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The Forest Pest Management Forum is sponsored annually by Natural Resources Canada, Canadian Forest Service, to provide a platform for representatives of various provincial governments and the federal government to present, review and discuss current forest pest conditions in Canada and the United States.

Le Forum sur la répression des ravageurs forestiers est parrainé annuellement par le Service canadien des forêts de Ressources naturelles Canada. Il permet à des représentants de divers gouvernements provinciaux et du gouvernement fédéral de présenter et d'examiner la situation des principaux ravageurs forestiers au Canada et aux États-Unis.

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THE 2008 FORUM ORGANIZING COMMITTEE

Le Forum 2008 sur la répression des ravageurs forestiers a connu encore un grand succès grâce à la contribution de plusieurs personnes. Nous remercions tout d'abord nos conférenciers qui ont fait état de leurs connaissances sur les questions discutées et qui ont bien voulu les résumer pour les besoins du présent recueil. Nous aimerions aussi témoigner notre reconnaissance aux personnes qui ont participé à Sciences et technologie à la carte et à l'Événement spécial du Forum 2008 et au soutien technique. Nos remerciements vont également aux participants et aux participantes qui provenaient de différentes régions du Canada et des États-Unis.

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Program: Forest Pest Management Forum 2008

FOREST PEST MANAGEMENT FORUM 2008
December 2 - 4, 2008
Château Cartier, Gatineau, Québec

TUESDAY, DECEMBER 2, 2008

08:00 **Registration** — **Foyer**

08:20 **Welcoming Remarks** — **Chaudière BC**
Jim Farrell, Assistant Deputy Minister
Natural Resources Canada, Canadian Forest Service

Chair: *Kami Ramcharan, Natural Resources Canada, Canadian Forest Service*

Session I: National Forest Pest Strategy Update
08:40 An Update of the National Forest Pest Strategy
Kami Ramcharan, Natural Resources Canada, Canadian Forest Service

Session II: Eastern Pest Management Issues
Cross-Country Checkup – Atlantic Canada

09:00 Newfoundland Report
Nelson Carter (for Hubert Crummey), Newfoundland Department of Natural Resources

09:20 Nova Scotia Report
Gina Penny, Nova Scotia Department of Natural Resources

09:40 New Brunswick Report
Nelson Carter, New Brunswick Department of Natural Resources

10:00 **Break** — **Chaudière A**

Session III: Forest Insect Pests – Spruce Budworm — Chaudière BC
10:30 Spruce Budworm: What's New and Why it Matters
Jacques Régnière, Natural Resources Canada, Canadian Forest Service

Session IV: United States Report

11:10 An Overview of Pest Conditions in the United States
Robert Mangold, United States Department of Agriculture, Forest Health Protection

Session V: Eastern Pest Management Issues

Cross-Country Checkup – Québec

11:40 Quebec Report
Pierre Therrien, Ministère des Ressources naturelles et de la Faune du Québec

12:00 **Lunch** **Chaudière A**

Chair: *Anthony Hopkin, Natural Resources Canada, Canadian Forest Service*

Special Session

12:50 *Presentation of the 2008 National Science and Technology Week Pellikan Award* **Chaudière BC**
François Faucher and Geoff Munro, Natural Resources Canada, Canadian Forest Service

Session V: Eastern Pest Management Issues **Chaudière BC**

Cross-Country Checkup – Ontario

13:00 Ontario Report
Ed Czerwinski (for Taylor Scarr), Ontario Ministry of Natural Resources

Chair: *Christian Hébert, Natural Resources Canada, Canadian Forest Service*

Session VI: Hemlock Looper: Overview of the Last 15 Years

13:20 Outbreak History, Impact and Monitoring of the Hemlock Looper
Christian Hébert, Natural Resources Canada, Canadian Forest Service

13:50 Population Ecology of the Hemlock Looper
Richard Berthiaume, Université Laval

14:20 Forest Protection and Hemlock Looper Outbreak Management: Welcome to the Twilight Zone
Alain Dupont, SOPFIM

14:50 **Break** **Chaudière A**

15:20 Sponsor Session **Chaudière BC**
Joe Meating, Bioforest Technologies Inc.

15:30 Hazard Ratings for Hemlock Looper: Improving Density-Defoliation Relationships
Dan Quiring, University of New Brunswick

Chair: *Terry Caunter, Pest Management Regulatory Agency*

Session VII: Pesticide Regulations, Alternatives, Minor Use

16:00 Introduction
Michael Irvine, Ontario Ministry of Natural Resources

16:10 Environmental Risk Assessment and the Protection of Non-Target Habitats
Scott Kirby, Pest Management Regulatory Agency

16:30 PMRA Update
Terry Caunter, Pest Management Regulatory Agency

17:00 Adjourn

WEDNESDAY, DECEMBER 3, 2008

08:00 **Registration** **Foyer**

Chair: *Vince Nealis, Natural Resources Canada, Canadian Forest Service*

Session VIII: Western Pest Management Issues **Chaudière BC**

Western Canada Round-up

08:30 Manitoba Report
Irene Pines, Manitoba Conservation, Forestry Branch

08:50 Saskatchewan Report
Rory McIntosh, Saskatchewan Ministry of Environment, Forest Service Branch

09:10 Alberta Report
Sunil Ranasinghe, Alberta Sustainable Resource Development, Forest Division

09:30 British Columbia Report
Harry Kope (for Tim Ebata), British Columbia Ministry of Forests and Range

10:00 **Break** **Chaudière A**

10:30 Sponsor Session **Chaudière BC**
Ian McLeod, Forest Protection Limited

10:40 Sponsor Session
Scott Macdonald, True North Specialty Products

Chair: *Sunil Ranasinghe, Alberta Sustainable Resource Development, Forest Division*

Session IX: Potential Impacts of Climate Change on Forest Pest Management in Canada

10:50 Are Diseases of Young Forests in Central BC Increasing? Is it Due to Climate Change?
Alex Woods, British Columbia Ministry of Forests and Range

11:10 Climate Change and Forest Defoliators
Jan Volney, Natural Resources Canada, Canadian Forest Service

11:30 Drought and its Aftermath in Canadian Aspen Forests
Ted Hogg, Natural Resources Canada, Canadian Forest Service

12:00 **Lunch** **Chaudière A**

Chair: *Harry Kope, British Columbia Ministry of Forests and Range*

Session X: Forest Pathology **Chaudière BC**

13:00 Introduction to Forest Pathology Session
Harry Kope, British Columbia Ministry of Forests and Range

13:10 Abiotic and Biotic Factors Associated with Red Pine Mortality in Southern Ontario
John McLaughlin, Ontario Ministry of Natural Resources

13:35 Biology of Tar Spot of Maple in Canada
Tom Hsiang, University of Guelph

14:00 Outbreak of *Scleroderris* Canker, European Race, in Central Newfoundland: Escape from Quarantine
Gaston Laflamme, Natural Resources Canada, Canadian Forest Service

14:25 *Phytophthora* in Forest Pathology – Is Sudden Oak Death Just the Tip of the Iceberg?
André Lévesque, Agriculture and Agri-Food Canada

14:50 **Break** **Chaudière A**

15:20 *Armillaria* Root Disease – A Hidden Enemy Exposed by Dendrochronology **Chaudière BC**
Gary Warren, Natural Resources Canada, Canadian Forest Service

