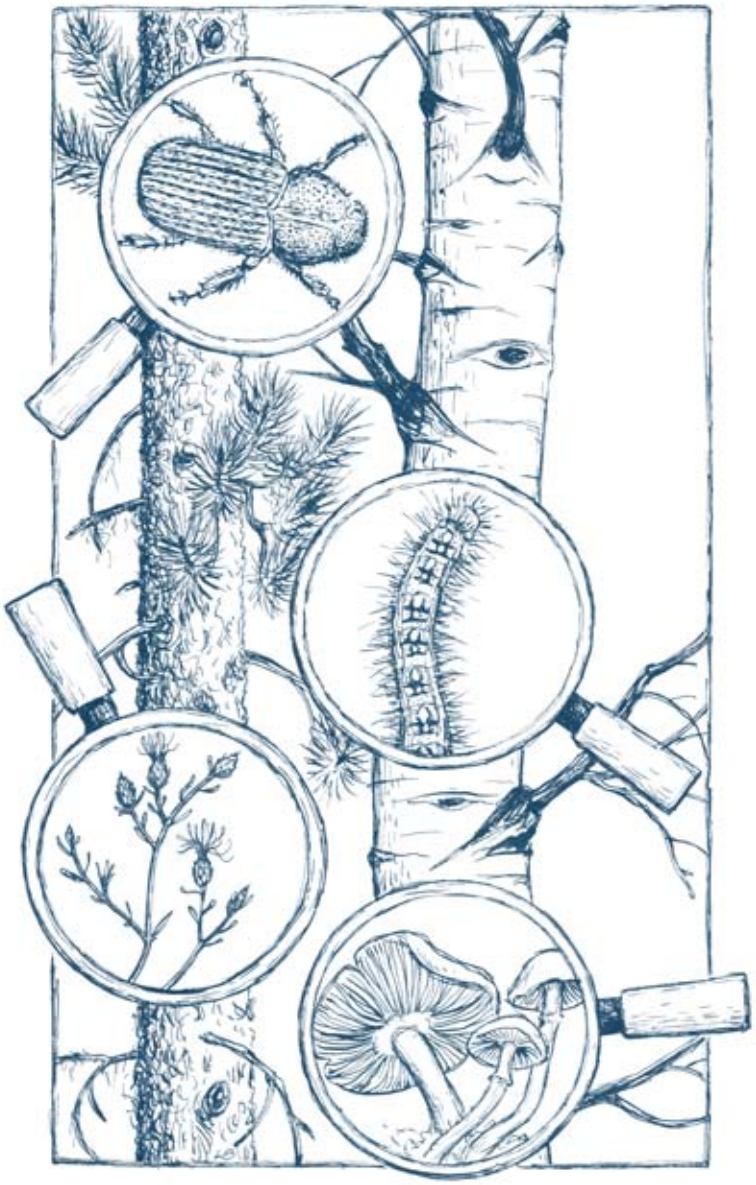
2003
Annual Report



Forest Health in Alberta

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2003 Annual Report

Alberta
SUSTAINABLE RESOURCE DEVELOPMENT

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Forest Health Vision

A healthy, sustainable forest landscape that fulfils the social, economic and environmental aspirations of all Albertans.

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Note: The mention of certain products does not necessarily imply their endorsements, nor does the exclusion of other products necessarily imply their disapproval by Alberta Sustainable Resource Development.

Acknowledgements

Sunil Ranasinghe, Forest Entomologist of Alberta Sustainable Resource Development (SRD), Public Lands and Forests Division, compiled this report. It is based on the annual reports submitted by the Regional Forest Health Officers: Tom Hutchison (Northeast Corporate Region), Erica Lee and Daniel Lux (Southwest Corporate Region) and Mike Maximchuk (Northwest Corporate Region). Mike Undershultz, Forest Health Officer (Forest Health Section) provided the details about the provincial invasive plant (noxious and restricted weeds) program. Christine Kominek, Forest Health Officer and Cody Crocker, Data Management Technologist (Forest Health Section) finalized the forest health data and pest distribution maps presented in this report.

Janet Feddes-Calpas of Alberta Agriculture, Food and Rural Development, provided an update on Dutch elm disease. Christopher Saunders, an entomologist with the Community Services of the City of Edmonton, provided information on urban forest pests.

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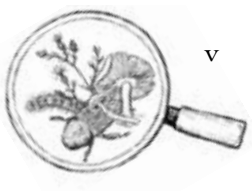


Summary

This annual report contains details of forest insect pests, diseases, and invasive plants in Alberta in 2003. Reported here are the results of the aerial and ground surveys of pest infestations; pest management programs; invasive plant management programs; training and increased awareness on forest health issues; and research and development carried out under the Forest Health Program of the Department of Sustainable Resource Development (SRD). In addition, the details of urban forest pests and Dutch elm disease program are also reported.

Given below is a summary of the extent of major forest pest infestations surveyed in 2003:

Pest Species	Extent of Infestation
Spruce budworm	124 815 ha net area and 33 443 ha gross area
Mountain pine beetle	• An estimated 6950 green-attack trees in Banff National Park (2725 removed) • 1013 green-attack trees in provincial parks and protected areas (1009 removed) • 303 infested trees within municipal and private lands (all 303 removed)
Aspen defoliators	5 414 276 ha gross area

The net defoliation by the spruce budworm, *Choristoneura fumiferana* (Clem.) in the inventoried forested Crown land decreased from an estimated 159 456 ha in 2002 to 124 815 ha in 2003. However, there was an increase of gross defoliation in non-inventoried forested Crown land from an estimated 23 658 ha in 2002 to 33 443 ha in 2003. New areas with budworm defoliation were detected during aerial overview surveys carried out in the Northwest Corporate Region. An ongoing extensive spruce budworm defoliation in Wood Buffalo National Park was mapped in 2003. The risk of new spruce budworm outbreaks occurring in 2004 has decreased in the Lac La Biche Corporate Area but remains relatively high in the Waterways Corporate Area in the Northeast Corporate Region. This risk is mostly low in the Northwest Corporate Region except in the Upper Hay Corporate Area. The risk of two-year cycle budworm outbreaks occurring in 2005 is low in the Southwest Corporate Region.

Seventeen trees with red crowns symptomatic of mountain pine beetle attack were detected in the Bow Valley during aerial overview surveys over the Southwest Corporate Region. In addition, 10 red-attacked trees were also observed in Willmore Wilderness Park. Approximately 4880 red-attacked trees were found during aerial overview surveys conducted over Banff National Park. Twelve beetle-killed trees were observed in Miette Valley in Jasper National Park. No beetle-killed trees were found either in Waterton National Park or in Cypress Hills Provincial Park.

The number of mountain pine beetle green-attack trees reported herein are those recorded in 2002/2003. An estimated 6950 green-attack trees were detected in Banff National Park. Out of these, 4150 green-attack trees were located within the beetle management zone and an additional 2800 green-attack trees were found within the beetle monitoring zone in this park. The beetle populations in Jasper National Park remained low in 2002/2003. However, due to increasing beetle pressure from B.C. the south-facing slopes near the west gate of Jasper National Park are at a higher risk of mountain pine beetle infestations in 2003/2004. During ground surveys carried out in areas around Canmore, 1013 green-attack trees were detected. In addition, another 303 green-attack trees were detected in the Town of Canmore by the municipal authorities and private developers.

Most of the mountain pine beetle monitoring plots with pheromone-baited trees set up in the Southern Rockies Corporate Area had beetle-hits; as well, beetles attacked some non-baited trees in the vicinity. Few monitoring plots in the Clearwater and Foothills corporate areas had beetle hits but both plots located in Willmore Wilderness Park were attacked. A new monitoring plot set up at Kakwa Wildland Provincial Park had beetle hits, making this the northernmost point of mountain pine beetle occurrence recorded in Alberta. Many beetle monitoring plots in Cypress Hills Provincial Park had beetle hits albeit at low numbers.

The 2003 mountain pine beetle management program of SRD composed of preventive measures to stop introduction of the beetle into susceptible forest stands and direct control measures to stop spread of the beetle. The Ministerial Order 12/2003 prohibiting transportation of pine wood and wood products with bark was enforced in cooperation with Alberta Transportation. There were no intercepts of unauthorized log movement in 2003 compared to 18 intercepts made in 2002.

Nearly 100% of the 1013 green-attack trees detected during the surveys were removed from the forested Crown land under a control program developed and implemented by the SRD in collaboration with other stakeholders. This program included surveys, public reviews and control actions over five beetle management units. The Town of Canmore and private developers removed a further 303 beetle-infested trees within their areas of interest.

Banff National Park authorities burnt 4420 ha of beetle susceptible forest stands and removed 2725 infested trees. They also baited an additional 524 trees to contain the infestation. In combination, these measures contributed immensely towards reducing the beetle pressure on adjoining provincial lands.

Yellowheaded spruce sawfly, *Pikonema alaskensis* (Rohwer), continued to affect spruce plantations grown on reclaimed sites in the Northeast Corporate Region. Aerial spraying was used to successfully control this pest.

The large aspen tortrix (LAT), *C. conflictana* (Walker), defoliation was scattered over a gross area of about 5.4 million ha. This infestation continued to move eastwards toward Saskatchewan border in the Northeast Corporate Region. The forest tent caterpillar, *Malacosoma disstria* Hübner, defoliation was mostly indistinguishable from the predominant large aspen tortrix-defoliation where overlapping populations of these two species were observed.

Aspen two-leaf tier, *Enargia decolor* (Walker), an occasional pest of broadleaf trees was widespread in the Northeast Corporate Region.

No gypsy moths were trapped in 2003 in pheromone-baited traps deployed by the SRD under Canadian Food Inspection Agency's (CFIA) gypsy moth monitoring program. However, four gypsy moths were trapped in two traps deployed by the City of Edmonton under this CFIA program.

The smaller European elm bark beetle (SEEBB), *Scolytus multistriatus* (Marsham), a vector species of Dutch elm disease (DED) continued to be trapped at many locations in the non-forested area of the province. The number of SEEBB trapped in the province increased in 2003 compared to 2002. No native elm bark beetles, *Hylurgopinus rufipes* (Eichoff), have been trapped in Alberta.

Alberta remains free of DED. However, there were many incidences of a similar vascular wilt disease, *Dothiorella ulmi*, affecting elm trees in the City of Edmonton.

The gray willow leaf beetle, *Tricholochmaea decora* (Say), damage declined in the Northeast Corporate Region. Ash leaf cone caterpillar, *Caloptila fraxinella* (Ely), damaged ash trees at a few locations in this region. The red elm weevil, *Magdalis armicollis* (Say), damaged some elm trees in Edmonton. The continuing drought conditions weakened many trees in the urban forest and exacerbated insect pest damage. The City of Edmonton lost nearly 4000 black ash trees due to 2003 drought.

The SRD formed an invasive species committee to unify invasive species management. The department also co-organized a well-received international conference on invasive plants.

The regional invasive plant management programs included meetings, information packages, public lectures and workshops to provide education and increase awareness. As well, cooperative initiatives such as sharing of contracts among stakeholders, shared databases and inventory surveys, and operational weed management working groups were used to efficiently manage invasive plants.

Invasive plant surveys were carried out in Ghost Area, Kananaskis Country, Livingstone Area, Castle Area and Porcupine Hills of the Southwest Corporate Region; north and west of Manning, west of Hines Creek, north of McLennan, and near Haig Lake in the Northwest Corporate Region; and, at 209 sites including waste transfer and landfill sites and pockets of White Area vacant Crown land in the Northeast Corporate Region. The invasive plant species encountered were: wild caraway (*Carum carvi*), field scabious (*Knautia arvensis*), common toadflax (*Linaria vulgaris*), bladder campion (*Silene cucubalus*), common tansy (*Tanacetum vulgare*), Canada thistle (*Cirsium arvense*), hound's-tongue (*Cynoglossum officinale*), spotted knapweed (*Centaurea maculosa*), Dalmatian toadflax (*Linaria dalmatica*), blueweed (*Echium vulgare*), ox-eye daisy (*Chrysanthemum leucanthemum*), tall buttercup (*Ranunculus acris*), orange hawkweed (*Hieracium aurantiacum*), common burdock (*Arctium minus*), scentless chamomile (*Matricaria perforata*) and perennial sow-thistle (*Sonchus arvensis*).

Herbicides were used to control invasive plants in the Blackstone/Wapiabi area, Carson Pegasus Provincial Park, Heustis Demonstration Forest, Greg River Day Use Area, a cutblock, a seismic line and a genetic site in the Southwest Corporate Region. Two grazing leases near Canyon Creek in the Northwest Corporate Region were also sprayed with a herbicide. Handpicking and cutting were used to control invasive plants along the North Saskatchewan River northeast of Drayton Valley, Heustis Demonstration Forest and at several small infestations in the Northeast Corporate Region. Seed pod weevil (*Omphalapion hookeri*) population appears to have established at a biological control site in the Southwest Corporate Region (SW3 & SW4).

The Forest Health Section (FHS) published a tri-annual newsletter and an annual report to increase forest health awareness. A combined insect and disease pest poster was printed and distributed in 2003. The Forest Pest Damage Diagnostic System and the Forest Health Website were posted on the internal website.

The first year results of a two-year field study indicate that checking has a bigger impact than woodborer damage on dimensional lumber produced from fire-killed timber. Personnel from the Forest Health Section helped a team that developed a computer-based model to predict the spread of mountain pine beetle across the landscape. The Northwest Corporate Regional Integrated Pest Management (IPM) Group initiated the implementation of a forest health monitoring system geared towards studying the impact of a selected group of forest pests.

