of the region.

In **Alberta**, moderate-to-severe defoliation of ornamental plantings was reported in the following urban centers: Edmonton, Calgary, Lethbridge, Red Deer, and Grande Prairie. Similar defoliation was reported in the west-central and northeast parts of the province, in the vicinities of Wabamun, Edson,

Whitecourt, Valleyview, High Prairie, Peace River, Slave Lake, High Level, and Fort Vermilion. In east-central and northeastern Alberta, varying degrees of light-to-severe defoliation were evident in most of the shelterbelts and ornamental spruce plantings that were examined.

In Waterton Lakes National Park, most of the spruce plantings examined in the townsite area were reported to have moderate-to-severe defoliation. This situation has been a perennial problem, and in 1990 some mortality was evident. Light-to-moderate injury was also evident on spruce regeneration at scattered locations along the Cameron Lakes and Red Rock Canyon roads and along Highway 6.

In Banff, Kootenay, Yoho, and Jasper national parks, light-to-moderate defoliation was reported on roadside spruce regeneration along the majority of major highways.

In **Saskatchewan,** scattered pockets of light-to-moderate defoliation were reported. Spruce regeneration was affected in Prince Albert National Park, in the Kingsmere Road and Namekus Lake areas. Similar defoliation was noted in several urban centers in the province.

In the **Northwest Territories**, moderate-to-severe defoliation of ornamental white spruce plantings was reported in the Fort Smith and Hay River areas.

DUTCH ELM DISEASE *Ophiostoma ulmi* (Buis.) Nannf. (= *Ceratocystis ulmi* (Buis.) C. Moreau)

In **Alberta**, surveys to detect the incidence of Dutch elm disease (DED) were conducted primarily by Alberta Agriculture personnel from the Alberta Special Crops and Horticulture Research Centre in Brooks. Pheromone baited traps and elm trap logs were set out at 31 locations throughout southern and central Alberta, and these trap sites were then monitored monthly by the field personnel of Alberta Agriculture and city parks within each of the regions surveyed. Some field monitoring of elm plantings by Forestry Canada (FIDS) personnel contributed to the program. In addition to the above mentioned assistance, Canada Customs Ports of Entry personnel also provided assistance by intercepting elm firewood that was being brought into the province by travelers. In 1990, a considerable number of the intercepted elm firewood logs showed evidence of previous attack by the smaller European elm bark beetle, *Scolytus multistriatus* (Marsh). Several of the adult beetles were cultured for the fungus by NoFC pathology staff, with negative results. No evidence of DED or its insect vectors was found in the pheromone traps or in trap logs in the province in 1990[5].

In **Saskatchewan,** aerial and ground surveys were conducted for the incidence of DED and its bark beetle vectors by personnel from Saskatchewan Parks, Recreation and Culture, with continuing cooperation from Canada's Prairie Farm Rehabilitation Administration (PFRA), and various city and town parks departments. In total, 41 pheromone baited traps were distributed to 25 locations in southern Saskatchewan. During the 1990 survey, along the Souris River south of Estevan, two DED suspect native elm were sampled and confirmed as positive for the fungus. Further investigations in the area determined that 70 American elm plantings were infected in Woodlawn Regional Park, south of Estevan. An additional 20 DED infected elms were found in shelterbelts near the west side of the park. In total, 92 elms were removed and destroyed, and an additional 3 000 high hazard trees have been identified for removal[6].

[5] Personal communication from A. Tellier, Entomology Section, Alberta Special Crops and Horticulture Research Centre, Brooks, Alberta, October 1990.

[6] Personal communication from B. Walter, Insect and Disease Protection Unit, Saskatchewan Department of Parks, Recreation and Culture, Prince Albert, Saskatchewan, October 1990.

In **Manitoba,** DED surveys in 1990 were conducted by the Manitoba Department of Natural Resources. Infections continued to escalate in native elm stands throughout most of the southern part of the province, and during the 1990 DED survey, 14 818 elms were marked for removal. Of this total, 985 trees were diagnosed as being infected with the fungus, and the remaining 13 833 were classified as hazards, the majority of which were decadent and considered capable of supporting elm bark beetle breeding activity. In the city of Winnipeg, 11 088 trees were marked for removal, of which 968 were DED-infected. Other major centers affected with diseased trees included Brandon, Portage la Prairie, Morden, Winkler, Morris, Dauphin, Steinbach, and Selkirk. Most native elms along river channels continued to support high levels of DED, especially along the Red and Assiniboine rivers, the Bayne River near Carman, and the Souris River in the southwestern part of the province. Substantial numbers of diseased trees were reported along the Wilson, Vermilion, and Ochre rivers, located along the northern escarpment area of Riding Mountain National Park[7].

LEAF BEETLES
Gray willow leaf beetle *Tricholochmaea decora* (Say)
Aspen leaf beetle *Chrysomela crotchi* Brown
Other leaf beetles of willow and poplar *Chrysomela* species

There was a marked increase in the 1990 population levels of the gray willow leaf beetle (*T. decora* (Say)). The damage that resulted caused varying degrees of leaf skeletonizing of the willow foliage in many areas of Alberta, Saskatchewan, and the Northwest Territories.