15:45 Multi-scale Testing an Operational *Armillaria* Root Disease Mapping Procedure for British Columbia
Richard Reich, British Columbia Ministry of Forests and Range

16:10 *Armillaria*: Risk Assessment and Management
Mike Cruickshank, Natural Resources Canada, Canadian Forest Service

16:35 Screening Half-sib Interior Douglas-fir Families for Resistance to *Armillaria ostoyae*
Barry Jaquish, British Columbia Ministry of Forests and Range

17:00 Adjourn

Science and Technology à la Carte — Chaudière A

Chair: *Matt Meade, Canadian Institute of Forestry*
A Roving, Learn–While–You–Eat Concept
Hosted by the Canadian Institute of Forestry and Forest Pest Management Forum

17:00 – 21:30 Cash bar and roving buffet dinner; government, commercial, corporate exhibitors; science-knowledge exchange and informal poster session

THURSDAY, DECEMBER 4, 2008

08:00 **Registration** — **Foyer**

Chair: *Marcel Dawson, Canadian Food Inspection Agency*

08:20 **Welcoming Remarks** — **Chaudière BC**
Marcel Dawson, Canadian Food Inspection Agency

08:30 **Opening Address – Forest Invasives**
Paul Mayers, Associate Vice-President, Policy and Programs Branch
Canadian Food Inspection Agency

Session XI: Canadian Food Inspection Agency Updates

08:50 Plant Health & Biosecurity Directorate
Marcel Dawson, Canadian Food Inspection Agency

09:00 Invasive Alien Species Update
Lesley Cree, Canadian Food Inspection Agency

09:20 Update on Wood Packaging Material Inspected at Marine Ports
Melanie Mecteau, Canadian Food Inspection Agency

09:40 Asian Gypsy Moth – NAPPO Standards
Shane Sela, Canadian Food Inspection Agency

10:00 **Break** **Chaudière A**

10:20 Regulatory Update for the European Woodwasp (*Sirex noctilio*) in Canada **Chaudière BC**
Loretta Shields, Canadian Food Inspection Agency

10:40 Emerald Ash Borer Update
Brian Hamilton and Louis-Phillipe Vaillancourt, Canadian Food Inspection Agency

11:00 *Phytophthora ramorum* Update
John McDonald, Canadian Food Inspection Agency

11:20 Brown Spruce Longhorn Beetle Update
Gregg Cunningham, Canadian Food Inspection Agency

11:40 Update on the Asian Long-Horned Beetle Eradication Program – 2008
Mary Orr, Canadian Food Inspection Agency

12:00 **Lunch** **Chaudière A**

Chair: *Marcel Dawson, Canadian Food Inspection Agency*

Session XI: Canadian Food Inspection Agency Updates **Chaudière BC**

13:00 CFIA – Invasive Alien Species Pest Interception Report 2008
Bruce Gill, Canadian Food Inspection Agency

Session XII: Risk Management Process

13:20 A Decision Support System for the Eradication and Containment of Pest Outbreaks in Europe: The PRATIQUE Project
Andrea Battisti, University of Padova, Italy

13:50 Safeguarding American Agriculture and the Environment: Pest Risk Identification, Assessment and Management
Shirley Wager Pagé, USDA, Animal and Plant Health Inspection Service

14:20 Response Cases of Failed Eradication of Invasive Plants and Plant Pests
Stéphane Wojciechowski and Dalal Hanna, University of Ottawa

14:40 The Risk Management Process for Invasive Alien Forest Pests at the CFIA
Greg Stubbings and Ian Campbell, Canadian Food Inspection Agency

15:00 Panel Discussion on Risk Analysis
Greg Stubbings and Ian Campbell, Canadian Food Inspection Agency
Andrea Battisti, University of Padova, Italy
Shirley Wager Pagé, USDA, Animal and Plant Health Inspection Service

Session XIII: Canadian Food Inspection Agency Updates

15:35 <u>Hemlock Woolly Adelgid: A Pest of Quarantine Concern</u>
Mireille Marcotte, Canadian Food Inspection Agency

16:00 Adjourn

Programme : Forum 2008 sur la répression des ravageurs forestiers

FORUM 2008 SUR LA RÉPRESSION DES RAVAGEURS FORESTIERS

Du 2 au 4 décembre 2008
Château Cartier, Gatineau (Québec)

MARDI 2 DÉCEMBRE 2008

8 h 00 **Inscription** — **Foyer**

8 h 20 **Mot de bienvenue** — **La Chaudière BC**
Jim Farrell, Sous-ministre adjoint
Ressources naturelles Canada, Service canadien des forêts

Présidente : *Kami Ramcharan, Ressources naturelles Canada, Service canadien des forêts*

Séance I : Le point sur la stratégie nationale de lutte contre les ravageurs forestiers

8 h 40 Le point sur la stratégie nationale de lutte contre les ravageurs forestiers
Kami Ramcharan, Ressources naturelles Canada, Service canadien des forêts

Séance II : La répression des ravageurs dans l'Est

Tour d'horizon – Le Canada atlantique

9 h 00 Rapport de Terre-Neuve
Nelson Carter (à la place de Hubert Crummey), Newfoundland Department of Natural Resources

9 h 20 Rapport de la Nouvelle-Écosse
Gina Penny, Nova Scotia Department of Natural Resources

9 h 40 Rapport du Nouveau-Brunswick
Nelson Carter, Ministère des Ressources naturelles du Nouveau-Brunswick

10 h 00 **Pause** — **La Chaudière A**

Séance III : Insectes ravageurs des forêts : la tordeuse des bourgeons de l'épinette — **La Chaudière BC**

10 h 30 La tordeuse des bourgeons de l'épinette : les dernières nouvelles et pourquoi devons-nous les prendre au sérieux?
Jacques Régnière, Ressources naturelles Canada, Service canadien des forêts

Séance IV : Rapport des États-Unis

11 h 10 Survol des insectes et des maladies des arbres aux États-Unis
Robert Mangold, United States Department of Agriculture, Forest Health Protection

Séance V : La répression des ravageurs dans l'Est

Tour d'horizon – Le Québec

11 h 40 Rapport du Québec
Pierre Therrien, Ministère des Ressources naturelles et de la Faune du Québec

12 h 00 **Déjeuner** — **La Chaudière A**

Président : *Anthony Hopkin, Ressources naturelles Canada, Service canadien des forêts*

Séance spéciale

12 h 50 *Présentation du Prix Pellikan de la Semaine nationale des sciences et de la technologie 2008* — **La Chaudière BC**
François Faucher et Geoff Munro, Ressources naturelles Canada, Service canadien des forêts

Séance V : La répression des ravageurs dans l'Est — **La Chaudière BC**

Tour d'horizon – L'Ontario

13 h 00 Rapport de l'Ontario
Ed Czerwinski (à la place de Taylor Scarr), Ministère des Richesses naturelles de l'Ontario

Président : *Christian Hébert, Ressources naturelles Canada, Service canadien des forêts*

Séance VI : Arpenteuse de la pruche : bilan des 15 dernières années

13 h 20 Historique des épidémies, impact et surveillance de l'arpenteuse de la pruche
Christian Hébert, Ressources naturelles Canada, Service canadien des forêts

13 h 50 Écologie des populations de l'arpenteuse de la pruche
Richard Berthiaume, Université Laval

14 h 20 La protection des forêts et la gestion des épidémies de l'arpenteuse de la pruche : une mystérieuse odyssée…
Alain Dupont, SOPFIM

14 h 50 **Pause** **La Chaudière A**

15 h 20 Séance des commanditaires **La Chaudière BC**
Joe Meating, Bioforest Technologies Inc.