Introduction

This is a report on forest pest conditions that occurred in 2003 and the forecast on major forest pest conditions in 2004 in Alberta[1]. This report contains the details of insect, disease and invasive plant pests (including noxious or restricted weeds). In addition, the other forest health-related programs aimed at increasing awareness, training, technology transfer, and research and development are also described in this report.

The Forest Health Section of the Department of Sustainable Resource Development (SRD) is responsible for addressing forest health concerns within the forested Crown land of the province. This forested Crown land is administered by 10 corporate areas located within three corporate regions (Appendix I). Urban forest pests are the responsibility of municipal governments. The provincial Dutch elm disease program is administered by the Society to Prevent Dutch Elm Disease (STOPDED) affiliated with the Department of Agriculture, Food and Rural Development. Forest pests in the national parks are a federal government responsibility.

The spruce budworm, mountain pine beetle and aspen defoliators are the major forest pests reported here. Some other major pests such as lodgepole pine dwarf mistletoe, terminal weevils, rusts and canker-causing diseases, root collar weevil, stem and root decays including Armillaria root disease occur in Alberta. However, these pests are not routinely monitored on an annual basis and no quantitative information on their annual occurrences is available. The details of minor pests are reported only if local outbreaks occurred in 2003.

Land descriptions in this report are based on Alberta Township System, which is used to describe any given parcel of land in the province.

The surveys reported in this document are conducted for operational purposes within the forested Crown land and do not cover the entire forested provincial land base.

[1] Although every effort is made to ensure that all information reported in this document is accurate and complete, its integrity is not guaranteed. This information is provided for personal use only and is not intended for commercial use. Written permission to publish this information must be requested from the Manager of Forest Health at (780) 427-8474; Fax (780) 427-0085

Insect and Disease Conditions in 2003 and Forecasts for 2004

Conifer Pests

Spruce Budworm
***Choristoneura fumiferana* (Clemens)**

Aerial Surveys on Defoliation

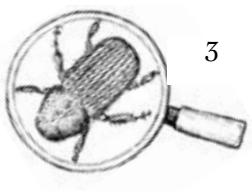
Forested Crown Land

Aerial surveys were carried out in 2003 to estimate the severity and extent of spruce budworm-defoliation in forest stands in Alberta. The procedure used for these surveys is described in the "Forest Health Aerial Survey Manual" (Ranasinghe and Kominek, 1999). The severity of spruce budworm defoliation was rated either as moderate (35% to 70% defoliation) or severe (over 70% defoliation) because it is difficult to observe light defoliation (i.e., less than 35% defoliation) from the air. The results of these surveys are shown on Figure 1. The extent and severity of budworm defoliation in 2002 vs. 2003 are shown in Table 1.

Spruce budworm defoliation increased in the three years following the 1999 discontinuation of the aerial spray program to control this pest (Figure 2). Several budworm-infested stands with tree-kill were reported from the Northwest Corporate Region during these three years. Most of these stands had eight or more consecutive years of moderate to severe spruce budworm defoliation.

However, in 2003 there was a noticeable decline in the extent and severity of spruce budworm defoliation compared to the previous three years (Figure 2). It is not yet clear whether this decline in budworm defoliation was due to limited and poor food quality following years of defoliation or due to climatic factors that affected the spruce budworm.

The overall extent and severity of the budworm defoliation in the province declined in 2003 compared to defoliation observed in 2002 (Table 1). The extent of moderate defoliation dropped by 24.6% and the severe defoliation dropped by 20.4% where forest inventory data are available to calculate the net area. In areas with no forest inventory data, the gross area with moderate defoliation decreased by 65.6% but the gross area with severe defoliation increased by 106%.



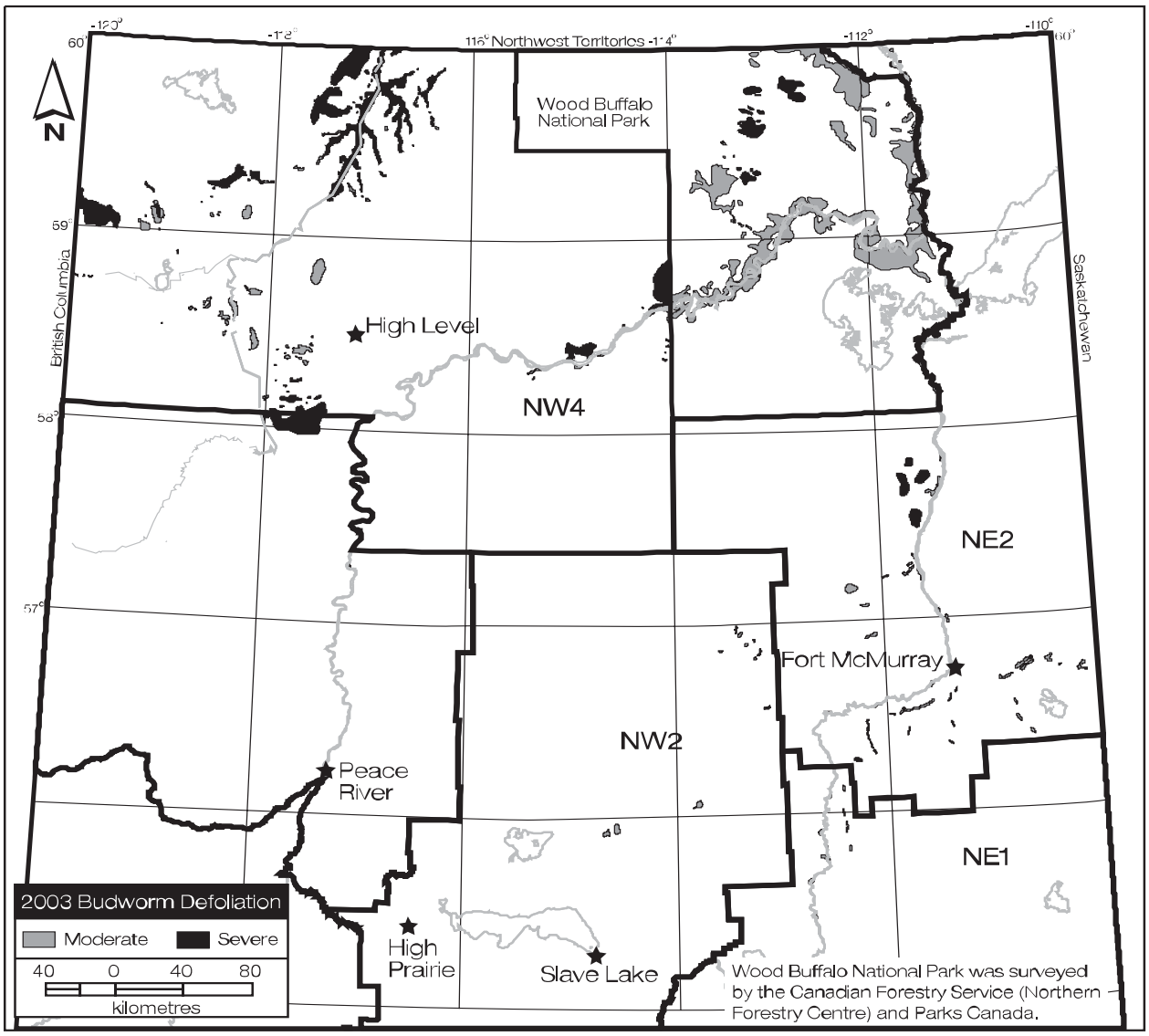


Figure 1 - Spatial distribution of moderate and severe spruce budworm defoliation in Alberta, 2003.

Table 1 - The extent and severity of spruce budworm defoliation in 2002 vs. 2003 in Alberta[a]

Region	Area	Defoliation (ha)				Remarks
		2002		2003		
		Moderate	Severe	Moderate	Severe	
Northwest	Upper Hay	13 764	82 085	22 277	66 429	Net Area
	Peace	560	15 022	321	14 492	Net Area
	Lesser Slave	------	-----	2428	157	Net Area
Regional Total		14 324	97 107	25 026	81 078	Net Area
Northeast	South of lat. 58°N[b]	35 108	12 917	12 235	6476	Net Area
		6500	-----	364	5959	Gross Area
	North of lat. 58°N[c]	2438	14 720	2713	24 407	Gross Area
Regional Total		35 108	12 917	12 235	6476	Net Area
		8938	14 720	3077	30 366	Gross Area
Provincial Total		49 432	110 024	37 261	87 554	Net Area
		8938	14 720	3077	30 366	Gross Area

[a]Excluding national parks [b]Lac La Biche Area and part of Waterways Area [c]Part of Waterways Area

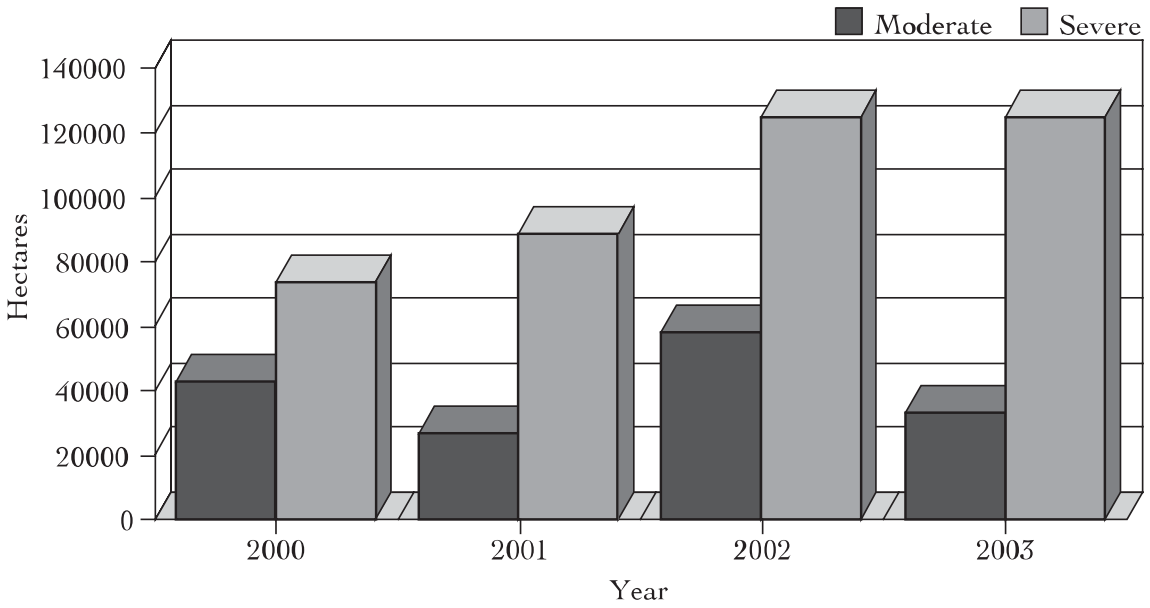


Figure 2 - Moderate and severe spruce budworm defoliation in Alberta, 2000-2003.
(Note: Combined net and gross area values were used in this graph to show the trend in budworm defoliation).

Northeast Corporate Region

An aerial overview survey was conducted from July 15-16, 2003, along the major river drainages to estimate the extent and severity of budworm defoliation in this corporate region. A fixed-wing aircraft (Cessna 206) was used for this survey. Alberta Vegetation Inventory (AVI) data were used to calculate the net defoliated area with spruce dominance in Alberta-Pacific Forest Industries' Forest Management Area (Alpac FMA). The extent of regional spruce budworm defoliation by severity categories is shown in Table 1. The spruce budworm-defoliated areas in this corporate region are shown in Figure 1.

In the area south of latitude 58° N the spruce budworm defoliated an estimated net area of 18 711 ha where Alberta Vegetation Inventory (AVI) coverage is available (i.e., within the AlPac FMA area). This is a 61 % decrease compared to the 48 025 ha defoliated in the corresponding area in 2002. Defoliation was moderate on 12 235 ha (65.4%) and severe on 6476 ha (34.6%), as shown in Table 1. In addition, the spruce budworm defoliated a gross area of 6323 ha outside of the FMA area where AVI coverage is unavailable. Most (94.2%) of this defoliation was severe and the remainder (5.8%) was moderate.

The forest inventory data are unavailable for the area north of latitude 58° N in this region. In this area, the spruce budworm defoliated an estimated gross area of 27 120 ha (Table 1); this is about a 58% increase in the defoliated area compared to 2002. Most of this defoliation (90%) was severe.

Northwest Corporate Region

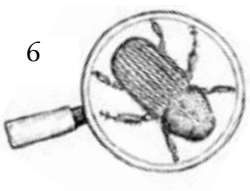
An aerial survey to estimate the extent and severity of spruce budworm defoliation was carried out between July 22 and August 14, 2003 in this corporate region. A fixed-wing aircraft (Cessna 210) was used for this general overview survey. The budworm-defoliated areas in this corporate region are shown in Figure 1.

The spruce budworm defoliated an estimated 106 104 ha in this corporate region. This is a 4.8% decrease compared to the 111 431 ha defoliated in 2002. Defoliation was severe on 81 078 ha (76.4%) and moderate on 25 026 ha (23.6%). In comparison, defoliation was severe on 97 107 ha (87.1%) and moderate on 14 324 ha (12.9%) of the affected area in 2002 (Table 1).