In **Alberta**, moderate-to-severe leaf skeletonizing was evident throughout most of the willow areas surveyed in the west-central and northern half of the province. Foliage injury was especially prevalent in the following general areas: west and north of Rocky Mountain House; along Highway 16 between Edmonton and Hinton; in the Gunn, Whitecourt, Swan Hills, Valleyview, and Peace River areas; along Highway 2 between Grande Prairie and the B.C. border; and at some locations along Highway 35 between Grimshaw and High Level. Similar foliage injury was reported in the Lac la Biche and Fort McMurray areas.

In **Saskatchewan**, extensive moderate-to-severe leaf skeletonizing, caused by the gray willow leaf beetle, was evident in most willow areas surveyed in the central and northern parts of the province.

In the **Northwest Territories**, the gray willow leaf beetle was also responsible for moderate-to-severe leaf skeletonizing that was commonly observed in willow clumps along Highway 1 from Trout River to Fort Simpson, and south along the Liard River to the B.C. border.

In **Alberta**, surveys indicated that one or more willow-and-poplar leaf beetle (*Chrysomela* species) has caused skeletonizing injury to the leaves of regenerated willow and balsam poplar in Banff, Jasper, and Yoho national parks. In Banff National Park, moderate-to-severe leaf injury was noted along Highway 1A between Banff and Johnston Canyon, and in the Banff Centre area. Scattered light-to-moderate leaf injury was observed between Banff and Lake Minnewanka, and along Highway 93 between the Lake Louise junction and the Saskatchewan River Crossing. In Yoho National Park, leaf beetles caused varying degrees of defoliation on regenerated willow and balsam

[7] Personal communication from R. Khon, Forest Protection, Manitoba Department of Natural Resources , Winnipeg, Manitoba, October 1990.

poplar in the Chancellor and Hoodoo campground areas, and at scattered locations along Highway 1 between the west gate and Field. In Jasper National Park, scattered light-to-moderate foliage injury was noted along Highway 93 between Athabasca Falls and Jasper townsite, and along Highway 16 from Jasper to the east gate. In other areas of Alberta, low populations of the leaf beetles caused partial damage in most of the survey areas.

In **Saskatchewan**, most surveys indicated small amounts of damage caused by low populations of the willow and poplar leaf beetles.

In the **Northwest Territories,** leaf beetles caused light leaf injury on balsam poplar, as reported in the Fort Smith, Trout River, Kakisa Lake, and Fort Providence areas.

In **Alberta** and **Saskatchewan**, the infestations of aspen leaf beetle (*C. crotchi*) that occurred in 1989 collapsed in 1990, and only small isolated pockets of defoliation by this beetle were observed during surveys.

SPRUCE NEEDLE RUST *Chrysomyxa ledicola* Lagh.

A marked increase in the incidence and severity of spruce needle rust was reported in 1990 in many areas of the Northwest Region.

In **Alberta**, medium-to-high incidences of infection occurred in spruce stands throughout the central and northern parts of the province. Numerous reports of severe needle discoloration were received from the following forest districts: Rocky-Clearwater, Lac La Biche, Whitecourt, Grande Prairie, Peace River, Footner, and Athabasca forests. Similar infections were also evident along the Edith Cavell road in Jasper National Park and in the Kootenay Crossing-McLeod Meadows area in Kootenay National Park. Scattered light-to-moderate infections were evident on regenerated and pole-sized spruce in Banff, Yoho, and Waterton Lakes national parks.

In **Saskatchewan**, varying infection levels of the spruce needle rust fungus were reported on regenerated spruce in many areas of the central part of the province.

In **Manitoba**, moderate-to-severe infections were reported on white and black spruce near Rennie in Whiteshell Provincial Park.

In the **Northwest Territories**, light infections were common on both white and black spruce throughout their range, which extended as far north as Inuvik.

TERMINAL WEEVILS
Lodgepole terminal weevil *Pissodes terminalis* Hopping
White pine weevil *P. strobi* (Peck)

The incidence of leader mortality caused by terminal weevils in young lodgepole pine stands in Alberta was higher in west-central Alberta in 1990 than in 1989. In young stands south of Hinton, the percentage of trees infested was generally 1-4%, but ranged as high as 8-10% in some blocks. In young pine stands north of Hinton and near Swan Hills, the incidence of damaged leaders was generally lower (approximately 0.5-2.0%). Weevil populations in young jack pine stands north of Meadow Lake and in the Forte à la Corne region of Saskatchewan remained at 1989 levels: usually between 10 and 15% yet as high as 30% in some stands.