15 h 30 Évaluation des risques liés à l'arpenteuse de la pruche : amélioration des rapports densité-défoliation
Dan Quiring, Université du Nouveau-Brunswick

Président : *Terry Caunter, Agence de réglementation de la lutte antiparasitaire*

Séance VII : Règlements sur les pesticides, solutions possibles, usage limité

16 h 00 Introduction
Michael Irvine, Ministère des Richesses naturelles de l'Ontario

16 h 10 Évaluation des risques pour l'environnement et protection des habitats non ciblés
Scott Kirby, Agence de réglementation de la lutte antiparasitaire

16 h 30 Mise à jour de l'ARLA
Terry Caunter, Agence de réglementation de la lutte antiparasitaire

17 h 00 Levée de la séance

MERCREDI 3 DÉCEMBRE 2008

8 h 00 **Inscription** **Foyer**

Président : *Vince Nealis, Ressources naturelles Canada, Service canadien des forêts*

Séance VIII : La répression des ravageurs dans l'Ouest **La Chaudière BC**

Tour d'horizon de l'Ouest canadien

8 h 30 Rapport du Manitoba
Irene Pines, Manitoba Conservation, Forestry Branch

8 h 50 Rapport de la Saskatchewan
Rory McIntosh, Saskatchewan Ministry of Environment, Forest Service Branch

9 h10 Rapport de l'Alberta
Sunil Ranasinghe, Alberta Sustainable Resource Development, Forest Division

9 h 30 Rapport de la Colombie-Britannique
Harry Kope (à la place de Tim Ebata), British Columbia Ministry of Forests and Range

10 h 00 **Pause** **La Chaudière A**

10 h 30 Séance des commanditaires **La Chaudière BC**
Ian McLeod, Forest Protection Limited

10 h 40 Séance des commanditaires
Scott Macdonald, True North Specialty Products

Président : *Sunil Ranasinghe, Alberta Sustainable Resource Development, Forest Division*

Séance IX : Effets potentiels des changements climatiques sur la répression des ravageurs forestiers au Canada

10 h 50 Les maladies des jeunes forêts sont-elles à la hausse dans le centre de la Colombie-Britannique? Le changement climatique en est-il responsable?
Alex Woods, British Columbia Ministry of Forests and Range

11 h 10 Le changement climatique et les défoliateurs des forêts
Jan Volney, Ressources naturelles Canada, Service canadien des forêts

11 h 30 La sécheresse et ses conséquences dans les tremblaies canadiennes
Ted Hogg, Ressources naturelles Canada, Service canadien des forêts

12 h 00 **Déjeuner** **La Chaudière A**

Président : *Harry Kope, British Columbia Ministry of Forests and Range*

Séance X : Pathologie forestière **La Chaudière BC**

13 h 00 Introduction à la séance sur la pathologie forestière
Harry Kope, British Columbia Ministry of Forests and Range

13 h 10 Facteurs abiotiques et biotiques associés à la mortalité du pin rouge dans le sud de l'Ontario
John McLaughlin, Ministère des Richesses naturelles de l'Ontario

13 h 35 Biologie de la tache goudronneuse de l'érable au Canada
Tom Hsiang, University of Guelph

14 h 00 Épiphytie de chancre scléroderrien, race Européenne, au centre de Terre-Neuve : échappée de la quarantaine
Gaston Laflamme, Ressources naturelles Canada, Service canadien des forêts

14 h 25 Le *Phytophthora* en pathologie forestière – l'encre des chênes rouges n'est-elle que la partie visible de l'iceberg?
André Lévesque, Agriculture et Agroalimentaire Canada

14 h 50 **Pause** **La Chaudière A**

15 h 20 Le pourridié-agaric – un ennemi caché révélé par la dendrochronologie **La Chaudière BC**
Gary Warren, Ressources naturelles Canada, Service canadien des forêts

15 h 45 Essai multi-échelles d'une méthode de cartographie opérationnelle du pourridié-agaric en Colombie-Britannique
Richard Reich, British Columbia Ministry of Forests and Range

16 h 10 Le pourridié-agaric : analyse et gestion du risque
Mike Cruickshank, Ressources naturelles Canada, Service canadien des forêts

16 h 35 Criblage de descendances uniparentales du douglas en fonction de la résistance à l'*Armillaria ostoyae*
Barry Jaquish, British Columbia Ministry of Forests and Range

17 h 00 Levée de la séance

Sciences et technologie à la carte **La Chaudière A**

Président : *Matt Meade, Institut forestier du Canada*
Un concept qui vous permet de circuler et d'apprendre tout en mangeant
Un événement organisé par l'Institut forestier du Canada et le Forum sur la répression des ravageurs forestiers

17 h 00 – 21 h 30 Bar payant et buffet à déguster tout en circulant à travers les exposants du gouvernement, du secteur commercial, de l'entreprise privée; échange de connaissances scientifiques et séance informelle de présentations d'affiches

JEUDI 4 DÉCEMBRE 2008

8 h 00 **Inscription** **Foyer**

Président : *Marcel Dawson, Agence canadienne d'inspection des aliments*

8 h 20 **Mot de bienvenue** **La Chaudière BC**
Marcel Dawson, Agence canadienne d'inspection des aliments

8 h 30 **Allocution d'ouverture – les espèces forestières**
Paul Mayers, Vice-président associé, politiques et programmes
Agence canadienne d'inspection des aliments

Séance XI : Mises à jour de l'Agence canadienne d'inspection des aliments

8 h 50 Direction de la protection des végétaux et biosécurité
Marcel Dawson, Agence canadienne d'inspection des aliments

9 h 00 Le point sur les espèces exotiques envahissantes
Lesley Cree, Agence canadienne d'inspection des aliments

9 h 20 Mise à jour sur les matériaux d'emballage en bois inspectés dans les ports maritimes
Melanie Mecteau, Agence canadienne d'inspection des aliments

9 h 40 La spongieuse asiatique – certification de l'origine
Shane Sela, Agence canadienne d'inspection des aliments

10 h 00 **Pause** **La Chaudière A**

10 h 20 Le point sur le *Sirex noctilio* **La Chaudière BC**
Loretta Shields, Agence canadienne d'inspection des aliments

10 h 40 Le point sur l'agrile du frêne
Brian Hamilton et Louis-Phillipe Vaillancourt, Agence canadienne d'inspection des aliments

11 h 00 Le point sur la situation du *Phytophthora ramorum*
John McDonald, Agence canadienne d'inspection des aliments

11 h 20 Le point sur le longicorne brun de l'épinette
Gregg Cunningham, Agence canadienne d'inspection des aliments

11 h 40 Le point sur le Programme d'éradication du longicorne étoilé – 2008
Mary Orr, Agence canadienne d'inspection des aliments

12 h 00 **Déjeuner** **La Chaudière A**

Président : *Marcel Dawson, Agence canadienne d'inspection des aliments*

Séance XI : Mises à jour de l’Agence canadienne d’inspection des aliments

La Chaudière BC

13 h 00 ACIA – Rapport sur les interceptions d’espèces exotiques envahissantes d’organismes nuisibles en 2008
Bruce Gill, Agence canadienne d’inspection des aliments