In the Upper Hay Corporate Area, the spruce budworm defoliated an estimated 88 706 ha compared to 95 849 ha defoliated in 2002. This is a 7.5% decrease in the defoliated area. Defoliation was severe over an estimated 66 429 ha (74.9%) and was moderate over 22 277 ha (25.1%). In comparison, defoliation was severe over 86% and moderate over 14% of the area affected in 2002. Cooler than normal spring weather conditions may have contributed to this decline of defoliation. In this corporate area, one new budworm outbreak was detected near the Zama-Hay Lake Complex. The extent and severity of defoliation declined, compared to the 2002 levels, in the following areas: at Hay River along the British Columbia border; West Sousa Creek; East Sousa Creek and Chinchaga River. The defoliated area declined but severity remained about the same in the F11 Forest Management Unit southwest of High Level. In the other infested areas defoliation remained at about the same levels as in 2002.

In the Peace Corporate Area, the spruce budworm defoliated an estimated 14 813 ha in 2003. This is about a 5% decrease compared to the 15 582 ha defoliated in 2002. Defoliation was severe over 14 492 ha (97.8%) and moderate over 321 ha (2.2%). In this corporate area, two new areas of budworm defoliation were detected north of Notikewin Provincial Park along the Peace River. Defoliation at the Paddle Prairie Metis Settlement remained severe and the extent was more or less unchanged compared to 2002 levels. However, spruce budworm defoliation that was reported at the Hawk Hills in 2002 was not found in 2003.

In the Lesser Slave Corporate Area budworm defoliated an estimated 2585 ha. One area with severe defoliation and three small areas of moderate defoliation were recorded on the west side of the Little Buffalo Lake located northeast of Wabasca. When Vanderwell Contractor staff reported this



defoliation in 2002 it was too late to be surveyed. In addition, moderate defoliation was found in several small patches near Chipewyan Lakes, east of North Wabasca Lake and in two areas near Brintnell Lake, which is located north of Lesser Slave Lake.

Southwest Corporate Region

No spruce budworm defoliation was observed in this corporate region in 2003.

National Parks

An ongoing extensive spruce budworm defoliation in Wood Buffalo National Park was mapped in 2003[2]. This infestation was found along the Peace River scattered over an estimated gross area of 422 837 ha (Figure 1).

Forecast for 2004 Based on Pheromone Trap Catches in 2003

The spruce budworm male moth populations in several forest stands located across the forested Crown land were monitored to forecast the risk of spruce budworm outbreaks occurring in 2004. These stands were either budworm-defoliated or considered to be at high risk of being defoliated by the spruce budworm in the near future. Multi-Pher I® traps (Le Groupe Biocontrole, Quebec) baited with female sex pheromone lures (Phero Tech Inc, B.C.) were used to monitor the moth populations. The monitoring procedure is described in the "Spruce Budworm Management Guide" (Ranasinghe and Kominek, 1998).

One hundred and fifty-three plots were established across the province to monitor spruce budworm moths. Three of these plots had both traps disturbed and these were excluded from further consideration. The forecast based on the results of the other 150 plots is shown in Figure 3.

Northeast Corporate Region

In the NE Corporate Region, 50 plots were established as follows in the corporate areas of Lac La Biche (28) and Waterways (22). At two of these plots, both traps were disturbed and therefore dropped from further consideration. The forecast based on catches from the other 48 plots is shown in Figure 3. Overall, the trap counts in 2003 were relatively lower than the trap counts in 2002.

In the Lac La Biche Area, the risk of outbreaks occurring in 2004 is low in 18 plots (64%), moderate in seven plots (25%) and high in three plots (11%). All except one of the plots with low outbreak risk were located south of township 83. These low outbreak risk plots had average catches ranging from 44 to 485 moths per trap. Six of the seven plots with moderate outbreak risk (average of 590 to 1581 moths per trap) and all three plots with high outbreak risk (average of 2072 to 2923 moths per trap) were located north of township 77; the other plot with a moderate risk of an outbreak was located in Twp 76 Rge 18 W4. All three plots with high risk of outbreak were located north of McMillan Lake. Overall, the risk of spruce budworm outbreaks occurring in 2004 has decreased in the Lac La Biche Corporate Area.

In the Waterways Corporate Area, pheromone trap catches indicated that the risk of spruce budworm outbreaks occurring in 2004 is low (average of 467 moths per trap) in one plot (5%), moderate (average of 791-1903 moths per trap) in 13 plots (65%) and high (average of 2175-3130 moths per trap) in six plots (30%). The average trap catch of the plot located at Twp 90 Rge 9 W4 dropped from 4439 in 2002 to 2860 in 2003. This plot still has a high risk of an outbreak occurring in 2004 and needs closer monitoring although no defoliation was visible in this area in 2003. Overall, the risk of spruce budworm outbreaks occurring is high in this corporate area.

[2] Roger Brett, Forest Health Technician, Canadian Forest Service, Northern Forestry Centre and Christina Kaeser, Wood Buffalo National Park.

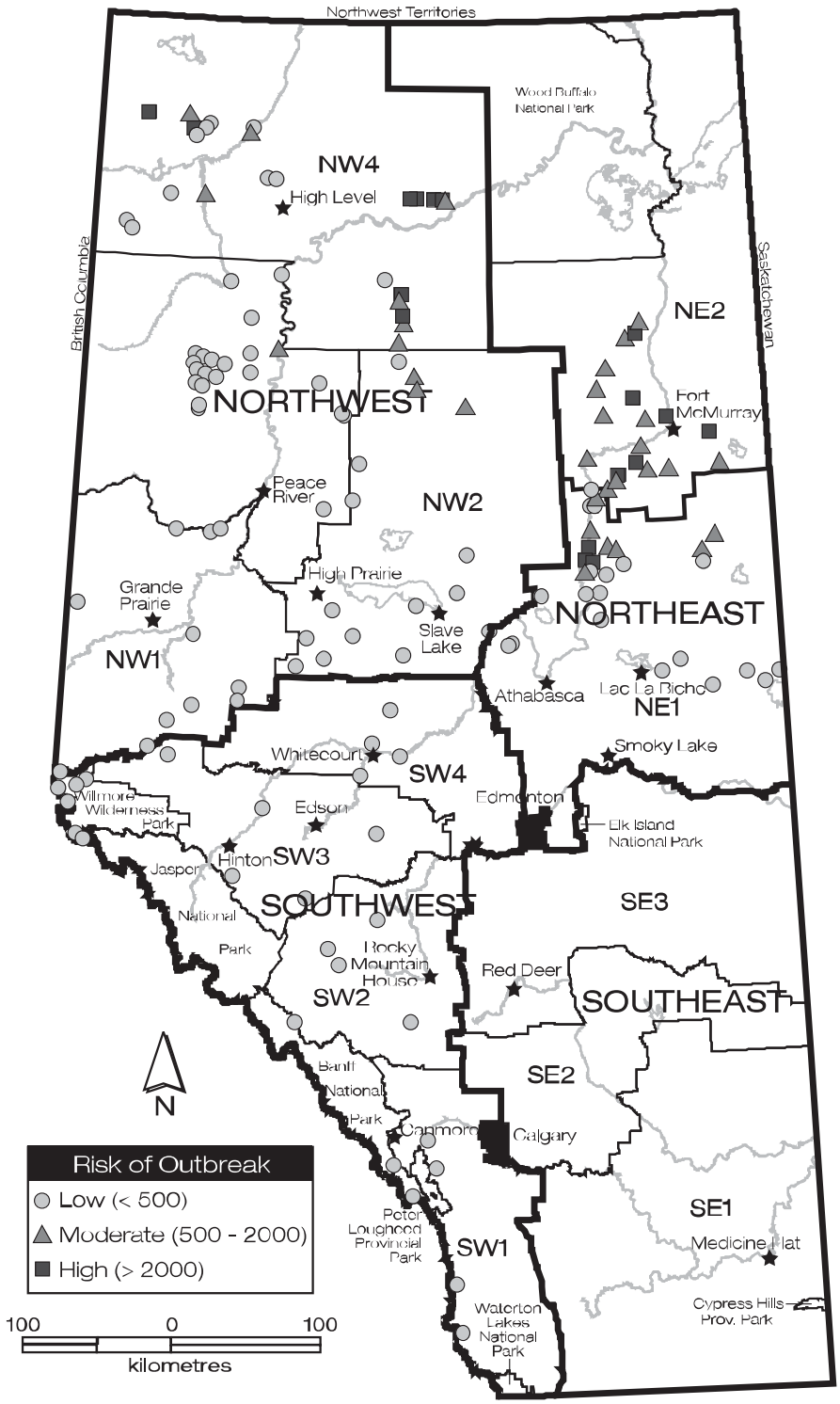


Figure 3 - Forecast on risk of spruce budworm outbreaks occurring in 2004, based on the moth catches in pheromone-baited traps in 2003, Alberta.

Northwest Corporate Region

In the NW Corporate Region, 74 plots were established as follows in the corporate areas of Lesser Slave (16); Peace (22); Smoky (9) and Upper Hay (27). The spatial forecast based on the moth catches in these traps is shown in Figure 3 and the results are summarized in Table 2. The risk of new outbreaks occurring in 2004 is low in 47 plots (74.3%), moderate in 11 plots (14.9%) and high in eight plots (10.8%). In comparison, 68.1% of the plots were rated low, 24.6% were rated moderate and 7.2% were rated high in outbreak risk in 2002. Thus the overall risk of budworm outbreaks occurring has decreased in this corporate region.

In the Smoky Corporate Area, the risk of budworm outbreaks occurring in 2004 is low. All nine plots in this area had low moth catches (average of 4-161 moths per trap). Historically, the risk of spruce budworm outbreaks occurring in this area has been low.

In the Lesser Slave and Peace corporate areas, the risk of spruce budworm outbreaks occurring in 2004 is low to moderate. In the Lesser Slave Corporate Area, the risk of outbreaks occurring in 2004 is low in 13 plots (81%) and moderate in three plots (19%). In the Peace Corporate Area, the risk is low in 21 (95%) of the plots and moderate in one plot (5%). Overall, the risk is low of new budworm outbreaks occurring in these corporate areas in 2004.

In the Upper Hay Corporate Area, the risk of new spruce budworm outbreaks occurring in 2004 is low in 12 plots (44%), moderate in seven plots (26%) and high in eight plots (30%). The average moth count per trap remained about the same in 2003 as in 2002 . This is the only corporate area to have plots with high risk of outbreaks occurring in 2004. Areas near Zama City, the Lawrence River and the Wentzel River each had two plots with high risk of outbreaks occurring in 2004. An additional plot with high risk was located near the Wabasca River north of Red Earth. Although there was a slight decrease in 2003 in the average trap catch in some plots located along this river drainage, budworm outbreaks remain a concern because of the history of spruce budworm outbreaks in this area. The trap catches were notably lower in plots at Adair Lookout Tower and at Tompkins Landing near the Peace River. The overall risk of new spruce budworm outbreaks occurring in 2004 in this corporate area has decreased compared to the risk in 2003.

Table 2 - The results of the 2003 spruce budworm moth surveys by using pheromone-baited traps in the Northwest Corporate Region of Alberta

Risk Category		Area			
		Lesser Slave	**Peace**	**Smoky**	**Upper Hay**
Low	No. of plots per category	13	21	9	12
	Percent of plots per category	81%	95%	100%	44%
	Min/Max average count in plots	32/497	36/167	4/161	163/493
Moderate	No. of plots per category	3	1	0	7
	Percent of plots per category	19%	5%	0%	26%
	Min/Max average count in plots	568/1733	780	-	591/1940
High	No. of plots per category	0	0	0	8
	Percent of plots per category	0%	0%	0%	30%
	Min/Max average count in plots	-	-	-	2016/3100

Southwest Corporate Region

In the Southwest Corporate Region 29 plots were established as follows to monitor the spruce budworm moth populations: Southern Rockies (6); Clearwater (6); Foothills (12); and Woodlands (5). Moth catches from one plot in the Woodlands Corporate Area was unavailable. The forecast based on the trap catches of the remainder of plots is shown in Figure 3.

This region is inhabited by the two-year cycle budworm, *Choristoneura biennis* Free. and the trap catches have been alternating between high and low numbers in even vs. odd years. In 2003, the plots in this region either had nil or low moth catches (range 0 to 422 moths per trap) indicating nil to low risk of budworm outbreaks occurring in 2005. These low catches were expected in 2003 because it is an odd year. Based on the 2002 moth catches, higher budworm catches indicating a relatively higher risk of outbreaks are expected in these plots in 2004. Thus, there is a moderate risk of an outbreak occurring in Willmore Wilderness Park in 2004.

Mountain Pine Beetle *Dendroctonus ponderosae* (Hopkins)

Municipal and Private Lands

Pest management either in privately owned or municipal land does not fall under the jurisdiction of the Department of Sustainable Resource Development. The land owners/managers are responsible for managing mountain pine beetle in these lands.

In 2002/2003, the managers of the Town of Canmore, Three Sisters Development and the Silver Tips Golf Course detected and removed 303 green-attack trees in their lands (Table 3).

Forested Crown Land

Forested Crown land has been monitored for incidence of mountain pine beetle (MPB) since the collapse of the last beetle outbreak in 1985. Plots with pheromone-baited host trees were annually established to detect the presence of the beetle in MPB-prone areas close to the Alberta-British Columbia border. As well, in recent years annual aerial surveys were carried out to detect the presence of MPB-killed trees on forested Crown land.