A survey was conducted mainly for white pine weevil incidence in a 25-year-old white spruce

Table 5. List of tree hosts of *Armillaria* species, and the number of collections in the three prairie provinces[a]

Host	Basidiocarp				Other[b]					
	A. ostoyae		*A. sinapina*		*A. ostoyae*		*A. sinapina*		*A. calvescens*	
	%	No.	%	No.	%	No.	%	No.	%	No.
Pinus contorta Dougl.	29.0	9	0.0	0	39.7	68	7.1	1	0	0
P. *banksiana* Lamb.	16.1	5	0.0	0	21.6	37	7.1	1	67	2
P. resinosa Ait.	6.4	2	0.0	0	10.0	17	0.0	0	0	0
Picea glauca (Moench) Voss	3.2	1	0.0	0	10.0	17	7.1	1	0	0
P. mariana (Mill.) B.S.P.	0.0	0	0.0	0	0.6	1	0.0	0	0	0
Pseudotsuga menziesii (Mirb.) Franco	0.0	0	0.0	0	0.6	0	0.0	0	0	0
Abies lasiocarpa (Hook.) Nutt.	6.4	2	0.0	0	7.6	13	0.0	0	0	0
A. balsamea (L.) Mill	13.0	4	0.0	0	3.0	5	21.4	3	0	0
Populus balsamifera L.	3.2	1	13.3	2	4.0	7	14.3	2	0	0
P. tremuloides Michx.	3.2	1	20.0	3	0.6	1	14.3	2	33	1
Populus spp.	9.7	3	6.7	1	0.0	0	0.0	0	0	0
Betula papyrifera Marsh.	3.2	1	46.7	7	0.6	1	21.4	3	0	0
Ulmus americana L.	0.0	0	0.0	0	0.0	0	7.1	1	0	0
Alnus sp.	0.0	0	0.0	0	0.0	0	0.6	1	0	0
Shepherdia argentea Nutt.	0.0	0	0.0	0	0.6	1	0.0	0	0	0
S. canadensis (L.) Nutt.	6.4	2	0.0	0	0.6	1	0.0	0	0	0
Salix spp.	0.0	0	13.3	2	0.0	0	0.0	0	0	0
Totals	100.0	31	100.0	15	100.0	171	100.0	14	100	3

[a]Mallett (1990); reproduced with permission from the National Research Council of Canada.
[b]Isolations from symptomatic or dead trees.

stand near the southern edge of Duck Mountain, Manitoba. The stand, originally a naturally grown spruce-aspen stand, was treated manually during the summer of 1987 to remove all aspen overstory, and thereby hasten the release of white spruce. A preliminary assessment of the results of the survey indicated an increase in the number of leaders attacked by *P. strobi*, and that most of the attacks were initiated in 1990. The area will be resurveyed periodically to determine if the weevil attacks are influenced by the aspen cover removal treatment.

A number of young white spruce plantations on the west side of the Duck Mountains were also examined for weevil injury. Evidence indicates that some of the plantation trees that are now more than 20 years old have experienced a long history of repeated attacks; these spruce may no longer develop into commercially usable trees.

ARMILLARIA ROOT ROT
Armillaria species

Armillaria root rot is a common and important disease of trees in the three prairie provinces; it causes significant mortality in some young stands of lodgepole, jack, and red pine. An extensive study was completed in 1990 to determine the *Armillaria* species present, their host tree species, and geographical distribution in the prairie provinces[8]. Three species were found: *A. ostoyae* (Romagn.) Herink; *A. sinapina* Bérubé and Dessureault; and *A. calvescens* Bérubé and Dessureault. Their geographic range is shown in Figure 6, and tree hosts are listed in Table 5. *Armillaria ostoyae* was the most common species in the boreal and subalpine forests and occurred on a variety of coniferous and deciduous host species. *Armillaria sinapina* was found in both the boreal and subalpine forests but primarily on deciduous hosts. *Armillaria calvescens* was rare and found only in the boreal forest on coniferous and deciduous hosts.