Séance XII : Processus de gestion du risque

13 h 20 Le projet PRATIQUE, un système d’aide à la décision pour l’éradication et la contention des pullulations de nouveaux ravageurs arrivant en Europe
Andrea Battisti, Université de Padova, Legnaro (PD), Italie

13 h 50 Protéger l’agriculture et l’environnement des États-Unis : la détermination, l’évaluation et la gestion des risques phytosanitaires
Shirley Wager Pagé, USDA, Animal and Plant Health Inspection Service

14 h 20 Études de cas de politiques d’éradications d’espèces envahissantes ratées
Stéphane Wojciechowski et Dalal Hanna, Université d’Ottawa

14 h 40 Processus de gestion du risque d’invasion de ravageurs forestiers exotiques de l’Agence canadienne d’inspection des aliments
Greg Stubbings et Ian Campbell, Agence canadienne d’inspection des aliments

15 h 00 Discussion en groupe sur l’analyse des risques
Greg Stubbings et Ian Campbell, Agence canadienne d’inspection des aliments
Andrea Battisti, Université de Padova, Legnaro (PD), Italie
Shirley Wager Pagé, USDA, Animal and Plant Health Inspection Service

Séance XIII : Mises à jour de l’Agence canadienne d’inspection des aliments

15 h 35 Puceron lanigère de la pruche : un organisme nuisible justiciable de quarantaine
Mireille Marcotte, Agence canadienne d’inspection des aliments

16 h 00 Levée de la séance

SESSION 1: NATIONAL FOREST PEST STRATEGY UPDATE

Chair: Kami Ramcharan
Natural Resources Canada
Canadian Forest Service

SÉANCE 1 : LE POINT SUR LA STRATÉGIE NATIONALE DE LUTTE CONTRE LES RAVAGEURS FORESTIERS

Présidente : Kami Ramcharan
Ressources naturelles Canada
Service canadien des forêts

An Update of the National Forest Pest Strategy

Kami Ramcharan

Natural Resources Canada, Canadian Forest Service

NOT AVAILABLE

SESSION 2: EASTERN PEST MANAGEMENT ISSUES

Cross-Country Checkup – Atlantic Canada

SÉANCE 2 : LA RÉPRESSION DES RAVAGEURS DANS L'EST

Tour d'horizon – Le Canada atlantique

Newfoundland Report

Nelson Carter (for Hubert Crummey)

Newfoundland Department of Natural Resources

NOT AVAILABLE

Forest Pest Conditions in Nova Scotia, 2008

Gina Penny

Nova Scotia Department of Natural Resources, Forest Health Unit,
P.O. Box 130, Shubenacadie, NS B0N 2H0

The **Spruce Budworm (*Choristoneura fumiferana*)** has caused more damage to Nova Scotian softwood forests than any other insect. Since the previous outbreak in the 1970's, spruce budworm population levels have decreased dramatically, with low moth catches being recorded throughout the eastern half of the province. In 2008 only 9% of our pheromone traps were positive as compared to 39% in 2007. Since 2002, we've seen a yearly fluctuation in the percentage of positive traps from a low of 3% to a high of 39% and the overall numbers of moths caught has remained low. No over wintering larvae were detected during our 2008 branch surveys. However, this came as no great surprise as none have been found since 1995.

Jack Pine Budworm (*Choristoneura pinus pinus*) defoliation was first detected in mature white pine in the Western Region in 2005. At that time, we found moderate to severe defoliation over 360 ha. The following year, total defoliation rose to 553 ha; the majority being light. In 2007, defoliation increased almost three fold to 1554 ha, all of it was light. Defoliation rose yet again to 3535 ha in 2008. With 3154 ha light and 381 ha moderate. 2008 also saw a geographical expansion of damage; northwest to Fifth Lake Flowage, eastward to Cowie Bay and south to Kempton Bay resulting in 102, 551 and 80 ha of new defoliation respectively.

Pheromone traps were used to monitor this emerging population beginning in 2006. At that time 89% of traps were positive. Since then, the percentage of positive traps has fluctuated. In 2008, 80% were positive up from 76% in 2007. We also survey for overwintering larvae. The mean number of L2s/m^2 of bark has risen steadily from 9.9 in 2006 to 49 in 2008.

The **Brown Spruce Longhorn Beetle (*Tetropium fuscum*)**, an insect native to Europe, was positively identified in Nova Scotia, in 1999. This is the only known occurrence of this beetle in North America. Since its introduction, trapping surveys for the brown spruce longhorn beetle have been conducted by the Canadian Food Inspection Agency in association with the Nova Scotia Department of Natural Resources. The 2008 survey resulted in eight new positive locations outside of the beetle containment area. The three points of note include Sheet Harbour which was positive in 2006, negative in 2007 and is now positive again in 2008 and the two new finds at Pictou and Lynn Mountain Road. These finds represents the most distant finds from the beetle containment area for 2008. Additional pheromone traps were also deployed in New Brunswick, Prince Edward Island, Newfoundland and Labradour, Quebec and Maine. All were negative for brown spruce longhorn beetle. Since 2006, there have been 26, primarily single finds, outside of the beetle containment area. Data from the 2008 survey will be examined to determine what actions must be taken to further slow the spread of the beetle.

Widespread mortality of mature and over mature white spruce is occurring throughout the province due to the **Spruce Beetle (*Dendroctonus rufipennis*)**. Recent mild winters have increased spruce beetle winter survival leading to a tremendous population buildup. Damage is occurring predominantly in areas where farm abandonment was common and where fields and pastures have regenerated into old field white spruce. There are more than 200,000 ha of old field white spruce in Nova Scotia. Many of these stands, as they are over mature, are prime beetle host material. To date it's estimated that spruce beetle damage can be found on approximately 25,000 ha of forest stands throughout the province. We've also detected mortality in mature red spruce in two provincial protected areas; Cape Chignecto Provincial Park and Abraham Lake in the Liscomb Game Sanctuary. In these two areas, spruce beetle attack has resulted in 308 and 38 ha of mature red spruce mortality respectively.

The native **Pale Winged Grey (*Iridopsis ephyraria*)** is normally a general plant feeder with no prior record of outbreak in Nova Scotia. However, in 2002 it caused high levels of defoliation in eastern hemlock in the Western Region. Results from 2006 surveys seemed to indicate that the population had collapsed in most areas where heavy defoliation had occurred for several years previously. However, in 2007, ground surveys detected new defoliation occurring in a few small areas in the Western Region. In 2008, defoliation has intensified in several areas with new defoliation being detected at Beaverskin Lake and Peskowesk Brook in Kejimkujik National Park and at Jordan Lake in Queens County.

Our **Gypsy Moth (*Lymantria dispar*)** survey was conducted in two parts. Delta traps were used to monitor gypsy moth populations in towns outside of the Canadian Food Inspection Agency regulated zone. New Glasgow is the only town that continues to show a population increase. Permanent multipher traps were also deployed across the province detecting increasing populations in both Halifax and Lunenburg Counties.

No detectable defoliation was observed during aerial surveys for **Blackheaded Budworm (*Acleris variana*), Hemlock Looper (*Lambdina fiscellaria fiscellaria*)** and **Balsam Fir Sawfly (*Neodiprion abietis*)**. However we're continuing to monitor.