Aerial Overview Surveys

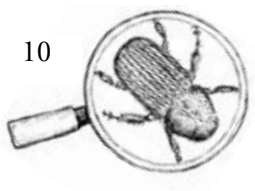
In the fall of 2003, the forested Crown land was surveyed to detect mountain pine beetle (MPB) infestations. The Regional Forest Health Officers in the Southwest Corporate Region used rotary-wing aircraft for these surveys. The surveys mainly covered the river valleys in the foothills bordering B.C., Willmore Wilderness Park and Waterton National Park.

In the Southwest Corporate Region 17 red-attacked trees symptomatic of MPB attack were observed from the air in the Bow Valley. In Willmore Wilderness Park two patches with suspected MPB-killed trees were observed. One patch of two trees was located near Beaverdam/Avalanche Creek Area and the other with eight trees was located at Meadowland Creek.

Ground Surveys

Following aerial surveys, ground surveys were carried out to detect the "green-attack" trees, i.e., trees successfully attacked in the current year but still retaining beetles and green crowns. Two types of ground surveys, i.e., walk-through surveys and transect surveys, are carried out to detect the green-attack trees. Extensive walk-through surveys delineate the general area of infestation. The results of the walk-through surveys are used to plan for more intensive and systematic transect surveys. The results of 2002/2003 surveys are reported here because the 2003/2004 surveys are still ongoing and will be reported in 2004.

A walk-through survey was conducted around the Town of Canmore and in the Bow Valley Wildland Park in 2002/2003. Personnel from Banff National Park, Bow Valley Provincial Park, Department of Community Development, Morley Indian Reserve, Spray Lake Sawmills (1980) Ltd. and the



Department of Sustainable Resource Development volunteered for this survey. The areas to be surveyed were pre-determined based on the mountain pine beetle hazard rating system and the proximity to red-attacked trees detected during the aerial surveys. The volunteers worked in groups of two. Each group was provided with a map with directions and a hand-held Global Positioning System (GPS) to record their tracks. Where needed the survey groups were trained in the use of the GPS and in survey methodology. Each survey group was expected to cover at least 60% of the assigned area.

The walk-through survey was followed by a transect survey. This survey was carried out from November 2002 through January 2003 by a group of three fire fighters hired by the Regional FHO. The transect survey areas were chosen based on the results of the aerial surveys and walk-through surveys. The goal of the survey was to detect all the green-attacks by systematically surveying 100% of the selected area. A baseline was established through the selected survey area and transect lines were established perpendicular to the baseline at 50m intervals. The surveyors systematically surveyed every potential beetle host tree within 25m either side of each transect line. All the suspected green-attack trees were flagged and their locations were recorded by using the GPS. The process was repeated until all the survey areas were covered.

The results of these ground surveys are summarized in Table 3. Originally, 1253 trees purportedly attacked by the beetle were identified during the ground surveys carried out in Canmore area. However, upon closer examination, some of these trees were found to be attacked by other bark beetles such as the red turpentine beetle, *D. valens* LeConte and the lodgepole pine beetle, *D. murrayanae* Hopkins. Following ground truthing, only 1013 beetle-attacked trees were found in this area.

Table 3 - Mountain pine beetle survey and control statistics for Alberta, 2002-2003

Location	Green Attacks	Number removed	Number left	Control	Remarks[1]
Banff National Park					
Fairholme Range	3000	1853	1147	65.1%	Mgt. Zone
Tunnel Mountain	1150	872	278	75.8%	Mgt. Zone
Brewster Creek	50	0	50	0%	Mon. Zone
Healy Creek	1650	0	1650	0%	Mon. Zone
Mount Norquay	1100	0	1100	0%	Mon. Zone
Canmore					
Town of Canmore	33	33	0	100%	
Silver Tips	180	180	0	100%	Golf Course
Three-Sisters	90	90	0	100%	Resort
Grassi Lake	1013	1009	4	99%	Prov. Park
Total	8282	4037	4229		

[1] Mgt. Zone = Management Zone and Mon. Zone = Monitoring Zone

Survey with Pheromones

A two-component aggregation pheromone bait (Phero Tech Inc., B.C.) was used to monitor MPB presence in high risk lodgepole pine stands in southwestern Alberta. The plot locations were readjusted in 2003 to better represent the MPB-susceptible lodgepole pine forest in the province. The procedure for deploying these pheromone baits is described in "Mountain Pine Beetle Management Guide 1999" (Kominek, 1999).

Thirty-five plots with pheromone-baited trees were established to monitor mountain pine beetle activity in south-western Alberta. The results of this survey are shown on Figure 4. In the Southern Rockies Corporate Area (SW1), 11 of the 15 plots had beetle hits on baited-trees. The number of hits per baited tree ranged from 1 to 100. At four of these plots the non-baited trees in the vicinity were also attacked. The beetle-hits on non-baited trees varied from 2-70 per tree. In comparison, none of the non-baited trees was attacked in 2002. These figures indicate an increasing trend in beetle activity in this corporate area during the past few years. In the Clearwater Corporate Area (SW2) only one out of six plots had trees with beetle-hits. Beetle activity in this corporate area has been low in the past few years as well. In the Foothills Corporate Area (SW3) 13 plots were established. Ten of these plots, including three plots located within the Berland Working Circle in Compartment 9 (within Weldwood FMA), had no beetle attacks. A new plot located along the Sheep Creek on the outskirt of Willmore Wilderness Park had two of the three baited-trees attacked.

In Willmore Wilderness Park, the number of pheromone plots was reduced from 12 to 2 in 2003 because of the ongoing infestation. In the plot located at Sunset Creek/Berland River, all three baited-trees each had a beetle hit. In the other plot located at Jackpine River/Spider Creek all three baited-trees had beetle hits varying from 1 to 117 per tree. The infested-trees will be cut and burned before beetle emergence in 2004.

In Kakwa Wildland Provincial Park in the Northwest Corporate Region, a new plot was set up along the Lower Kakwa River. All three baited-trees in this plot were attacked. These trees had 74 to 97 beetle-hits. This finding is significant because this is the northernmost record of the presence of MPB to date in the province.

In Cypress Hills Provincial Park, mountain pine beetles attacked trees at 10 out of 13 plots with pheromone-baited trees[3]. The number of beetle-hits per-baited tree was relatively low (1-11 per tree). One non-baited tree was attacked at the headwaters of Battle Creek. Overall the MPB population in this park is still rather low.

National Parks

Banff National Park

Aerial Surveys

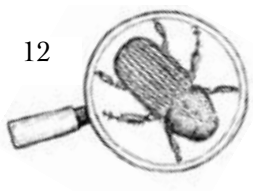
Approximately 4880 "red-attacked" trees, i.e., lodgepole pines killed in 2002 and turning red colour in 2003, were mapped during an aerial survey of this park[4]. The estimated numbers of red-attacked trees are as follows: Brewster Creek (30); Healy Creek (1000); Mount Norquay, Stony Squaw and Forty-mile Creek (1500); Tunnel Mountain (300); Lake Minnewanka, Cascade and Two Jack Lake (200); Mount Cory along Helena Ridge from Castle Junction to Johnson Canyon (150) and Fairholme Range (1700).

Ground Surveys

The estimated number of green-attack trees found in Banff National Park in 2002/2003 is shown in Table 3. About 60% of the 6950 green-attack trees in the park were found in the "Management Zone" where action taken by the park authorities helped to control the MPB infestation. The remainder of the green-attack trees were found in the "Monitoring Zone" where no management action was taken.

[3] Les Weeks, Park Forest Officer, Cypress Hills Inter-Provincial Park, Alberta

[4] Leo Unger, Forest Health Technician, Pacific Forestry Centre, Canadian Forest Service, 506 West Burnside Road, Victoria, B.C. V8Z 1M5



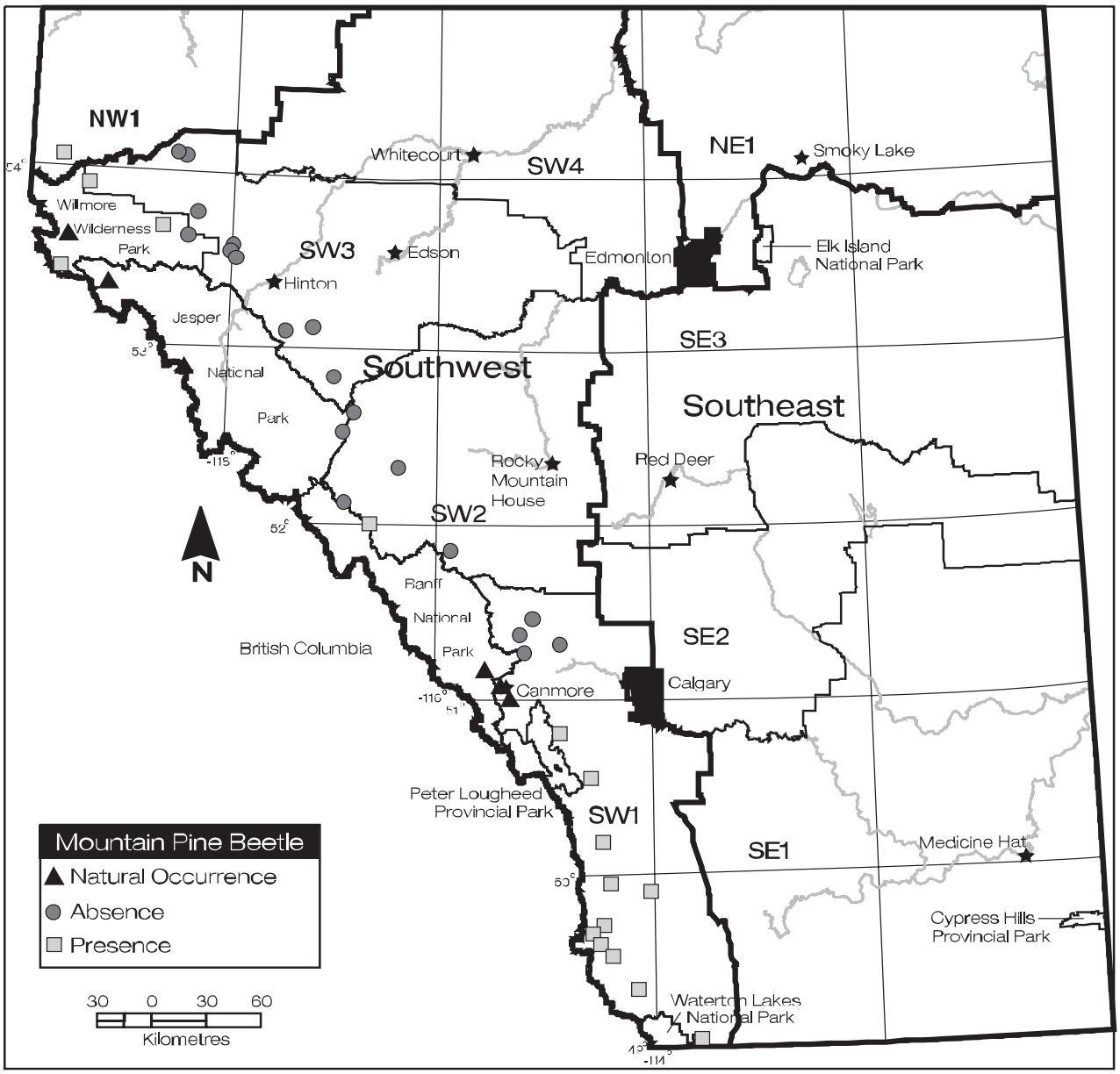


Figure 4 - Natural occurrence of mountain pine beetle infestations and presence/absence of beetle-hits in pheromone-baited plots in Alberta, 2003.

Jasper National Park

Twelve MPB-killed trees were observed in Miette Valley near the west gate. Beetles produced broods in two trees. Most of the other attacked trees had *Ips* sp., which prevented further MPB attacks. The MPB infestation along the Smoky River drainage within this park did not expand in 2003[5]. However, many beetle-killed trees were observed along the highway during aerial surveys between the western boundary of this park and Mount Robson Park in B.C. These may trigger new beetle infestations on mature lodgepole pines on the south-facing slopes of Jasper National Park.

Waterton National Park

No faders due to MPB-killed trees have been reported from this national park in 2003.

Yellowheaded Spruce Sawfly *Pikonema alaskensis* (Rohwer)

The yellowheaded spruce sawfly (YHSS) severely defoliated some young white spruce plantations in the Northeast Corporate Region. Open grown white spruce at oil and gas reclamation sites were particularly vulnerable to this attack. Some plantations suffered up to 40% of tree kill.

In 2003, several oil and gas companies carried out programs to control this pest on reclamation sites. Suncor and Syncrude, both located in Fort McMurray, carried out aerial applications by using a helicopter. Suncor and Syncrude treated 32 and 87 ha respectively with Dylox®. They achieved 90-95% efficacy in YHSS control. Imperial Oil Resources treated their YHSS-infested stands with Permethrin. The efficacy of this treatment has not been reported. Suncor is planning to continue these field applications.

[5] Dave Smith, Fire and Vegetation Specialist, Jasper National Park, Jasper, Alberta

Broadleaf Pests

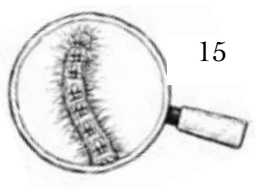
The extent and severity of aspen defoliation by insect pests were estimated during aerial surveys carried out in the summer. The survey procedures are described in the "Forest Health Aerial Survey Manual" (Ranasinghe and Kominek, 1999). The observers categorized aspen defoliation severity as light (<35% defoliation); moderate (35 - 70% defoliation) or severe (>70% defoliation). Table 4 and Figure 5 show the results of these surveys.