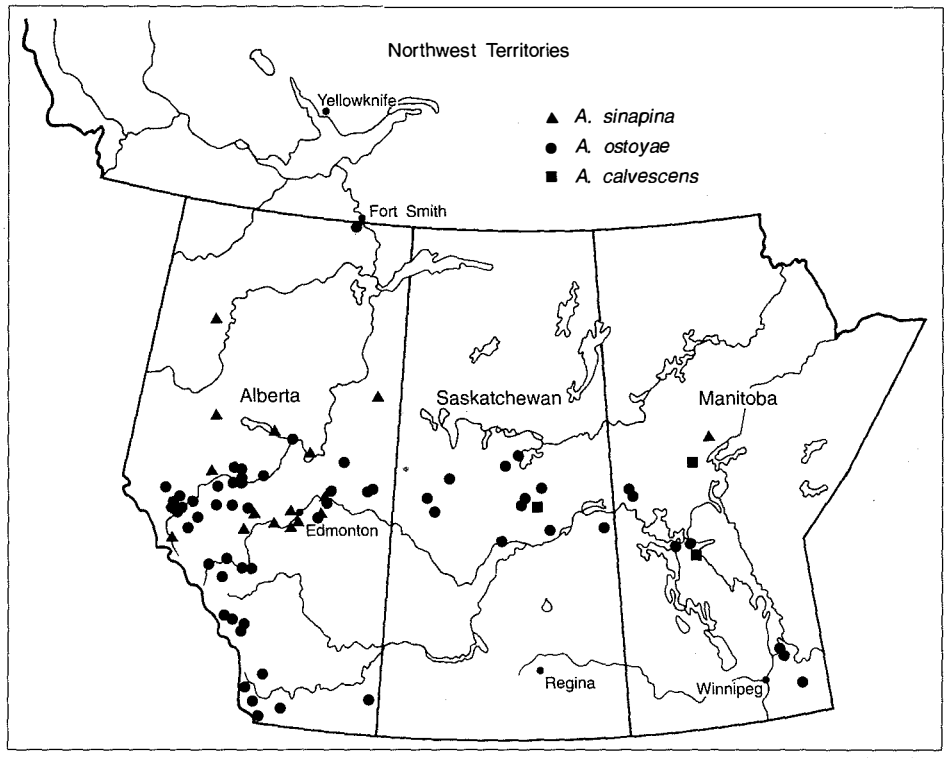

Figure 6. Distribution of *Armillaria* species in the prairie provinces.

In 1990, numerous reports were received of dead and dying balsam fir (*Abies balsamea* (L.) Mill.), especially in the Slave Lake and Lac La Biche forest districts of Alberta. The cause of this mortality has not been determined, but Armillaria root rot was found in the roots of some of the dying trees.

[8] Mallet, K.I. 1990. Host range and geographical distribution of Armillaria root rot for pathogens in the Canadian Prairie Provinces. Can J. For. Res. 20:1859-1863.

Table 6. Tree pest extension diagnoses of the 14 most important tree damage agents summarized by the frequency of client requests

Damage agent and tree hosts	Origin of client request			
	Urban	Shelterbelt	Park	Natural forest
Winter frost damage Spruce, juniper, cedar, apple	100	35	--[a]	--
Chemical injury Various species	100	10	12	10
Fireblight Apple, plum, mountain-ash	120	--	--	--
Aphid species Many species	80	15	14	--
Leaf-mining sawflies Birch	70	--	15	8
Spruce sawflies Spruce	60	10	15	6
Spruce spider mite Spruce, cedar, juniper	80	11	--	--
Foliage diseases Aspen, poplar	12	20	35	21
Silverleaf Mountain-ash, apple, cherry, plum, cotoneaster	80	--	--	--
Terminal weevils Spruce, pine	35	15	10	27
Spruce needle rust Spruce	4	10	19	30
Pitch moth Spruce, pine	59	--	--	--
Spruce gall aphids Spruce, Douglas-fir	30	11	11	7
Needle casts Pine, spruce	16	10	9	7

[a] Indicates no requests.

TREE PEST EXTENSION HIGHLIGHTS

In 1990, a total of 2 249 tree pest extension inquiries (Table 6) were responded to by telephone, correspondence, on-site inspection, or personal consultation at the Northern Forestry Centre, when specimens were brought for analysis to NoFC by clients.

On coniferous species, the major insect problems were the yellowheaded spruce sawfly, spruce spider mite, white pine weevil, a clearwing moth, and aphid species. On deciduous tree species, the major insect pests were birch leaf-mining sawflies, forest tent caterpillar, Bruce spanworm, canker-worms, scale insects, an oak gall wasp, and an apple leaf miner.

Infectious disease problems caused concern in many locations. The most important problems included fireblight, silverleaf, needle rusts, needle casts, septoria canker, and leaf rusts and leaf spot

diseases of poplars. Noninfectious problems, such as the misuse of chemicals (e.g., road salts, herbicides, fertilizers, and soil sterilants) continued to escalate during 1990. Frost damage and winter drying were also common problems. The majority of the above mentioned problems are listed as noteworthy insects, diseases, and other damage agents in Appendix 1.

Assistance was provided to the Canadian Parks Service in Jasper National Park to rate stand health and to assess hazards of trees in high-use areas, including major campgrounds and the townsite. This survey had several components: assessment of the general health of the forest cover; identification of potentially hazardous trees with a high risk of blowdown; identification of fuel loads; and an assessment of forest regeneration.

ACID RAIN MONITORING

The Acid Rain National Early Warning System (ARNEWS) was established in 1984 to detect early signs of acid rain damage to forests. There were 12 permanent sampling plots established in the Northwest Region: 5 in Alberta, 3 in Saskatchewan, and 4 in Manitoba. One of the plots (Plot No. 804) identified as Suwannee River, Manitoba, was destroyed by forest fire in 1989, and a new site was chosen in 1990, in which to establish a replacement plot. The ARNEWS plots in the Northwest Region are part of a permanent nationwide network of plots where changes in soil, minor vegetation, tree condition, and tree growth are detected and monitored.

In 1990, all of the 11 regional plots were visited once, and some were visited twice. All plots were assessed to provide a complete 5-year data base of information. For each tree component the assessment included: radial and vertical tree growth measurements; tree crown structure and density; tree mortality; and tree condition related to any insect or disease, to acid rain, or to other damage agent symptoms (Forms 3, 4, 7, 8, 9, 10, and 12)[9]. Soil and foliage sample materials were also collected from each plot to provide qualitative and quantitative assessment of soil profile characteristics and chemical nutrients, in accordance with ARNEWS Forms 11A and 11B. Regeneration and ground vegetation surveys were completed for each plot and their results summarized on ARNEWS Forms 5 and 6. The plot and tree data will be submitted to the Petawawa National Forestry Institute for analysis.