Wet spring conditions between 2004 and 2007 have contributed to an increase in intensification and spread of **Sirococcus Shoot Blight (*Sirococcus conigenis*)** in red pine plantations throughout the Central Region. Surveys conducted in the Trafalgar and Garden of Eden areas revealed that infection levels have increased from generally low - moderate in 2006 to moderate - severe in 2007. Forest managers plan on removing all of the infected red pine, approximately 6000 hectares, and are currently salvaging the plantations with the highest levels of infection.

A wet spring and very wet late summer have also resulted in increased reports of foliar diseases including tar spot on maples, spruce needle cast and anthracnose on ash and maple.

Preliminary Summary of Forest Pest Conditions in New Brunswick in 2008 and Outlook for 2009

N. Carter, L. Hartling, D. Lavigne, J. Gullison
D. O'Shea, J. Proude, R. Farquhar, and D. Winter

M. Lewis, M. Stewart, E. Moreau, D. Niblett, S. Toole, and J. Clarkson

New Brunswick Department of Natural Resources, Forest Pest Management Section,
1350 Regent Street, Fredericton, NB E3C 2G6

SUMMARY

Spruce Budworm: In 2008, the percent of positive pheromone traps (39%) was down for the third consecutive year since the high that was reached in 2005 when 81% of the traps were positive. These three consecutive years of decrease follow three years of increases. These ups and downs add to the complexity of forecasting long-term trends when populations are at endemic levels. In addition, three of the L2 plots (30-tree plots) were positive – yielding 2, 21 and 5 larvae per plot. The first two of these plots are located on the panhandle in northwestern NB and the other is located in the central region. Defoliation by spruce budworm in NB was last recorded in 1995 when the last outbreak subsided.

Jack Pine Budworm: Populations remain at low endemic levels according to pheromone trap catches since 1997. No defoliation is expected in 2009.

Hemlock Looper: No defoliation was forecast for 2008, and none was detected. Following a minor population increase in 2004, pheromone trap catches declined in 2005 and 2006, increased very slightly in 2007, and decreased again in 2008. Populations remain at endemic levels.

Whitemarked Tussock Moth: Despite an apparent increase in populations from 2002 to 2006, pheromone trap catches declined in 2007 and 2008 indicating that populations remain at endemic low levels. Only one trap caught one moth in 2008. No defoliation is expected in 2009.

Rusty Tussock Moth: In 2008, populations, as revealed by pheromone trap catches, declined to even lower levels than those recorded last year. No defoliation is expected in 2009.

Balsam Twig Aphid: In 2007, the number of plots with detectable balsam twig aphid decreased to 47% compared to 70% in 2006 presenting a case where it was uncertain if populations might further decline in 2008 or rebound. As it happened, populations appeared to rebound somewhat with 66% of the plots being positive. Once again it is not clear from the year-to-year trends whether populations will increase or decrease in 2009.

Balsam Gall Midge: In 2007, fir plots with balsam gall midge populations increased for the second straight year to 41%, and we speculated that if historic patterns repeat themselves, populations could still increase somewhat over the next few years. Because the percent of positive plots rose to 66% in 2008, we again speculate that they may slightly increase or possibly remain at or about these levels for the next few years if the historic pattern repeats itself.

Balsam Woolly Adelgid: A spring survey at 12 sites indicated decreases in populations at 4 locations and increases at 8 locations, albeit slight in some cases. This was somewhat surprising considering the cold winter of 2007-08. Damage assessments at 10 of these sites revealed no change for 68% of the tress, 20% had an increase in damage, and 12% had a decrease in damage (i.e., showed signs of recovery). Overall, 86% of the trees still have damage levels of light or nil. It should be kept in mind that these data come from a small sample size of 5 trees per site. Data collected over the past six years continue to indicate what an insidious pest this insect is. Populations fluctuate depending on winter and possibly other unexplored/unexplained factors. Symptoms of damage are prone to show increases and recovery. Although galling and distorted tops are common on balsam fir in southern New Brunswick, we have yet to encounter any area suffering from stem attack – a condition that is more associated with tree mortality. Finally, branch sampling and damage assessments were done at 69 balsam fir thinnings and 12 permanent sample plots to gather data for UNB/CFS who are working towards a hazard rating system for balsam woolly adelgid.

Brown Spruce Longhorn Beetle: This invasive insect, known to occur in Nova Scotia, has not yet been detected in New Brunswick. Surveys are conducted by the CFIA. Management actions for 2009 are yet to be determined pending meetings this winter between the CFIA and forest industry stakeholders. New Brunswick's forest industry extended their import moratorium on regulated spruce materials from Nova Scotia in 2009.

Pine Shoot Beetle: This invasive insect has not yet been detected in New Brunswick. Surveys are conducted by the CFIA.

Pine Leaf Adelgid: This insect alternates hosts between white pine and spruce between years. In 2005, widespread attack was noted on white pine in central as well as eastern New Brunswick. Damage on white pine was generally much less evident in 2006. In 2007, widespread damage was again apparent within the same areas, as well as other parts of the province and a preliminary damage assessment survey was conducted along with observations on the insect's life cycle. In 2008, no damage was seen on white pine, but observations revealed new galls on red/black spruce and the presence of winged adults and immature life-stages of the adelgid on white pine were confirmed. We expect to see damage on white pine in 2009, unless over winter mortality and natural bio-controls reduce the adelgid populations.

Hemlock Woolly Adelgid: No forest surveys were conducted for this invasive insect in 2008. Detection surveys conducted in 2005 and 2007 did not find any signs or symptoms.

European Larch Canker: This disease is known to be present throughout southeastern New Brunswick and has been occasionally surveyed by the CFS in the past. No specific surveys have been done since 2000.

Scleroderris Canker of pines - European Race: The European race of this disease was once thought to occur at about a dozen sites in New Brunswick, but newer testing methods used by the CFS confirmed only three sites to be positive. These occur in northwestern New Brunswick within a few kilometres of each other. Two sites contain Scots pine and the other is red pine. A reconnaissance visit was made to the infected sites in the summer of 2008. The original positive site was heavily overgrown and was not directly visited. The second site (Scots pine) also had significant in-growth within the under story and was quite dense to walk in. At its perimeter, a number of dead trees and trees with dead and dying tops were easily seen. At the third site, the red pine looked quite healthy with no obvious sign of red needles or other obvious symptoms of infection – in fact, it was remarkably healthy looking. Quarantine regulations are in place under the federal *Plant Protection Act* administered by the CFIA.

Sirococcus Shoot Blight on red pine: From time to time, isolated stands of red pine with damage from Sirococcus shoot blight have been identified in New Brunswick. In 2008, two stands – one in northwestern New Brunswick and one in southwestern New Brunswick – had mortality and damage caused by Sirococcus.

Gypsy Moth: Over-winter egg survival, as measured at four sites in the spring of 2008, was down from the last two years following the cold winter of 2007-08. All egg masses were collected at heights believed to have been above the snowline. The overall combined egg survival was 65% compared to 92% in 2006, and 82% in 2007. Levels at each site were: 28%, 51%, 95% and 99%, indicating the range of variability that can occur between sites. No defoliation was detected by the provincial aerial survey or ground surveys; though some minor defoliation was detected in the City of Fredericton where populations appear to be increasing. Interestingly, results from the Provincial early detection pheromone trap survey revealed increases in trap catches from last year, i.e., the mean trap catch was 55 moths/trap compared to 34 moths/trap in 2007. In addition, population increases were noted in the egg mass survey conducted at a number of plots that have been monitored annually since 1995, i.e., a mean of 30 new egg masses/person-hour searching compared to 12 new egg masses/person-hour searching in 2007. Despite these increases, no areas of defoliation are forecast for 2009. Nonetheless, given the right circumstances of high over-winter survival and lack of significant natural bio-controls next summer, it's possible that some noticeable feeding could occur at some isolated, localized sites. Survey results indicate that much of the northern part of the province still remains free of this pest and no new locations with gypsy moth life-stages were found outside the currently regulated areas in 2008.