In 2003, aspen defoliation caused by forest pests was found scattered over an estimated gross area of 5 414 276 ha (Table 4 and Figure 5). This is a 28.9% increase in the gross defoliated area compared to 4 199 609 ha defoliated in 2002. The large aspen tortrix (LAT) continued to be the predominant aspen defoliator in the province.

Table 4 - The extent of aspen pest defoliation in Alberta, 2002 vs. 2003

Corporate Region	Gross area of defoliation (ha)[a]					
	2002			2003		
	Light	Moderate	Severe	Light	Moderate	Severe
Northeast	1489	109 691	15 733	74 548	323 640	176 999
Northwest	74 165	2 612 780	908 006	44 491	4 399 735	0
Southwest	141 324	252 594	83 827	76 020	163 094	155 749
Total		4 199 609			5 414 276	

[a]Gross area, i.e., total area covered by the polygons containing defoliation excluding Wood Buffalo National Park



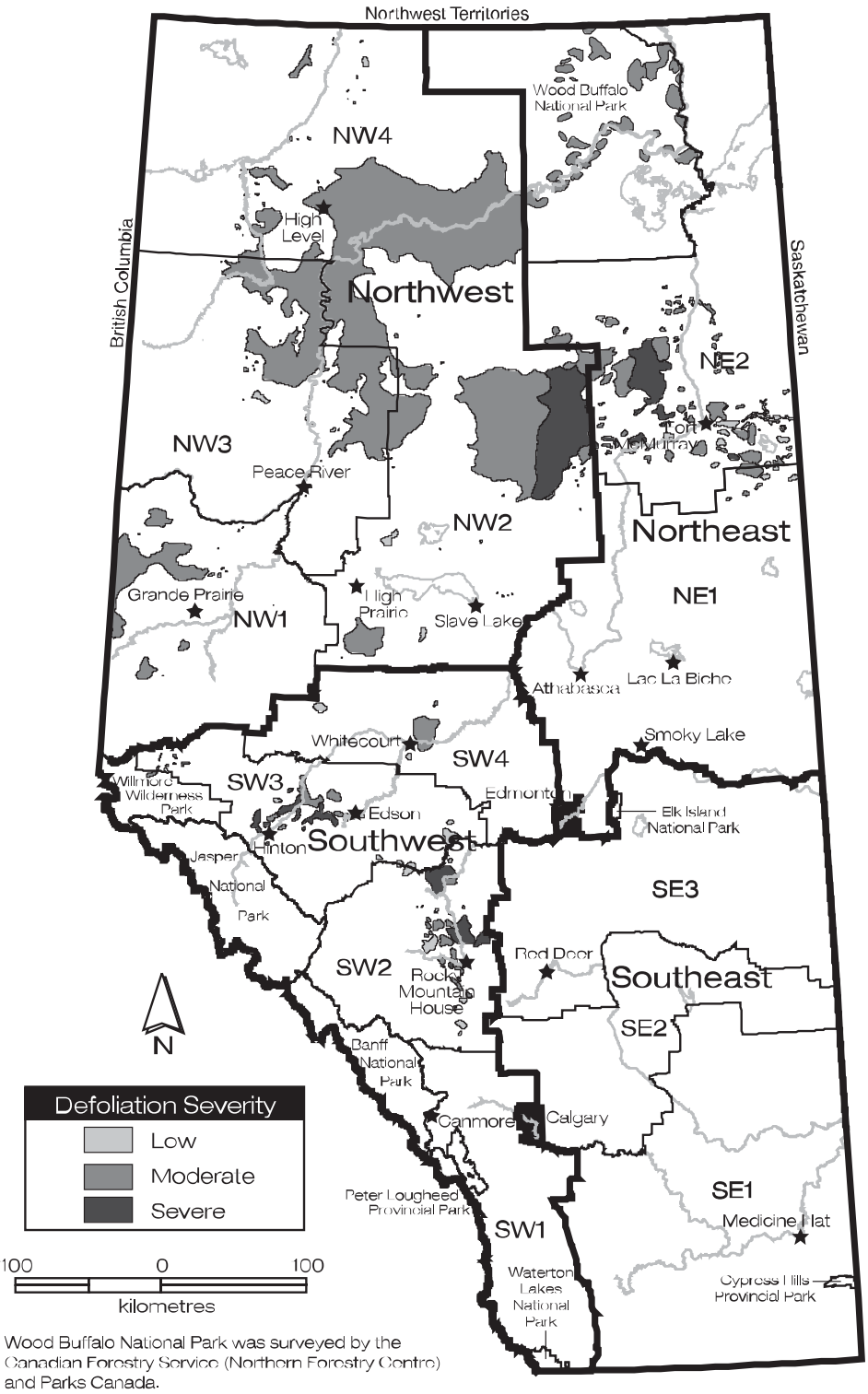


Figure 5 - Spatial distribution of insect pest-caused aspen defoliation in Alberta, 2003.

Large Aspen Tortrix *Choristoneura conflictana* (Walker)

Forested Crown Land

Northeast Corporate Region

Howard Gates and Tom Hutchison used a fixed-wing aircraft (Cessna 206) from July 8-11 to aerially survey the region for broadleaf defoliator damage. Ground-truthing, where conducted, confirmed that the large aspen tortrix was the predominant defoliator of these stands. The LAT defoliation was found over an estimated gross area of 575 187 ha; this is an increase of about 353% compared to the aspen defoliation in 2002. The defoliation was light over 74 548 ha, moderate over 323 640 ha and severe over 176 999 ha. The bulk of the defoliation was observed in the Waterways Corporate Area (Figure 5) .

Northwest Corporate Region

Mike Maximchuk used a fixed-wing aircraft (Cessna 210) between June 24 and July 14 to carry out overview aerial surveys on aspen defoliation in this region. A follow-up ground truthing survey indicated that the LAT caused most of the defoliation. This defoliation was scattered within a gross area of 4 444 226 ha. This is a 24% increase compared to the area defoliated in 2002. Severe defoliation was reported southwest of Grande Prairie near Two Lakes and along the Chinook Ridge near Boundary Lake. These two infestations could not be mapped because the reports were received after the 2003 aerial surveying was already completed. Pockets of severe defoliation mixed with moderate defoliation were recorded in Fort Vermillion, John D'or Indian Reserve, Battle River Fire Lookout Tower, Teepee Lake and Saddle Hills areas. Moderate aspen defoliation was recorded in Chipweyan Lakes, Peerless Lake, Cadotte Lake, Keg River, south of Grande Prairie and north of Manning. The eastward movement of LAT infestations in this corporate region continued in 2003.

Southwest Corporate Region

The aspen defoliator damage was scattered over 394 863 ha. This is a 17.3% decline in the gross defoliated area compared to the 477 745 ha defoliated in 2002 (Table 4 and Figure 5). In the southern section of this region (SW1 and SW2), defoliation was caused by the large aspen tortrix and the forest tent caterpillar over a gross area of 187 664 ha. In the northern section of the region (SW3 and SW4) defoliation was found over a gross area of 207 199 ha. Most (53%) of this defoliation was moderate; nearly 19% of the defoliation was light and 28% was severe. The defoliation in this section was solely caused by the large aspen tortrix.

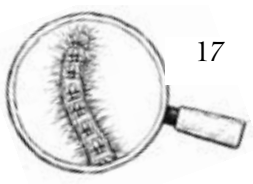
National Parks

In 2003, Roger Brett (Canadian Forest Service) and Christina Kaeser (Wood Buffalo National Park) surveyed an ongoing LAT defoliation. This was scattered over an estimated gross area of 360 683 ha in Wood Buffalo National Park. Most of this defoliation occurred along the Peace and Slave rivers (Figure 5).

Forest Tent Caterpillar *Malacosoma disstria* (Hübner)

Defoliation

In 2003, the forest tent caterpillar (FTC) defoliated some forest stands in the southern section of the SW Corporate Region; however, there was no forest tent caterpillar defoliation detected in the northern section of this region. Some forest tent caterpillar larvae were observed during the ground surveys along the Chinchaga River in the NW Corporate Region. In most cases, the damage caused by the FTC and LAT was indistinguishable and was ascribed to the predominant defoliator, the large aspen tortrix. There was some forest tent caterpillar defoliation in 2003 in the NE Corporate Region. This damage was mixed with damage caused by the aspen two-leaf tier, *Enargia decolor*.



Survey with Pheromone Traps

In the NE Corporate Region, Unitraps® baited with pheromone lures (Phero Tech Inc., B.C.) were deployed in 25 plots to monitor the forest tent caterpillar moth populations. Five of these plots were located around Calling Lake and the Alberta-Pacific Mill, seven were located near Lac La Biche and eight were located near Cold Lake. A new plot was set up at each of Seibert Lake, Marguerite Lake and Touchwood Lake; two new plots were set up along Highway 881 near Conklin. The average trap catch in the plots varied from 8 - 137 moths per trap. There was no defoliation in any of the plots.

Ten plots were established in the Northwest Corporate Region. The tent caterpillar moth counts ranged from 0 - 47. No defoliation was reported from these plots. Traps at eight plots had aspen two-leaf tier moths ranging from 1-200 per trap. Traps at seven plots had large aspen tortrix moths varying from 20-1500 per trap.

Aspen Two-Leaf Tier
Enargia decolor (Walker)

This occasional pest was widespread in the Northeast Corporate Region in 2003. These moths were attracted to the pheromone traps; up to 873 moths were caught in the FTC pheromone traps. However, there was no large-scale damage caused by this pest. **Note:** Usually this pest co-occurs with *E. infumata*, which is very similar in appearance. Dissections of individual specimens are necessary to separate these two species[6]. However, due to limited facilities available in the field such dissections were not undertaken to separate the species.

Gypsy Moth
Lymantria dispar (Linnaeus)

The Public Lands and Forests Division set up 75 traps as a part of the annual gypsy moth survey conducted by the Canadian Food Inspection Agency (CFIA). Delta traps baited with Dispalure® were used in this survey. No gypsy moths were caught in these 75 traps that were deployed in July-August at high risk areas such as the truck stops, railway yards, camp grounds etc. However, in 2003 four gypsy moths were trapped in two traps deployed in Edmonton by the city working under the CFIA program. No gypsy moth egg masses were found in a follow-up survey. The City of Edmonton is planning to intensify the gypsy moth detection plan in 2004.

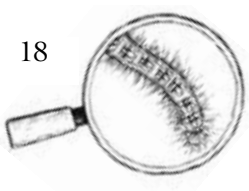
Smaller European Elm Bark Beetle
Scolytus multistriatus (Marsham)

Alberta does not have any native elm tree species. The smaller European elm bark beetle (SEEBB), a vector of Dutch elm disease, has been found recurrently in Calgary since 1994; in Edmonton since 1995; and in Medicine Hat since 1998. This beetle has been trapped in the past near Balzac, in Coutts, High River, Killam, Lethbridge, Lloydminster, Red Deer, St. Albert, Strathcona County, Taber, Vauxhall, and in Wainwright.

Sticky panel traps baited with the pheromones were placed in 117 municipalities, 52 provincial sites and 28 nurseries. In 2003, the number of SEEBB trapped in pheromone-baited traps increased compared to the previous years. Thirty-nine beetles—a new record—were trapped in the greater Edmonton area. Multiple catches on individual traps as well as the trapping of beetles over several months suggest that they are established in Edmonton. Thirty beetles were trapped at 18 locations in Calgary. The trap catches over the years suggest the presence of endemic SEEBB populations in Alberta. However, there is still no conclusive evidence of their establishment, i.e., SEEBB galleries with live beetle larvae in elm in Alberta.

No native elm bark beetles, *Hylurgopinus rufipes* (Eichoff), have been trapped in Alberta.

[6] Personnal Communication, Greg Pohl, Insect ID Officer/Museum Curator, Northern Forestry Centre, Canadian Forest Service, Edmonton, Alberta



Other Noteworthy Pests

Diseases and Disorders

Dutch Elm Disease (DED), *Ophiostoma ulmi* (Buis.) Nannf. and O. *novo-ulmi* Brasier

Although elm trees are not native to Alberta, a relatively large American elm population is found in the province. Alberta remains free of Dutch elm disease (DED). To date the only confirmed record of DED in Alberta was from samples collected in 1998 from an elm tree in Wainwright. No new cases of DED were reported in 2003 in Alberta.

In 2003, the Society to Prevent Dutch Elm Disease (STOPDED) monitored municipalities, provincial or municipal parks, plant nurseries, and all of the ports-of-entry at Alberta-Montana border for one of the vector species of this disease, the smaller European elm bark beetle (SEEBB). Large volume of elm firewood was also confiscated at the Alberta-Montana ports-of-entry.

For further details about DED in Alberta, please visit the web site:
www.agric.gov.ab.ca/navigation/pests/trees/index.html

Dothiorella Wilt Disease of Elm, *Dothiorella ulmi* Verall & May

Since 1996, a vascular wilt disease caused by the fungus, *Dothiorella ulmi*, has affected American elm trees growing in Edmonton. This disease results in progressive die back and eventual tree mortality. In 2003, another 60 elms with wilt symptoms were observed in the city. Samples from all these wilted trees were submitted to the University of Alberta's plant pathology laboratory, which confirmed Dothiorella wilt on 56 of the samples. This disease has affected over 200 elms in the city since 1996.

Drought

The effects of drought adversely affected many forest trees. In addition to the direct effect, drought-weakened trees also became more susceptible to other pests. The City of Edmonton lost nearly 4000 trees of an introduced species, black ash, due to 2003 drought. Drought killed many forest trees in the Northeast Corporate Region. Many birch trees had chlorosis. Stress-induced cone crops were common on white spruce, which also suffered some tree mortality.