No injury attributable to acid rain symptoms was identified in any of the plots in 1990.

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APPENDIX 1

NOTEWORTHY INSECTS, DISEASES, AND OTHER DAMAGE AGENTS

Insect, disease, or damage agent	Host	Location	Remarks
Aspen leafroller *Pseudexentera oregonana* Wlsm.	Aspen	Alberta Manitoba	Light-to-moderate leaf injury noted in many areas of northern Alberta, often in association with forest tent caterpillar and large aspen tortrix. Light-to-moderate damage in Bird's Hill Provincial Park, and near Lundar, Ashern, and Pine Falls, Manitoba.
Atropellis canker *Atropellis piniphila* (Weir) Lohman & Cash	Pine	Alberta Saskatchewan	Infections in Cypress Hills in Saskatchewan and Alberta, in the Kananaskis area and in Waterton Lakes, Banff, and Jasper national parks.
Birch leaf miners *Fenusa pusilla* (Lep.) *Profenusa thompsoni* (Konow)	Birch	Alberta	Moderate-to-severe damage on ornamental birch in most urban centers. Moderate-to-severe mining in some native stands in Yoho and Jasper national parks.
Black knot of cherry *Apiosporina morbos* (Schw.) Arx	Mayday Chokecherry	Alberta Saskatchewan	Infections continue to occur on urban plantings. Very common on chokecherry in natural stands in Alberta. Common-to-high incidence in Saskatchewan.
Blowdown	Pine Spruce	Alberta Saskatchewan	Found in some areas along the Yellowhead Highway, and along the east slope of Pyramid Mountain in Jasper National Park. Some blowdown noted in Meadow Lake Provincial Park, Saskatchewan.
Boxelder leafroller *Caloptilia negundella* (Chambers)	Manitoba maple	Saskatchewan	Moderate-to-severe defoliation reported in Prince Albert, Nipawin, and Saskatoon.
Bronze birch borer *Agrilus anxius* Gory	Birch	Alberta Manitoba	Light damage on ornamental plantings in Red Deer and Edmonton. Some infested trees removed from Riding Mountain National Park, Manitoba.
Cankerworms *Alsophila pometaria* (Harris) *Paleacrita vernata* (Peck)	Elm Maple Green ash	Alberta Saskatchewan	Variable infestation levels reported throughout mid-central and southern Alberta. Moderate-to-severe infestations in Saskatoon and Regina.
Ceratocystis canker of aspen *Ceratocystis fimbriata* Ell. & Halst.	Aspen	Alberta	Some canker infections reported in Whistler's Campground in Jasper National Park.
Chemical injury	Many hosts	Alberta Saskatchewan	A continuous and escalating problem in some urban and rural areas.
Comandra blister rust *Cronartium comandrae* Pk.	Pine	Alberta Saskatchewan	Infestations fairly common in Banff and Jasper national parks. Localized infections common in Saskatchewan.

NOTEWORTHY INSECTS, DISEASES, AND OTHER DAMAGE AGENTS *continued*

Insect, disease, or damage agent	Host	Location	Remarks
Cottonwood leafmining beetle *Zeugophora scutellaris* Suffrian	Poplar	British Columbia Alberta Saskatchewan	Infestation appears to be increasing in most areas surveyed. Widely scattered light damage in Sasakatchewan.
Cystospora canker *Cystopora chrysosperma* (Pers.) Fr.	Mountain-ash Poplar	Alberta Saskatchewan	Becoming increasingly more common on urban plantings affected by sunscald and frost injury. Common in native poplar stands.
Douglas-fir beetle *Dendroctonus pseudotsugae* Hopkins	Douglas-fir	British Columbia Alberta	Mature trees attacked in Kootenay, Jasper, and Yoho national parks.
Drought injury	Aspen	Alberta Saskatchewan	Contributing factor in increased mortality in south-central Alberta and southern Saskatchewan.
Dwarf mistletoe *Arceuthobium americanum* Nutt. ex Engelm. Pk.	Pine	NWT Alberta Saskatchewan	Common in most native pine stands across the region, causing some mortality.
European alder leafminer *Fenusa dohrnii* (Tischbein)	Alder	British Columbia Alberta Saskatchewan NWT	Light-to-moderate mining noted in Kootenay, Yoho, and Jasper national parks. Light injury noted throughout Alberta, Saskatchewan, and the NWT.
Fire blight *Erwinia amylovora* (Burr.) Winsl. et al.	Apple Mountain-ash	Alberta Saskatchewan	A significant increase in infections were evident on urban plantings. Occasional reports of this disease in Saskatchewan.
Frost & winter injury	Spruce Apple	Alberta Saskatchewan	Light-to-severe bud injury reported on spruce in some urban centers and in some areas in northeastern Alberta.
Gypsy moth *Lymantria dispar* (Linnaeus)	Many hosts	Manitoba	One male moth captured in a pheromone trap at Lakeside Campground on Falcon Lake, Whiteshell Provincial Park. Moths also captured in adjacent Ontario at Quetico, Caliper, Sioux Narrows, and Blue Lake provincial parks.
Hail damage	Pine	Alberta	About 3 500 ha of forests affected. Trees show reddish-brown foliage, and about 80% of branch terminals have bark lesions.
Hare damage	Pine	Alberta Saskatchewan NWT	Light-to-moderate damage to pine in many areas, especially northern Alberta and NWT.
Honeysuckle aphid *Hyadaphis tataricae* (Aizenberg)	Honeysuckle	Alberta Saskatchewan	Severe injury common throughout both provinces.