Forest Tent Caterpillar: According to pheromone trap catch data, populations seemed to decline from 2002 to 2005; but catches increased in 2006 leading to a speculation that this might be the start of increasing populations. In 2007, however, trap catches drastically declined. In 2008, a further decrease was experienced in terms of the percent of traps that were positive; nonetheless, the overall provincial mean trap catch rose very slightly as did the maximum trap catch. These increases appear to be mainly associated with a number of traps in the north-central part of the province. It will be interesting to see if trap catches increase there again in 2009 and if so, by how much. Nonetheless, populations remain at low levels and no defoliation is forecast 2009.

Large Aspen Tortrix: In 2007, ground surveys and aerial reconnaissance detected small but widespread patches of trembling aspen defoliation in the northern half of the province (from Plaster Rock southwest to Arthurette, northeast of Kedgwick, south of Dalhousie, and from Nash Creek to Bathurst). In 2008, ground surveys again detected defoliation in these areas as well as an area north of Tracy Depot.

Fall Webworm: Webs of this insect were commonly seen along the roadside around the province in 2004. Reports have been less common since then though it was detected in 2008.

Fall Cankerworm: In 2005, feeding damage was reported to about 15 ha along the southwest Miramichi River. In 2006, a visit to the area found numerous larvae of fall cankerworm. There were no significant reports of this pest in this area in 2007. In 2008, small patches of defoliation were observed in the Grand Lake Meadows Area between McGowans Corner and Jemseg.

Butternut Canker: This disease was first confirmed to be in NB in 1997 at 5 sites near Woodstock. In 2004, the CFS confirmed several more positive sites, some about 50 km farther north. In 2005, butternut trees were put on the Endangered List under the Canadian *Species at Risk Act*, partly because of the presence of butternut canker. No evidence of newly infected areas was reported in 2005 or 2006. In 2007, however, the CFS reported 5 new positive sites once again, this time somewhat farther south representing a significant southerly expansion of the known distribution of butternut canker in New Brunswick. In 2008, the CFS reported two more new positive locations. Each location is about 35 km due north and southeast (respectively) from the previous finds above Fredericton.

Miscellaneous: A small number of miscellaneous insects were also reported, especially aspen leaf roller observed in the Saint John River Valley. Hail damage (attributed to a weather event in June) was observed over a widespread area in north-central New Brunswick. Beech mortality associated with beech bark disease was again detected by aerial survey in north-central and northwestern parts of the province.

No significant pests were encountered in Provincial seed orchards or the Provincial forest tree nursery.

INTRODUCTION

Outbreaks of minor and major forest pests occasionally occur and cause variable amounts of growth loss and tree mortality. Besides affecting the natural forest, outbreaks can adversely affect high-value reforestation and tree improvement programs, from nurseries to seed orchards, to plantations and thinned stands. Thus, long-term forest management plans are constantly under threat of possible compromise from unwanted pest outbreak. In addition to timber losses, major effects can be caused to non-timber values such as terrestrial and aquatic wildlife habitat, recreational sites and aesthetics.

Besides native pests, today's global economy brings increased risk from the accidental introduction of insects and diseases from around the World. Such introductions could not only cause direct impacts on natural forests and the environment, but also indirect economic impacts through regulations placed on domestic, national, or international movement of goods. These trade issues can negatively affect the ability of small and large companies to be competitive in local and global markets. For all these reasons, it is necessary to know about the status of forest pests and the threats they pose.

Monitoring and forecasting the status of forest pests requires the use of different techniques that reflect survey objectives, pest population levels, the pest's biology, and knowledge of relationships between numbers of pests and damage. For some pests these are well established; for others these are not. Aerial surveys provide the means to map damage in various categories to assess the extent and severity of outbreak over vast areas.

For some insects, surveys can be conducted to establish population levels by sampling appropriate locations for eggs or egg masses, depending on the female's egg laying habits. Surveys of larvae can be conducted during the insect's active feeding period, or during periods when they are inactive, such as in the over-wintering stage. Surveys of pupae to estimate insect population levels are less common.

Special odours or scents, called pheromones, are given off by female insects to attract males of the same species for mating. In recent years, the identification and artificial synthesis of sex pheromones for a number of forest insects has led to the use of pheromone-baited traps as a technique to monitor these pests. This is especially true when populations are very low and not detectable by traditional survey sampling intensity for other life stages. Because these artificial lures are often very potent, they sometimes offer the opportunity to detect subtle increases that might not be as easily detected by the other means. In other instances, they might still be under development and results have to be interpreted with caution. Depending on trap catch thresholds or yearly trends, these surveys could result in the implementation of other methods to forecast levels of damage expected the ensuing year.

One of the cornerstones of DNR's pest monitoring program is the use of pheromone traps for the early detection of changes in population levels of many softwood and hardwood forest pests, before they increase to potential outbreak status. It is important, however, to be aware that the number of insects captured in a trap is greatly influenced by the type of lure used, its concentration, the trap design and the insect species itself. Therefore, a moth count considered to be biologically significant for one species may be insignificant for another by several orders of magnitude. Consequently, the absolute number of insects in a trap is not as important as the trends between years and over time.

PESTS OF SOFTWOODS

Spruce Budworm

No defoliation by spruce budworm has been reported since 1995, the last year that controls were applied. Since then, operational monitoring has been done using a combination of spruce budworm pheromone traps to capture male moths and branch samples to collect over-wintering second instar larvae (L2). Monitoring locations are more or less evenly distributed throughout the province, and supplementary sampling is done as needed. So far, pheromone trap catches were lowest in 1997. This was followed by an overall general upward trend to a maximum of 81% of the traps that caught moths in 2005. In 2006, the percent of positive traps decreased to 60% followed by a decrease to 48% in 2007, with a further decline to 39% in 2008 (Table 1). The Provincial mean trap catch also decreased over these years (Table 1). These three consecutive years of decreases following a fluctuating but more or less upward trend since 1995 add to the complexity of forecasting long-term trends for spruce budworm when populations are at endemic levels. Nonetheless, the highest trap catches were once again detected in northwestern New Brunswick where, since 2000, they have been perennially higher than the rest of the province.

Table 1. Summary of spruce budworm pheromone trap surveys conducted by FPMS in New Brunswick from 1995 to 2008.