Insects

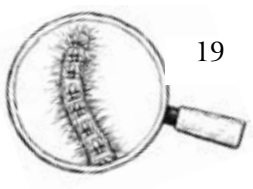
Gray Willow Leaf Beetle, *Tricholochmaea decora* (Say)

In 2003, the gray willow leaf beetle defoliation that affected vast swaths of willow in 2002 in the NE Corporate Region has petered out. The extent of defoliation was not mapped. In some areas, willow trees are dying back after two consecutive years of severe defoliation by this pest.

Ash Leaf Cone Caterpillar, *Caloptila fraxinella* (Ely)

Ash leaf cone caterpillar (ALCC) was first reported on black ash in Edmonton in 1999. This pest still occurs at outbreak levels in the City of Edmonton. Measures to use an *Apantales* sp. for biological control of this pest are yet to pick up speed. Most trees in the city are under drought stress and this seems to make them more prone to ALCC attack. Similar damage was reported from ash trees growing around Wandering River Ranger Station and in Fort McMurray in the NE Corporate Region. The pest damage at these locations was less severe compared to last year and no further spread has been reported.

This pest is known to attack ash as well as lilac trees. The young larvae feed on the leaf surface and the mature larvae roll the leaves into a characteristic cone-shape. However, the ALCC damage is cosmetic and does not cause long term effects. Moreover, this insect is susceptible to many natural enemies such as parasitic wasps and it is unlikely to become a serious pest.

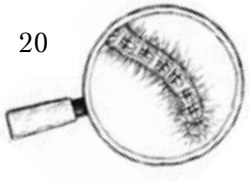


Red Elm Weevil, *Magdalis armicollis* (Say)

In 2002, the red elm weevil, *Magdalis armicollis* (Say), damage was reported on elm trees growing in Lethbridge and surrounding areas. In 2003, this pest infested drought-weakened elms of Edmonton. The drought conditions in these areas exacerbated weevil damage on elm trees.

Other Minor Pests

In Edmonton, the continuing drought conditions weakened many trees that became prone to other pests. The city-wide occurrence of the cottony psyllid, *Psyllopsis discrepans* (Flor), on black ash was overtaken by the leaf hopper, *Gyponana* sp. The western ash bark beetle, *Hylesinus californicus* (Swaine), attacked the black, Manchurian and green ash trees in Edmonton. The spiny ash sawfly, *Eupareophora parca* (Cresson), was found on many parts of the city.



Mountain Pine Beetle Management Program

Introduction

The current mountain pine beetle (MPB) outbreak in Alberta was detected in 1997 during a survey carried out over Banff National Park (BNP). Facilitated by the mild winters and warm, dry summers, the MPB population in BNP increased rapidly. In 2002, MPB-killed trees were detected in forested Crown land adjacent to BNP. As stipulated in the departmental business goals, a management program was undertaken in 2002/2003. The provincial MPB management strategy is described in the "Mountain Pine Beetle Management Strategy" (Alberta Sustainable Resource Development, 2002).

Parks Canada also undertook a mountain pine beetle initiative to limit the eastward spread on MPB across the continental divide region of the Mountain District National Parks. This program, aimed at reducing forest susceptibility to MPB, provided for coordination with similar programs on adjacent provincial lands.

Prevention

Restrictions on Movement of Pine Logs and Products

Alberta's *Timber Management Regulations* under the *Forests Act* require that imported shipments of coniferous logs or forest products with bark attached are accompanied by written authorization from the Minister. Authorizing the importation of specific shipments is based on the product having a low risk of either causing or increasing the damage to forest growth by insects or diseases. The Ministerial Order 12/2003, prohibited the transportation within Alberta of pine logs and forest products with bark attached, between June 1st and October 1st, 2003.

With the assistance of Alberta Transportation — Inspection Services, SRD was able to effectively prevent the importation of unauthorized shipments of pine with bark attached through regular vehicle inspections and random checkstops. Between May 1 and October 31, 2003 no unauthorized shipments were intercepted. In comparison, 18 unauthorized shipments were intercepted last year.

Mountain Pine Beetle Control

Forested Crown Land

2002/2003 Surveys

In the Bow Valley in the southern section of the Southwest Corporate Region 1253 green-attack trees were identified during the initial ground surveys. However, some of these trees were found to be killed by other bark beetles such as the red turpentine beetle, *D. valens* LeConte, and the lodgepole pine beetle, *D. murrayane* Hopkins. Consequently a ground truthing was carried out; this narrowed down the number of green-attack trees to 1013. The height and the diameter at breast height (dbh) of every 10th infested tree were recorded. These data are summarized in Table 5.

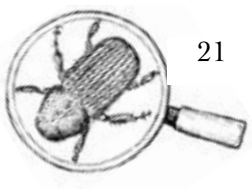


Table 5 - Average heights and dbh of mountain pine beetle green-attack trees in the Bow Valley in Alberta, 2002/2003

Criterion	Quarry Lake Area	Grassi Lake Trailhead	Nordic Centre
dbh:			
No. measured	5	275	135
Avg. dbh in cm	27.9	30.6	27.8
Height:			
No. measured	1	32	16
Avg. height in metres	23.9	30.4	27.3

Control Plan

Once the survey was completed, the Regional FHO developed a MPB control plan. This was done in consultation with the Department of Community Development (CD) that has jurisdiction over provincial parks. The stakeholders and the general public were given a thirty-day period to review the control plan. The control plan was implemented once the review was over. The infested area was divided in to five Beetle Management Units (BMU) (Figure 6). Cut and burn and sanitation harvesting were identified as control treatments. One of these two treatments was identified as the chosen method of control in a given BMU.

Public Review

Wide publicity to the proposed control plan was provided through mass media (newspapers, radio talks, television presentations, leaflets and telephone interviews). Two well-attended public information sessions were conducted in Canmore to review the SRD's proposed MPB control program, fuel modification plans and Banff National Park's proposed prescribed fire. In addition, all the stakeholders were given a 30-day period to comment on the program. Local mass media as well as those from urban centres were invited for a field tour that included a demonstration of cutting and burning as part of one information session. The regional FHO also briefed the town councils and two major land developers on MPB threat and the need to build partnerships to address the problem.

Control Action

Grassi Lakes "A"

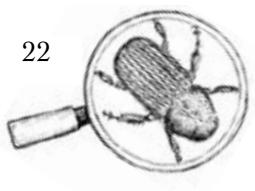
Due to close proximity to trails, salvage harvesting was used in this BMU to remove the infested trees. The salvage plan was formulated by CD in consultation with SRD and the Nordic Centre. This operation was combined with the removal of trees that posed either a high hazard or interference with the trails. Altogether 224 infested trees and 173 other trees were removed between March 24-28 from this area. The trees were mechanically felled, delimbed and the logs were moved to a loading area by using a grapple skidder. The debris was burned on site.

Grassi Lakes "B"

This included the infested trees found scattered outside the sanitation block in Grassi Lakes "A." Cutting and burning was the chosen method of MPB control in this BMU. A qualified contractor felled and burned 40 infested trees in this area.

Canmore Southeast, Canmore North and Nordic Centre

Cutting and burning was prescribed for infested trees in these BMUs. The fire-fighter crews provided by the Forest Protection Division cut and burned all except six trees at the Nordic Centre; the contractor cut and burned these six trees. The fire-fighter crews were briefed on the procedures and provided with GPS locations of infested trees. These crews were directed to survey one hectare around each infested



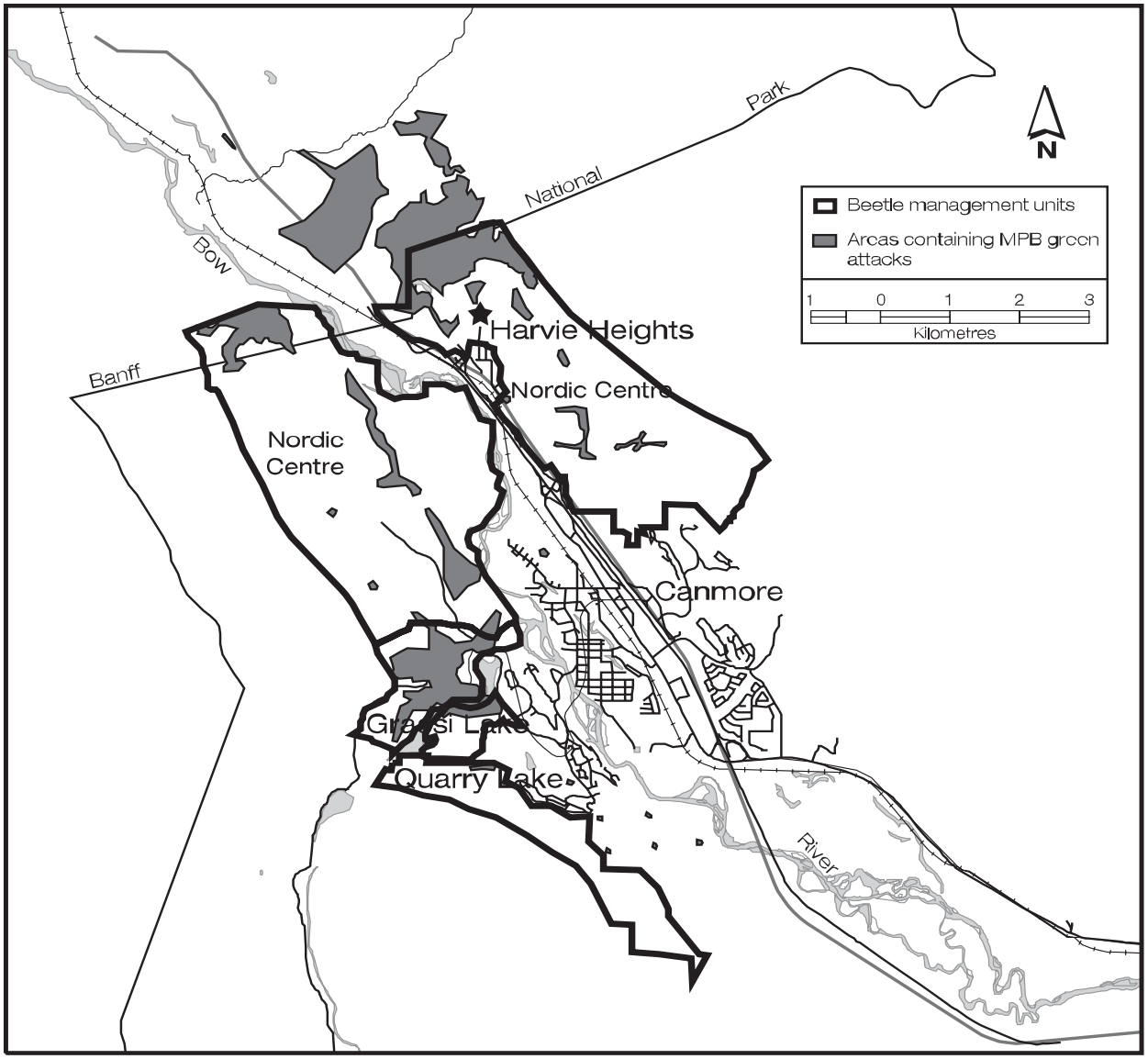


Figure 6 - Mountain pine beetle management units in the Bow Valley of the Southwest Corporate Region in Alberta, 2002/2003.

tree. Any additional infested trees found by the crews were tallied, measured and burned similarly.

Synopsis

In the forested Crown land in Canmore area 785 infested trees were cut and burned; the crews treated 739 trees and the contractor treated 46 trees. All the control operations were completed by March 30, 2003. The Regional FHO randomly checked the burned piles of logs and was satisfied that all the beetle larvae under the bark were killed. During the aerial surveys carried out in the fall, 19 faders were detected in the control area and none outside the control area in the Bow Valley. Thus the control program achieved a 98% success in detecting and removing the beetle-infested trees. The Town of Canmore and the developers treated 100% of the green-attack trees found within their landbases. (Table 3).

National Parks

Forest fire suppression in the past has increased the susceptibility of forest in mountain parks to mountain pine beetle. In view of this, the Mountain District of Parks Canada has undertaken a long-term plan to restore a representative stand structure and reduce forest susceptibility to the MPB. This project is closely co-ordinated with the MPB management programs on adjacent provincial lands.

Banff National Park

The MPB-infested area within Banff National Park (BNP) is divided into a monitoring zone and a management zone. Beetle management action is confined to the management zone (Figure 7).

In 2002/2003, crews burned 4420 hectares of beetle-susceptible forest stands within the management zone of BNP. During this period, 4150 green-attack trees were detected in BNP. Under the management program, 1853 (65.1%) of the estimated 3000 green-attack trees were removed from Fairholm Range in 2002/2003. As well, 872 (75.8%) of the estimated 1150 green-attack trees in Tunnel Mountain were removed. In addition, 524 pheromone baits were deployed in Fairholm Range to contain the beetles for the 2003/2004 treatment program (Table 3).