NOTEWORTHY INSECTS, DISEASES, AND OTHER DAMAGE AGENTS *continued*

Insect, disease, or damage agent	Host	Location	Remarks
Hypoxylon canker *Hypoxylon mammatum* (Wahl.) Miller	Aspen	Alberta Saskatchewan NWT	Infections common in native aspen stands throughout the region; cause of some mortality in native aspen stands on the University of Calgary campus.
Ink spot *Ciborinia whetzelii* (Seavae) Seaver	Aspen	Alberta	Light, scattered patches of infections common between Grande Prairie and Grande Cache.
Jackpine budworm *Choristoneura pinus* Freeman	Pine	Alberta Saskatchewan Manitoba	Low populations evident north of Clyde, Alberta, and in central Saskatchewan. Manitoba Natural Resources predict light defoliation at Pineland, Nopiming Provincial Park, Devil's Lake, Wicked Point and The Pas.
Larch sawfly *Pristiphoria erichsonii* (Hartig)	Larch	Alberta Saskatchewan NWT	Caused moderate-to-severe defoliation of tamarack stands near Fort Smith, but low populations in most other areas of the NWT. Light-to-moderate defoliation occurred near Loon and Wabasca rivers, Alberta. Light incidence in Saskatchewan.
Lilac leafminer *Gracillaria syringella* (Fabricius)	Lilac	Alberta Saskatchewan	A slight increase in leaf mining injury evident on ornamental plantings in most urban centers.
Northern lodgepole needleminer *Coleotechnites starki* (Freeman)	Pine	Alberta	Caused an increase in damage at Saskatchewan River Crossing and light damage on Mount Norquay, Banff National Park.
Northern tent caterpillar *Malacosoma californicum pluviale* (Dyar)	Poplar Chokecherry Willow	Alberta Saskatchewan Manitoba NWT	Common along roadsides in many areas. High populations on willow, for the third consecutive year at Norman Wells, NWT. Parasitized cocoons and virus-infected larvae were collected. Moderate-to-severe damage occurred near Nopiming Lake, Manitoba.
Pear sawfly *Caliroa cerasi* (Linnaeus)	Hawthorn Cotoneaster Pin cherry	Alberta	Moderate-to-severe leaf skeletonizing in Grande Prairie and Fort McMurray.
Pine needle casts *Lophodermella concolor* (Dearn.) Darker *Davisomycella ampla* (Davis.) Darker *Elytroderma deformans* (Weir) Darker	Pine	Alberta Saskatchewan	High incidence of *L. concolor* in shelterbelts and on ornamentals in the Red Deer, Edmonton, Grande Prairie, Rocky Mountain House, and Caroline areas. Light infections present in the forested areas of the provinces. *D. ampla* and *E. deformans* infections remained light.
Pine needle scale *Chionaspis pinifoliae* (Fitch)	Spruce Pine	Alberta Saskatchewan	Low-to-medium infections in some areas.