Year	Number of traps	Percent of traps in each class of moths/trap			Trap catch		% of traps positive
		0	1-10	>10	Range	Mean	
1995	296	42%	50%	8%	0 - 47	3.27	58%
1996	99	53%	41%	6%	0 - 54	3.24	47%
1997	148	73%	27%	0%	0 - 6	0.49	27%
1998	148	67%	33%	0%	0 - 10	0.95	33%
1999	155	59%	41%	<1%	0 - 12	1.05	41%
2000	154	55%	42%	3%	0 - 25	1.67	45%
2001	197	42%	50%	8%	0 - 32	2.90	58%
2002	198	65%	33%	2%	0 - 12	1.02	35%
2003	198	57%	39%	4%	0 - 18	1.89	43%
2004	196	52%	45%	4%	0 - 17	1.86	49%
2005	255	19%	73%	8%	0 - 41	3.81	81%
2006	281	40%	54%	6%	0 - 42	2.68	60%
2007	298	52%	45%	4%	0 - 56	2.28	48%
2008	295	61%	37%	3%	0 - 18	1.29	39%

In 1998, DNR modified its L2 monitoring survey (which replaced the egg mass survey in 1985) by using a combination of sampling intensities consisting of a 'traditional' set of plots, where 3 trees/plot are sampled; and more intensive plots, where 30 trees/plot are sampled. Additional plots are added as deemed necessary in any particular year, and this may also be followed by supplementary sampling to refine the population forecast.

From 1995 to 2008, L2 surveys also show endemic populations within the province. Only trace levels have been detected at a small number of plots fluctuating from a low of 0% in 1999 to a high of 7.1% in 2004 (Table 2). In 2006, only one plot had detectable larvae (i.e., 2 larvae from a 3-tree plot). That plot was located on the northwestern part of the province referred to as the 'panhandle'. In 2007, only two plots, both in north and northwestern New Brunswick, were positive for L2 larvae; 2 larvae were extracted from a 3-tree plot and 4 larvae from a 30-tree plot.

Table 2. Summary of spruce budworm larvae detected in L2 surveys conducted by FPMS in New Brunswick from 1995 to 2008. (Supplementary samples to refine the forecast are not included in this table).

Year	Number of plots	Number of trees/plot	Number of branches	Number of L2 detected	Number (%) of plots with L2 detected	Plot type where L2 found
1995	814	3	2442	65	28 (3.4%)	
1996	503	3	1509	8	3 (0.6%)	
1997	317	3	951	2	2 (0.6%)	
1998	75	3 & 30	900	4	3 (4.0%)	3 x 30-tree plots
1999	75	3 & 30	900	0	0 (0.0%)	
2000	75	3 & 30	900	5	1 (1.3%)	1 x 30-tree plot
2001	78	3 & 30	909	1	1 (1.3%)	1 x 30-tree plot
2002	75	3 & 30	900	1	1 (1.3%)	1 x 3-tree plot
2003	79	3 & 30	1020	8	4 (5.1%)	4 x 30-treeplots
2004	99	3 & 30	1269	19	7 (7.1%)	5 x 30-tree plots; 2 x 3-tree plots
2005	95	3 & 30	1041	5	3 (3.2%)	2 x 30-tree plots; 1 x 3-tree plot
2006	100	3 & 30	1056	2	1 (1.0%)	1 x 3-tree plot
2007	110	3 & 30	1167	6	2 (1.8%)	1 x 30-tree plot; 1 x 3-tree plot
2008	105	3 & 30	1125	28	3 (2.9%)	3 x 30-tree plots

In 2008, a total of 28 larvae were obtained from three separate 30-tree plots. Two plots were located on the panhandle and one in the central region. One of the plots on the panhandle yielded 21 larvae from one branch and the other plot yielded 2 larvae from one branch. The central plot yielded 5 larvae from one branch.

Overall, any population trends suggested by the pheromone trap data and L2 data at this time continue to present a challenge for making predictions into the future due to the difficulties associated with detecting subtle changes within low density spruce budworm populations. Nevertheless, the data do not suggest any threat for 2009.

In addition to the Provincial pheromone trapping and L2 surveys conducted by FPMS, J.D. Irving, Limited conducts similar surveys on parts of their freehold limits and submits samples to FPMS for processing. Pheromone traps hung at approximately 100 plots on their freehold lands gave similar results to the Provincial survey. Results of their L2 survey are not available at this time.

Jack Pine Budworm

Defoliation by jack pine budworm in New Brunswick has not been reported since 1983, though monitoring is conducted annually because of the importance of natural jack pine stands and plantations for the Provincial wood supply. A network of pheromone traps was initiated in 1997 at locations selected to represent these stands. In 2008, a review of the survey resulted in the addition of a number of plots and increasing the area surveyed to include some areas felt to be under represented. No moths were caught in the first year, but since then moths have been caught annually, albeit in low numbers, with the maximum being 41 moths in one trap in 1999 (Table 3). In that year, a follow-up L2 survey was done, but no larvae were detected. In 2004, we switched from Delta traps (sticky on 3 sides) to the Multi-Pher1® traps with Vaportape ll® killing strip to improve the quality of samples collected and facilitate more accurate moth identification.

In 2006, we conducted a comparative test using traps baited with a rubber septa pheromone lure (100 μg load) produced by the New Brunswick Research & Productivity Council (RPC), and traps baited with a PVC flex lure (300 μg load) commercially available from Phero Tech Inc. (PTI) in British Columbia. Based on that test (results previously reported), and similar studies done in higher populations in Manitoba and Saskatchewan which yielded no significant differences between the two lure sources, we switched to the PTI lure in 2007.

Since the inception of the trapping program in New Brunswick, jack pine budworm populations have remained at endemic levels, with only low moth counts found in pheromone traps. Against this backdrop, 2007 seemed an opportune time to switch lures to the commercially available PVC flex lure (300 μg load). Any spikes in trap catches in future years can then be attributed to population change rather than the switch to the new lure.

Table 3. **Summary of jack pine budworm pheromone trap surveys conducted by FPMS in New Brunswick from 1997 to 2008.**

Year	Number of traps	% of traps positive	Percent of traps in each class of moths/trap					Moths/trap	
			0	1-10	11-20	21-40	>40	Range	Mean
1997	46	0%	100%	0%	0%	0%	0%	0	0.00
1998	52	42%	58%	42%	0%	0%	0%	0 – 8	1.42
1999	51	55%	45%	45%	8%	0%	2%	0 – 41	3.25
2000	51	27%	73%	25%	2%	0%	0%	0 – 17	1.45
2001	51	57%	43%	47%	2%	8%	0%	0 – 30	1.51
2002	51	41%	59%	35%	4%	2%	0%	0 – 22	1.92
2003	50	26%	74%	24%	2%	0%	0%	0 – 14	1.12
2004	50	34%	66%	34%	0%	0%	0%	0 – 10	1.46
2005	49	39%	61%	39%	0%	0%	0%	0 – 10	0.82
2006	47	43%	57%	43%	0%	0%	0%	0 – 9	1.02
2007	49	53%	47%	49%	4%	0%	0%	0 – 13	1.59
2008	59	58%	42%	51%	5%	2%	0%	0 – 21	3.00

Since 1998, 26% to 58% of the traps have been positive and average moth counts have fluctuated within the range of 0.82 to 3.25 moths/trap (Table 3). It is interesting to note that the percent of traps positive has increased annually for the last five years since 2003, and the average number of moths/trap has increased annually for the last three years since 2005. These are most likely normal endemic fluctuations, though it will be interesting to see if populations do indeed increase within the next few years.

Overall, the survey results in 2008 indicate that jack pine budworm populations are still at endemic levels throughout the zones monitored; hence, larval densities in 2009 are expected to stay at very low to undetectable levels throughout New Brunswick and no defoliation is anticipated.