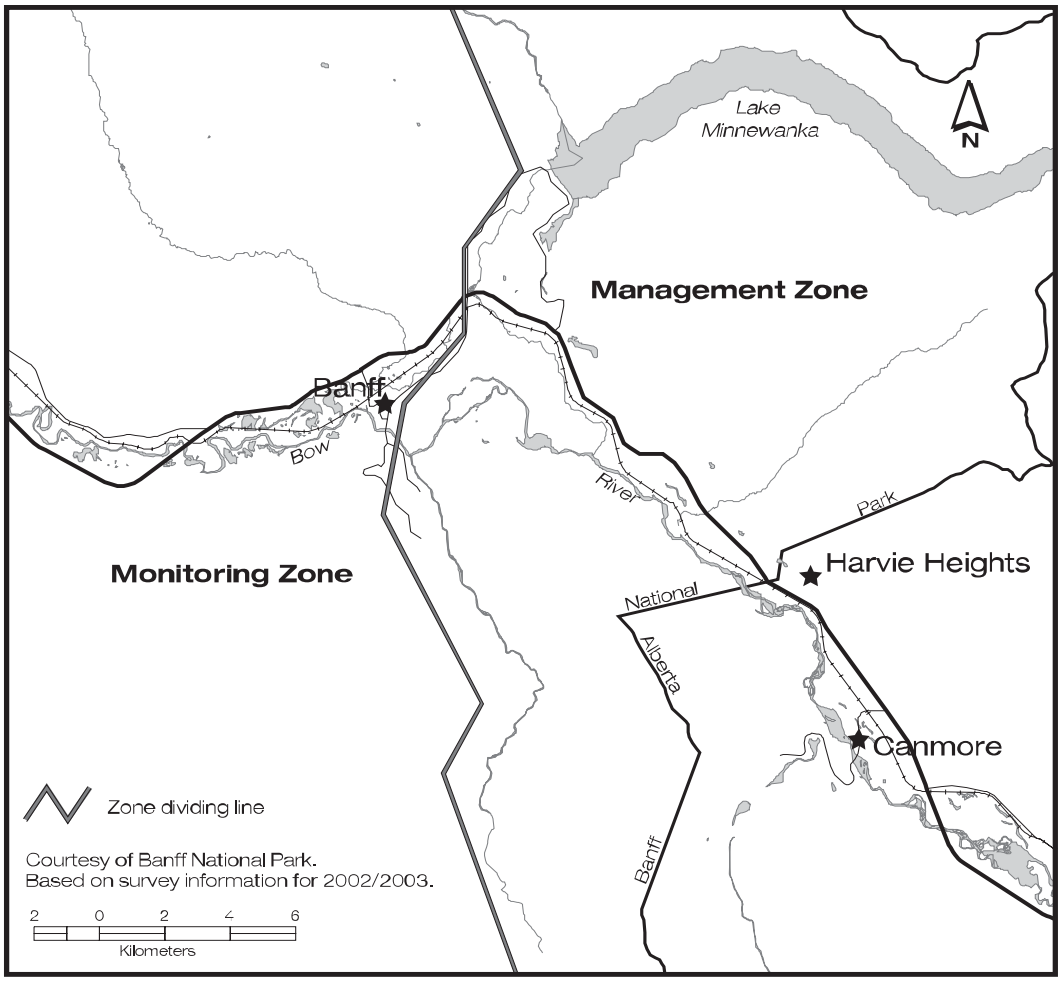


Figure 7 - Mountain pine beetle management zones and monitoring zones in Banff National Park in Alberta, 2003.

Invasive Plant Management

Provincial

Education, Awareness and Co-operative Initiatives

The Department of Sustainable Resource Development (SRD) has formed an Invasive Species Committee. Representatives from each of the three SRD divisions (Public Lands and Forests Division, Fish & Wildlife Division and Forest Protection Division) are working toward the unified management of invasive species. The committee will develop recommendations on a departmental invasive species strategy. During this process SRD will focus on developing an invasive plant management strategy in 2004. As well, the committee will act as liaison between the SRD and

1) Federal/Provincial/Territorial invasive species initiative;
2) Other departments/agencies of the Government of Alberta.

The SRD in collaboration with the Eastern Slopes Invasive Plants Council co-organized a conference on invasive plants entitled "Understanding the Threat," held in October 2003 in Calgary. Speakers from across North America informed over 200 participants on impacts and status of invasive plants in Alberta and in North America. Topics covered at this successful conference included management of invasive plants, the Canadian national plan for alien species, success stories and future directions.

Regional

Southwest Corporate Region (SW1 & SW2 corporate areas)

Education, Awareness and Co-operative Initiatives

Industry leaseholders were invited to attend a meeting in Calgary on June 4th to discuss cooperative invasive plant management. All of those who were present and those invited received meeting notes, maps of the 2002 inventory, weed identification booklets, info-sheets on plants where provincial designation has been elevated to noxious in some municipalities, and information on the Invasive Plants Conference.

Invasive plant information packages were sent to all recreation leaseholders, grazing allotment holders, and commercial trail ride permit holders. The packages included a covering letter promoting awareness adapted to suit the various leaseholders, weed identification booklets and Certified Weed Free Hay Program information for livestock related operations. Approximately 250 packages were mailed to this group of stakeholders.

The area invasive plant coordinator of Public Lands and Forests Division (PFLD) spoke at two stewardship functions of Alberta United Recreationists Society. One was held in Blairmore on June 7th and the other was held at MacLean Creek on June 14th. The group was presented information on the negative impacts of invasive plants and ways to help prevent their spread. Invasive plant identification booklets and prevention information were handed out.

Devon Energy Corp., Atlas Lumber Ltd. and PLFD cooperated by contracting a single company to spray a large infestation spanning dispositions and Crown land. This saved money and enabled the infestation to be treated effectively.

Surveys and Control

A thorough survey of the Ghost Area was completed this year. Despite the high level of use by both industry and recreation, the area seems to be relatively free of invasive plants. One large infestation (12 km long) of wild caraway (*Carum carvi*) was found southwest of Bergen. Smaller wild caraway infestations were found in the Boggy Lake Area and along roadsides in the Burnt Timber Area and near the Fallen Timber Recreation Site.

In and around the Kananaskis Country the most extensive invasive plant problems are the ongoing field scabious (*Knautia arvensis*) infestations in the Jumping Pound and Sibbald areas. Fortunately, this year the spray contractor was able to treat some less accessible areas of Sibbald Meadow including a rather large patch of common toadflax (*Linaria vulgaris*). Herbicides were applied to control field scabious west of the Sibbald Campground and off the right of way along Highway 68. The off-highway vehicle use areas around MacLean Creek and adjacent timber harvesting areas were found to have wild caraway, bladder campion (*Silene cucubalus*) and common tansy (*Tanacetum vulgare*). The MacLean Creek Trail Road south to Millarville had several patches of Canada thistle (*Cirsium arvense*).

In the Livingstone Area, tall buttercup (*Ranunculus acris*) is the dominant invasive plant along and around the lower elevations of Hwy 532. Hound's-tongue (*Cynoglossum officinale*) was discovered around the old Willow Creek Ranger Station (this is the farthest north this plant has been found by PLFD to date). A few spotted knapweed (*Centaurea maculosa*) plants were found and handpulled at a random campsite along Hwy 517. The Forestry Trunk Road southward to the Crowsnest Pass has occasional small patches of common toadflax, dalmation toadflax (*Linaria dalmatica*) and blueweed (*Echium vulgare*). The Atlas Haul Road and all of the surrounding quad trails to the western portion of the Dutch Creek Road are infested with ox-eye daisy (*Chrysanthemum leucanthemum*). Both Atlas Lumber and PLFD treated their respective areas for ox-eye daisy this year. Tall buttercup is becoming as common as ox-eye daisy along the southern quad trails. The trail edges were sprayed in early July to prevent seed being picked up by traffic.

The Castle Area continues to have the greatest invasive plant problem in SW1 & 2. The Lost Creek Area is a spider-web of quad trails and random campsites that are populated by ox-eye daisy and tall buttercup. Due to forest closures resulting from the Lost Creek Fire in this area complete surveying and control work did not take place. The persistent common toadflax in the Gregor's Cabin Area increased through small meadows. Ox-eye daisy has increased dramatically along the Lynx Creek, but at present is not spilling into the Carbondale River. A Junior Forest Ranger Crew hand-pulled 29 bags of ox-eye daisy along the Lynx Creek. In reclaimed areas of the 2000 Cherry Hill Fire, the incidence of invasive plants decreased when moving further away from Sartoris Road. Along trails that remained, blueweed was common east of Sartoris Road. A patch of orange hawkweed (*Hieracium aurantiacum*) was discovered at the summit of a trail heading west off Sartoris Road and ended in the Lost Creek Area. Forest Protection Division funded spraying of invasive plants attributed to fireguard reclamation. Most of the spraying along Sartoris Road was completed before the fire began. The areas with mine tailings/pits in the York Creek that have not been reclaimed have become heavily infested with ox-eye daisy and common toadflax. The area was thoroughly sprayed in early September. Hound's-tongue was found at the Bathing Lake Recreation Site.

In the Porcupine Hills Area, hound's-tongue has become a growing problem. As well two small patches of wild caraway were discovered along the Beaver Creek. This season hand-pulling the bolting stalks of both hound's-tongue and spotted knapweed was essential to remove the seed source. Hound's-tongue and common and dalmation toadflax persist along a poorly reclaimed skid trails in the holding area at Beaver Creek. South and east of there, roads/trails leading into the forest reserve are populated by hound's-tongue, and to a lesser extent by common burdock (*Arctium minus*).

A PLFD contractor applied herbicide to control invasive plants in the Blackstone/Wapiabi Area. Tall

buttercup was sprayed along the Blackstone Road near the Blackstone Gap, around the Blackstone Patrol Cabin, and at the Chungo Creek Outfitters Camp and surrounding horse trails.

A large infestation of common tansy along the North Saskatchewan River, northeast of Drayton Valley was handpicked and cut by the PLFD and the County of Brazeau staff. This location will be inspected in the summer of 2004 to assess control efficacy.

Southwest Corporate Region (SW3 & SW4 corporate areas)

Education, Awareness and Co-operative Initiatives

The focus of the 2003 invasive plant program in the SW3 & 4 areas was on a multi-stakeholder management program. A meeting was held in January with the industrial users of the management zone being concentrated upon this year. Each participant was asked to submit a list of active sites in the management zone by April 1st. The companies were expected to inspect their active sites and provide the PFLD with an invasive plant inventory and specifics of control actions either taken or planned.

Twenty-one invasive plant management plans were submitted and reviewed by the PLFD and the Yellowhead County. A database was created by using the survey data submitted by the PFLD and the companies. This database was used to produce maps and graphs that identified infestation hotspots and the most common species found.

A workshop on invasive plant identification was held in Edson for industry field operators. As well, several individual invasive plant identification sessions were held for companies during their safety or update meetings.

Surveys and Control

Of the sites surveyed this year by the PLFD and industry stakeholders, 66% had ox-eye daisy (*Chrysanthemum leucanthemum*), 34% had scentless chamomile (*Matricaria perforata*), 23% had Canada thistle (*Cirsium arvense*), 12% had tall buttercup (*Ranunculus acris*) and 2% had common tansy (*Tanacetum vulgare*).

A contractor successfully completed herbicide applications for the PLFD. This year, five sites were sprayed to control Canada thistle (*Cirsium arvense*). Two of these sites were in Carson Pegasus Provincial Park and two were in Heustis Demonstration Forest. The largest Canada thistle infestation sprayed was located within a PLFD tree genetics site.

The Greg River Day Use Area was treated with herbicide for tall buttercup control again this year. It had been treated in 2001 for the same species. The infestation level and size at this site have been significantly reduced from the 2001 levels.

The Whitecourt Junior Forest Rangers handpicked an area of Canada thistle in the Heustis Demonstration Forest. This project, though successful, will likely continue in 2004 to significantly reduce the thistle population.

A large common tansy infestation spanning a cutblock, a logging road, a seismic line and a pipeline was controlled this year. The PFLD applied herbicide on the cutblock and the seismic line. Weyerheauser Company and Imperial Oil Ltd. controlled the common tansy on the logging road and the pipeline respectively. Due to severity and extent of this infestation, this site will be monitored and likely will be sprayed again in 2004.

There were no further releases of the two biological control insects, scentless chamomile gall midge (*Rhopalomyia* sp.) and the seedpod weevil (*Omphalapion hookeri*) this year. The seed pod weevil site was inspected this year and the weevil population appears to be established.

Northwest Corporate Region

Education, Awareness and Co-operative Initiatives

Within the Peace Area, the cooperative invasive plant management was continued with the Municipal Districts of Clear Hills and Northern Lights, and with Northern Sunrise County. The main focus of the group was inventory surveys within targeted oil and gas fields in the Green Area.

Various workshops were held this year to promote invasive plant management issues and increase knowledge and awareness of priority pest species. Three invasive plant awareness workshops were held in early May in Grande Prairie, Manning and Peace River. The workshops focused on identification of common invasive plant species, their potential impacts to the ecosystem, management techniques as well as discussions on current local invasive plant issues.

Surveys and Control

Within the Smoky Area, herbicides were applied within two grazing leases and in an area near Canyon Creek. Approximately 12 hectares of infested land were sprayed to control Canada thistle (*Cirsium arvense*) and perennial sow-thistle (*Sonchus arvensis*). Common tansy (*Tanacetum vulgare*) was also controlled within one of the grazing leases. A contractor completed the control program in mid-August.

In the Peace Area, sites north and west of Manning, west of Hines Creek along the British Columbia border, north of McLennan and near Haig Lake were surveyed. Surveys were conducted from late-June till early September. The most abundant invasive plant species found were scentless chamomile (*Matricaria perforata*), perennial sow-thistle and Canada thistle. Common tansy was identified, but was found at fewer locations than the other invasive plants encountered.