NOTEWORTHY INSECTS, DISEASES, AND OTHER DAMAGE AGENTS *continued*

Insect, disease, or damage agent	Host	Location	Remarks
Pitch blister moths *Petrova albicapitana* (Busck) *Petrova metallica* (Busck)	Pine	Alberta Saskatchewan NWT	Light damage common in some lodgepole pine plantations in Alberta. Similar injury to young jack pine stands in NWT. Light, scattered infestations found in Saskatchewan.
Poplar borer *Saperda calcarata* Say	Aspen	Alberta Saskatchewan	Common in aspen stands near new housing developments.
Poplar leaf rusts *Melampsora medusae* Theum. *Melampsora occidentalis* Jacks.	Aspen Poplar	Alberta Saskatchewan	High infection levels reported in most native stands examined.
Poplar leaf spots *Marssonina populi* (Lib.) Magn. *Marssonina tremuloides* Kleb. *Mycosphaerella populicola* G.E. Thompson *Linospora tetraspora* G.E. Thompson	Aspen Poplar	Alberta Saskatchewan	Common in most native stands examined in both provinces. Attributed to excessively wet conditions occurring in the early part of the season.
Poplar serpentine leafminer *Phyllocnistis populiella* Chambers	Aspen	British Columbia Alberta Saskatchewan NWT	Leaf-mining common in most areas surveyed in Alberta. A marked decline in leaf-mining damage from that reported in 1989 in the NWT. Extensive leaf injury in Yoho National Park. Light-to-moderate scattered infestations in Saskatchewan.
Poplar vagabond aphid *Mordwilkoja vagabunda* (Walsh)	Aspen Poplar	Alberta Saskatchewan NWT	Light infestations common in young aspen in Northern Alberta. Common at several locations in Jasper National Park. Light damage in Saskatchewan Landing Provincial Park north of Swift Current. Moderate infestations were associated with forest tent caterpillar outbreak areas in Saskatchewan.
Porcupine damage	Pine Spruce Apple Birch	Alberta Saskatchewan	Caused pine mortality at several locations in Yoho and Jasper national parks and girdling injury to planted spruce, birch, and apple in Edmonton. Porcupine damage common in Saskatchewan.
Rusty tussock moth *Orgyia antiqua* (Linneaus)	Willow Caragana	Alberta NWT	Cause of light defoliation on willow at Inuvik, and of moderate defoliation on caragana in Grande Prairie.
Scale insects *Parthenolecanium corni* (Bouche) *Lepidosaphes ulmi* (Linneaus)	Poplar Elm Cotoneaster	Alberta Saskatchewan	Medium-to-high infestation levels on host plants in many urban centers. Cause of some branch mortality on poplars at the University of Saskatchewan, Saskatoon.

NOTEWORTHY INSECTS, DISEASES, AND OTHER DAMAGE AGENTS *continued*

Insect, disease, or damage agent	Host	Location	Remarks
Septoria canker *Mycosphaerella populorum* G.E. Thompson	Poplar	Alberta Saskatchewan	Caused infections on branches and stems of hybrid poplars in many shelterbelts in central Alberta and Saskatchewan. Foliage infections occurred on native poplars in Banff and Jasper national parks.
Silverleaf *Stereum purpureum* (Pers.; Fr.) Fr.	Apple Mountain-ash Nanking cherry Cotoneaster	Alberta Saskatchewan	A slight increase in infection levels reported in both provinces in 1990.
Smaller European elm bark beetle *Scolytus multistriatus* (Marsham)	Elm	Alberta	Adult beetles found in elm firewood logs at Chief Mountain Customs Port, Waterton Lakes National Park.
Spruce bud midge *Rhabdophaga swainei* Felt	Spruce	Alberta Saskatchewan	Common on young spruce, naturally grown and in plantations in Alberta. Light infestations occurred in Saskatchewan.
Spruce cone rust *Chrysomyxa pirolata* Wint.	Spruce	Alberta Saskatchewan NWT	Infected cones at scattered locations throughout the provinces. Found on white spruce near Inuvik, NWT.
Spruce gall aphids *Adelges cooleyi* (Gill.) *A. lariciatus* (Patch)	Spruce Douglas-fir	Alberta Saskatchewan Manitoba NWT	Very common in most surveyed areas. Present on the alternate host, Douglas-fir, in Kootenay, Yoho, and Jasper national parks. Light damage common throughout the NWT. An increase in the incidence of attacks noted in Saskatchewan. High infestations south of Duck Mountain Provincial Park, Manitoba.
Spruce gall mite *Mayetiola piceae* (Felt)	Spruce	Alberta Saskatchewan NWT	Moderate damage near Fort Smith area, and along the Kakisa and Trout rivers west of Enterprise, NWT. Small pockets of moderate damage between Red Earth and the Wabasca River, Alberta. Light damage reported on plantings in Edmonton, Red Deer, and Lethbridge, and in Saskatchewan.
Spruce spider mite *Oligonychus ununguis* (Jacobi)	Spruce Pine Cedar Douglas-fir	Alberta Saskatchewan	Common in most urban areas on open-growth planted trees.
Spruce needle cast *Lirula macrospora* (Hartig) Darker	Spruce	Alberta Saskatchewan	Low-to-medium infections occurred along the Bow and Kananaskis rivers. Light damage noted in Yoho, Banff, and Jasper national parks.
Spruce shoot rust *Chrysomyxa woroninii* Tranz.	Spruce	Alberta	Light infections found on black spruce and on Engelmann spruce (at 1 524 m elevation) near Hinton.

NOTEWORTHY INSECTS, DISEASES, AND OTHER DAMAGE AGENTS *continued*

Insect, disease, or damage agent	Host	Location	Remarks
Squirrel damage	Pine	Alberta Saskatchewan NWT	Light branch flagging injury resulted from cone clipping at many areas in northern Alberta, Saskatchewan, and NWT. Young lodgepole pine stems were girdled near Hinton, Alberta.
Stalactiform blister rust *Cronartium coleosporioides* Arth.	Pine	Alberta	Infections common at Saskatchewan River Crossing, Banff National Park; between Jasper townsite and Athabasca Falls; between Jasper townsite and the east gate of the park; and along Cameron Lake road in Waterton Lakes National Park. Low incidence near Kakwa fire tower northeast of Grande Cache.
Tar spot on willow *Rhytisma salicinum* (Pers.) Fr.	Willow	Alberta	Light infections in northeastern Alberta.
Twig blight or canker *Stigmina negundinis* (Berk. & Curt.) M.B. Ellis	Manitoba maple	Alberta	Caused branch cankers on trees in farm shelterbelts near Evansburg.
Two-year-cycle budworm *Choristoneura biennis* Freeman	Spruce	British Columbia Alberta	Low populations found at Yuma Creek, Kootenay National Park and in Banff National Park near Saskatchewan River Crossing.
Ugly-nest caterpillar *Archips cerasivorana* (Fitch)	Chokecherry	Alberta Saskatchewan	Caterpillar tents were common in the east-central area of Alberta, but were widely scattered in Saskatchewan.
Warren root collar weevil *Hylobius warreni* Wood	Pine	Alberta	Common incidence in lodgepole pine plantations in Virginia Hills and Fox Creek areas; cause of up to 7% tree mortality.
Western gall rust *Endocronartium harknessii* (J.P. Moore) Y. Hiratsuka	Pine	Alberta Saskatchewan NWT	Common in native stands throughout both provinces and NWT. Occurs on some native pine planted in urban centers.
White trunk rot or false tinder conk *Phellinus tremulae* (Bond.) Bond. & Boriss	Aspen	Alberta Saskatchewan NWT	Common in most native stands across the region.
Willow leafminer *Micrurapteryx salicifoliella* (Chambers)	Willow	Alberta NWT	Scattered patches of light-to-moderate damage fairly common in northern Alberta and NWT. Moderate-to-severe damage widespread in northern Saskatchewan.
Willow leaf rust *Melampsora epitea* Thuem.	Willow	Alberta Saskatchewan NWT	Common in Alberta and Saskatchewan, and near Inuvik and Yellowknife, NWT.
Willow pinecone gall midge *Rhabdophaga strobiloides* (Osten Sacken)	Willow	Alberta Saskatchewan NWT	Common in most areas surveyed.

NOTEWORTHY INSECTS, DISEASES, AND OTHER DAMAGE AGENTS *concluded*

Insect, disease, or damage agent	Host	Location	Remarks
Willow redgall sawfly *Pontania proxima* (Lepeletier)	Willow	Alberta Saskatchewan	Light infestations common.
Woolly elm aphid *Eriosoma americanum* (Riley)	Elm	Alberta Saskatchewan	Common on boulevard and landscape trees in most urban centers in Alberta. Low incidence of leaf injury in Saskatchewan.
Yellow witches' broom *Chrysomyxa arctostaphyli* Diet.	Spruce	Alberta Saskatchewan Manitoba NWT	Common in many mature and semi-mature stands.
Bark beetles *Dryocoetes affaber* (Mann.) *Dryocoetes autographus* Ratz. *Dendroctonus punctatus* LeC. *Dendroctonus rufipennis* Kby. *Polygraphus rufipennis* Kby. *Scolytus piceae* (Swaine)	Spruce	Alberta Saskatchewan Manitoba	*D. affaber* caused some mortality to overmature shelterbelt plantings. The species, *D. autographus, D. punctatus, D. rufipennis,* and *P. rufipennis* were all associated with dying 80-year-old planted spruce in the Turtle Mountains, Manitoba. Low populations of *S. piceae* were reported in the Red Deer and Lethbridge areas.
Defoliator sawflies *Nematus* sp. *Neodiprion* sp. *Xyela bakeri* Konow	Pine Willow	Alberta Saskatchewan	The *Nematus* sp. caused light scattered infestations in Alberta on willow. Low populations of the *Neodiprion* sp. occurred on pine in Banff National Park, between Edson and Carrot Creek, Alberta, and at scattered locations in Saskatchewan. Medium-to-high populations of *X. bakeri*, a pollen-feeding sawfly, were found on pine in Banff National Park.
Leaf-mining lepidoptera *Lyonetia* sp. *Phyllonorycter* sp.	Apple Aspen Poplar Willow	Alberta	The *Lyonetia* sp. caused injury to leaves of apple, poplar, and willow, while the *Phyllonorycter* sp. caused severe mining injury to aspen and poplar in Yoho National Park, but light injury in Banff, Kootenay, Waterton Lakes, and Jasper national parks.
Miscellaneous insects and mites *Aceria* nr. *dispar* (Nalepa) *Callirhytis* nr. *flavipes* (Gill. *Coleophora* sp.) *Lepyrus* sp. *Reticulitermes* sp.	Aspen Birch Oak Willow	Alberta Saskatchewan Manitoba	Injury on aspen, caused by a gall-forming mite *A* . nr. *dispar*, was fairly common in Alberta. A gall wasp, *C.* nr. *flavipes*, caused injury to oak in Alberta and appears to be increasing. The casebearer, *Coleophora* sp., caused light injury to birch in Edmonton and at scattered locations in Saskatchewan. An infestation of a leaf-feeding weevil, *Lepyrus* sp., on willow occurred along the Athabasca River near Fort McMurray. A termite, *Reticulitermes* sp., caused damage to old foundations and new wood structures in 9 houses in Winnipeg.