Northeast Corporate Region

Education, Awareness and Co-operative Initiatives

Invasive plant posters and identification booklets were distributed among those attending HAC Crew Leader orientation, Co-operative Invasive Plant Management Working Group meetings, Junior Forest Warden sessions and National Forestry Week events. Invasive plant information was also provided to Landing Trail Intermediate School while on a guided field tour. In Fort McMurray and in Athabasca, identification and management presentations were given as part of the Co-operative Invasive Plant Management Working Group sessions held in late May.

Surveys and Control

In 2003, invasive plant surveys targeted specific sites such as waste transfer and landfill sites, pockets of White Area vacant Crown land, and previously surveyed locations. Invasive plants were noted on 151 (72%) of the 209 sites surveyed. This in an increase from 2002 when invasive plants were noted on 62% of the sites surveyed. Most sites had either a trace (40%) or low (33%) degree of infestation and the remaining sites had either moderate (18%) or high (8%) degree of infestation. The frequency of occurrence of the invasive plant species encountered in the surveys is given in Table 6 below.

Table 6 - Frequency of invasive plant species occurrence in surveys carried out in the Northeast Corporate Region of Alberta, 2003

Common Name	Scientific Name	Frequency
Perennial sow-thistle	*Sonchus arvensis*	30%
Canada thistle	*Cirsium arvense*	25%
Scentless chamomile	*Matricaria perforata*	24%
Common tansy	*Tanacetum vulgare*	17%
Ox-eye daisy	*Chrysanthemum leucanthemum*	3%
Tall buttercup	*Ranunculus acris*	1%

Frequency of species encountered varied regionally between the Waterways and Lac La Biche corporate areas. In the Waterways Corporate Area ox-eye daisy and tall buttercup were not noted on any sites surveyed and Canada thistle was found on only 3% of the sites. All six waste transfer and landfill sites surveyed in 2003 in Athabasca County had at least two invasive plant species and 50% of these sites were infested by four different invasive plant species.

At several locations, small infestations primarily of scentless chamomile were handpicked. The PFLD did not spray any herbicides in 2003 in the Northeast Corporate Region. From the invasive plant inventory, a list of 45 sites have been selected and ranked for potential control in 2004.

Increased Awareness and Training

Provincial

Increased Awareness

Bugs and Disease Newsletter

The Forest Health Section publishes a tri-annual newsletter entitled "Bugs and Diseases" Info Note. This publication carries updates on the Forest Health Program, pest information and other forest pest-related news of interest. In 2003, three issues of this newsletter were published and distributed across Canada. This publication is also available on-line at the Forest Health website.

Forest Health Website

This year the forest health website was made available internally. Frequent updates to the external website were also completed. Given below is the external website address: www3.gov.ab.ca/srd/forests/health/

The "pest alert" section of the external website was used to communicate with and increase awareness of the general public about the current mountain pine beetle outbreak in Alberta.

Forest Pest Damage Diagnostic System

This web-based diagnostic system has been finalized and posted on the internal forest health web site. We are still working on providing access to users of the external website. This system offers more flexibility and choices to the user. In addition to diagnosis of damage caused by common forest pests in Alberta, it offers search either by forest pest damage code or host tree and comparison of pests.

Posters and Brochures

A new combined poster on Important Forest Insects and Diseases of Alberta was published in collaboration with Canadian Forest Service, Northern Forestry Centre. This double-sided poster depicts the important insect pests on one side and the important diseases on the other. This poster is available free of charge at: Information Centre, Main Floor, Great West Life Building. 9920-108 Street, Edmonton, AB T5K 2M4 (Telephone (780) 422-2079).

Regional

Workshops

Regional Forest Health Officers were instrumental in organizing several workshops aimed at increasing forest health awareness within the province.

Research and Development

Woodborer Study

In 2002, the Forest Health Section initiated a two-year field study to compare the impact of woodborer vs. checking damage (splitting) in fire-killed timber. Lindgren funnel traps baited with wood borer attractants (Phero Tech Inc. B.C.) were used to detect the incidence and type of wood borers in the study area. Three one-hectare blocks each representing a light, moderate or a severe burn were selected in the area burned by the House River Fire. Four plots were laid out in each block. The height, diameter at breast height (dbh) and woodborer incidence on each conifer tree in these plots were recorded. In addition, the trees earmarked for detailed sampling were also demarcated.

Half of these trees were harvested in 2003 winter and the logs from each plot were piled separately in a mill yard. Once the pre-selected trees have been sampled, the logs were cut into merchantable sizes and debarked to assess the incidence of wood borer and checking. Later the logs were processed at a small sawmill and the resulting lumber was graded based on the 'worm-holes' and checking damage. This process will be repeated for the other half of the trees in the plots in 2003/2004 winter.

The trap catches composed of woodborer species belonging to the genera of *Monochamus*, *Trypanodendron*, *Xylotrechus* and *Dicerca*; bark beetles belonging to genera of *Ips* and *Dendroctonus*; and predatory Clerids. Results to date indicate that:

- Woodborer damage is common in dimension lumber cut from fire-killed trees within one year of the fire.
- Woodborer damage is most prevalent in moderately burned timber where as checking is most prevalent in severely burned timber.
- In the first year after a fire, the impact of woodborer damage on the commercial grades is low (Table 6) except in one-inch thick dimensional lumber used for cosmetic purposes. In one-inch thick lumber pieces, the "worm-holes" degrade the commercial value more readily than in structural lumber (two or more inches thick).
- Checking has a bigger impact on the grade of dimensional lumber thicker than one inch cut within one year from fire-killed timber.

MPB Dispersal and Spread Model

Hideji Ono, Erica Lee and Cody Crocker of the Forest Health Section participated in a project by the Foothills Model Forest (FMF) to develop a model to predict the spread of the mountain pine beetle (MPB). This model was developed by research scientists from the Pacific Forestry Centre of Canadian Forest Service and Gowlland Technologies Ltd.

The model was developed to assess the potential impacts of the mountain pine beetle (MPB) on pine resources within the FMF. The main goal of this project was to determine under what conditions would an MPB outbreak occur. The MPB management activities in the different management areas within the FMF were evaluated for their effectiveness at minimizing the potential for an outbreak.

Table 7 - Impact of woodborer vs. checking damage on lumber grades in fire-killed timber in Alberta, 2003

Burn intensity	# of Pieces	Woodborer Damage		Checking Damage	
		damage	impact	damage	impact
Light	250	10%	0%	19%	9%
Moderate	182	71%	2%	31%	13%
Severe	167	38%	4%	49%	15%

The project involved inputting geographic, forest inventory, weather and mountain pine beetle infestation data for the study area into the system and projecting it using the Spatially Explicit Landscape Event Simulator (SELES), a landscape modelling tool, to evaluate potential MPB activity, primarily in terms of areas affected and volumes killed by the beetle. During the modelled outbreak, various management scenarios were tested for effectiveness. The modelled outbreak continued for 20 years with impacts assessed on year 10 and year 20.

Outputs of the model included a susceptibility map of the entire FMF area, which identifies stands that are more likely to be attacked and sustain damage due to their characteristics. As the beetles develop and disperse over the landscape over time, the most likely dispersal pattern is mapped over a 20-year period. The number of hectares affected and, the volume and percent of trees killed are summarized.

Various scenarios were run to assess the conditions under which an outbreak may occur. Ninety-six scenarios were developed and tested based on factors such as warmer weather conditions, increased or decreased beetle presence, increased or decreased immigration of beetles, and increased or decreased beetle management.

Conclusions reached by the model are as follows:

- The potential for an outbreak is present and could increase provided the weather conditions are conducive to beetle development and there are moderate to high levels of MPB pressure (immigrating beetles).
- Vigilant spot detection and adequate levels of cut and burn treatments are likely to be critical to minimizing the development of an outbreak. If an outbreak reaches the size beyond which cut and burn treatments are ineffective, other larger scale treatments may need to be considered.
- An outbreak is unlikely to reach the Weldwood Forest Management Area within 10 years, although, under certain conditions the potential exists. A focus on reducing the susceptibility while monitoring for spots both within the FMA and in nearby areas is warranted.

Forest Health Monitoring System

The implementation of the forest health monitoring system in the Northwest Corporate Region was initiated in 2003. In addition to SRD, Buchanan Lumber, Canadian Forest Products (Grande Prairie), Manning Diversified Forest Products and Slave Lake Pulp Corporation are participating in this project. These participants complete growth and yield measurements within their permanent sampling plot networks. A contractor will collect forest health data required and store those in a database. This is a long-term project to find the impact of forest pests in this region.

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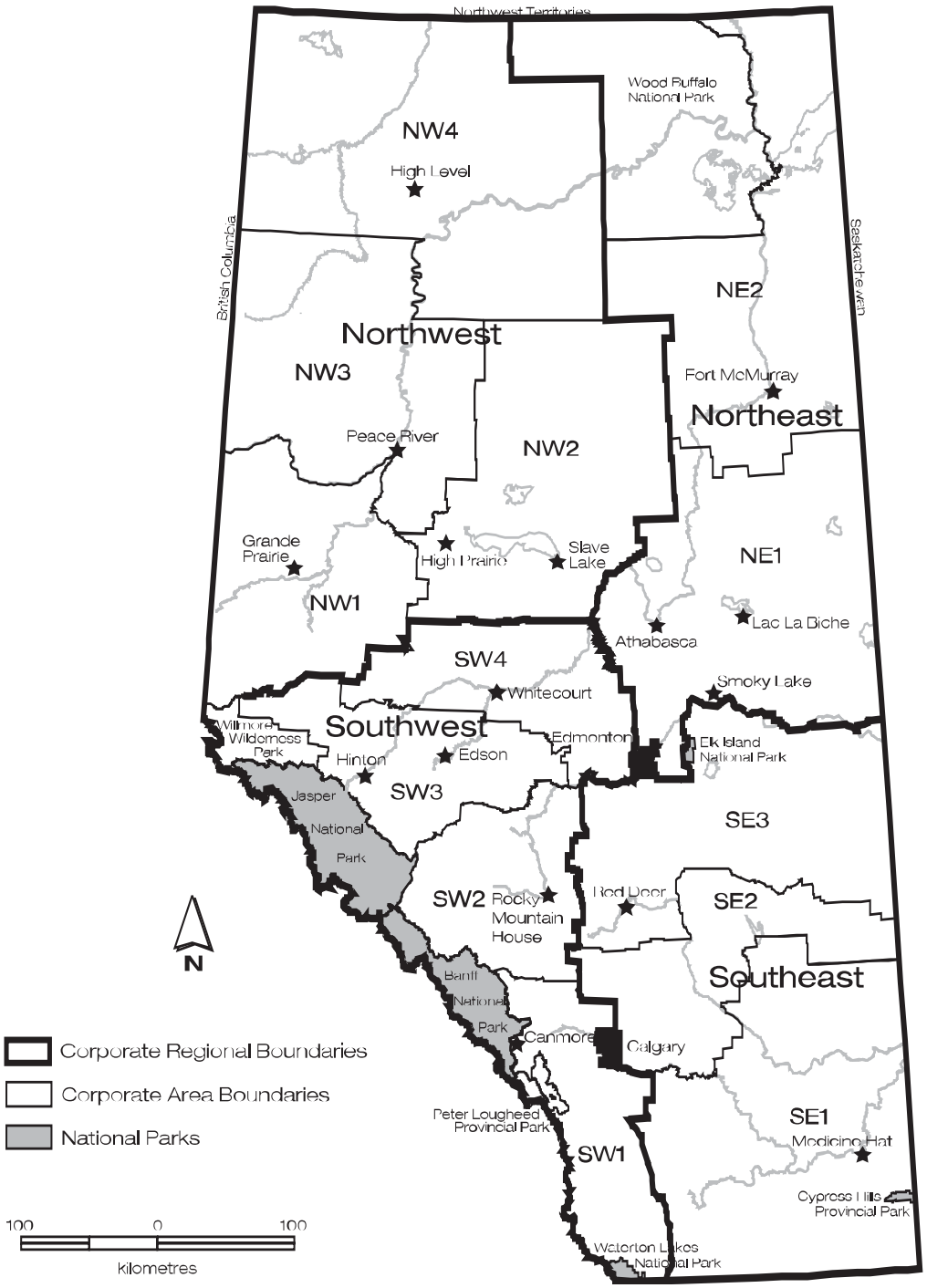
Appendixes

Appendix I - Corporate Areas and Regions of the Public Lands and Forests Division, Department of Sustainable Resource Development in Alberta, 2003



Appendix II - Information on Operational Use of Pheromones in Alberta, 2003

Forest Tent Caterpillar

Chemical component(s):	*Z5, E7* - dodecadienal
Lure type:	Flexlure®
Trap type:	Uni-trap®
Pheromone source:	Phero Tech Inc., Delta, British Columbia

Gypsy Moth

Chemical component(s):	(+)cis-*7*, 8-epoxy-2-methyloctadecane
Lure type:	Disparlure®
Trap:	Delta sticky trap
Pheromone source:	Trécé Inc., Salinas, California (purchased and distributed by Canadian Food Inspection Agency)

Mountain Pine Beetle

Chemical component(s):	trans-verbenol, exo-brevicomin
Lure type:	Pre-packed tree-bait
Trap:	not applicable
Pheromone source:	Phero Tech Inc., Delta, British Columbia

Spruce Budworm

Chemical component(s):	95% E-11-tetradecenal, 5% Z-11-tetradecenal
Lure type:	Plastic lure
Trap type:	Multi-Pher I®
Pheromone source:	Phero Tech Inc., Delta, British Columbia