Hemlock Looper

This insect can kill trees in a single year. The only reported outbreak of hemlock looper in New Brunswick occurred from 1989 to 1993. Areas affected were in the northwestern, north-central and southwestern parts of the province. In the north, the Canadian Forest Service (CFS) estimated about 650 000 m^3 of merchantable balsam fir were killed during this period, though salvage harvesting by Fraser Inc. and Repap New Brunswick Inc. reduced the volumes actually lost. Controls were applied in 1990, 1991 and 1993.

Since 1997, populations have been monitored using a network of pheromone traps throughout the province supplemented by egg surveys as needed. Pheromone trap catches had increased 3.3-fold province wide in 2000 (hinting an impending outbreak), but decreased in 2001, though defoliation was mapped over 760 ha that year. In 2002 and 2003, no defoliation was recorded and trap catches resembled those of 1997-1999 (Table 4). In 2004, a 2.5-fold province-wide increase in trap over 2003 occurred, somewhat resembling the increase seen in 2000. Highest trap catches occurred in the extreme northwest close to the Québec border and in the north-central parts of the province. Consequently, a follow-up egg survey was done in selected areas to see if populations were high enough to anticipate defoliation in 2005. Based on previous experience with the number of eggs encountered, no defoliation was anticipated for 2005, and none was detected from aerial surveys or ground observations. Likewise, no defoliation was reported in 2006.

Mean and maximum trap catch progressively decreased from 2004 to 2006 suggesting the increase in 2004 was part of normal population fluctuations. Moth counts slightly increased in 2007, but remained at endemic levels. In 2008, the overall Provincial mean trap catch decreased to 63 moths/trap – somewhat comparable to the low levels in 1999, and 2003 (Table 4). There appears to be very little likelihood of defoliation in 2009. Nonetheless, yearly increases and trend analyses are worth doing to ensure prompt detection of an outbreak and decision-making because this insect can kill trees in a single year.

Table 4. Summary of hemlock looper pheromone trap surveys conducted by FPMS in New Brunswick from 1997 to 2008.

Year	Number of traps	% of traps positive	Mean trap catch*	Moths/trap (range)*
1997	103	99	92	0 – 448
1998	95	99	71	0 – 524
1999	98	100	69	3 – 411
2000	99	100	230	3 – 863
2001	199	>99	89	0 – 837
2002	101	99	77	0 – 444
2003	98	100	64	1 – 342
2004	101	100	157	6 – 1127
2005	198	>99	115	0 – 723
2006	93	99	105	0 – 649
2007	105	99	121	0 – 719
2008	102	99	63	0 – 545

* *Numbers are based on pheromone lure strength of 10-µg. For 1997 to 2000, the numbers of moths/trap (using 200-µg lure) were converted to estimates of moth catches using 10-µg strength lure using the equation: $Y = 0.565 X + 1.469$ developed from a 3-year study, 1998 – 2000.*

In addition to the Provincial pheromone trap survey conducted by FPMS, J.D. Irving, Limited conducts a similar survey on parts of their freehold limits and submits samples to FPMS for processing. Those results are not available at this time.

Whitemarked Tussock Moth

The last outbreak of this pest in New Brunswick occurred in the 1970s. Thus, the population explosion of this insect in Nova Scotia in 1997 coupled with their forecast for 1998 caused great interest in New Brunswick. Since 1998, however, annual monitoring with pheromone traps (Table 5) and occasional egg mass searches had not revealed any significant populations in this province. Nonetheless, a low-level increasing trend in populations seemed somewhat evident since 2001 when no moths were detected followed by increases up to 2006 when the highest percent (39%) of traps were positive with the highest mean (0.92 moths/trap) and maximum trap catch (12 moths) (Table 5). Indeed, the frequency of encountering incidental levels of larvae in the field significantly increased in 2006.

<u>Table 5.</u> Summary of adult whitemarked tussock moths caught in pheromone trap surveys conducted by FPMS in New Brunswick from 1998 to 2008.

Year	Number of traps	Number (%) of traps positive	Moths/trap (range)	Mean trap catch
1998	59	5 (8%)	0 – 4	0.17
1999	57	2 (4%)	0 – 2	0.05
2000	54	2 (4%)	0 – 1	0.04
2001	49	0 (0%)	0	0.00
2002	49	1 (2%)	0 – 1	0.02
2003	49	6 (12%)	0 – 4	0.22
2004	51	5 (10%)	0 – 1	0.10
2005	49	12 (24%)	0 – 4	0.51
2006	75	29 (39%)	0 – 12	0.92
2007	102	11 (11%)	0 – 2	0.15
2008	101	1 (1%)	0 – 1	0.01

In view of these changes, an egg-mass/life stage survey was conducted in southern New Brunswick at 245 locations. New cocoons were found at 26% of the sites, yet new egg masses were only detected at 2% of the sites. Examination of the cocoons/pupae found that on average 25% of the insects successfully emerged from their pupal cases, 39% were parasitized; 22% failed to successfully complete development, 7% were diseased; and 6% were predated upon. Whether these low-level changes in pheromone trap catches and findings of cocoons are indications of an impending outbreak, or are normal endemic fluctuations, were then unclear.

As it turned out, in 2007, moth catches in pheromone traps declined from the previous two years. Only 11% of the traps were positive, with 1-2 moths/trap. Positive traps were found in southeastern New Brunswick, in a geographic band east of Saint John, running along the Bay of Fundy to the Nova Scotia border and Northumberland Strait. Whitemarked tussock moth populations were expected to remain at endemic levels in 2008. Indeed, populations appeared to decline this year as only 1 trap caught a single moth. There appears to be no threat of defoliation by this pest in 2009.

[Note: One drawback of the current pheromone trapping program for whitemarked tussock moth is the lack of information on the chemistry of the commercial lure. For other moth pheromone lures used by FPMS the load is known and the information readily available from the supplier (e.g., 2.8 mg load for spruce budworm; 10 µg load for hemlock looper and 300 µg for load jack pine budworm). While it is known that the whitemarked tussock moth lure is loaded with (Z)-6-heneicosen-11-one (Z6-11-one-21Hy), a sex pheromone component of the whitemarked tussock moth, its specific dosage is unknown and considered proprietary information by the company that manufactures it.

As such, if the manufacturer were to unilaterally modify the dosage of the lure, the end user of the product really has no way of knowing there was a formulation change. Consequently, changes in trap catches from one year to the next could actually reflect a formulation change rather than an actual population change. Purchasing lures from a more supportive manufacturer is not currently an option as there are no other known manufacturers of the whitemarked tussock moth lure.]

Rusty Tussock Moth

This insect, of European origin, is now transcontinental in distribution. It is highly polyphagous and can attack most conifers and hardwoods. Outbreaks are usually small and of short duration, and are not common in New Brunswick, but they have been reported several times in Newfoundland. Each year since 1998, pheromone traps used for detecting whitemarked tussock moth have also caught moths of this closely related species (Table 6).

In 2005, the mean trap catch was the highest yet, and the data hinted an increasing trend, though overall results were not significantly beyond levels seen in the past. And, no defoliation has been detected so far, thereby suggesting that the numbers of moths being caught are below the threshold of impending detectable larval feeding, and hence below an indication of when an egg mass survey might be needed. Thus no defoliation was forecast for 2006 and none was detected.

<u>Table 6.</u> Summary of adult rusty tussock moths caught in pheromone trap surveys conducted by FPMS in New Brunswick from 1998 to 2008.

Year	Number of traps	Number (%) of traps positive	Moths/trap (range)	Mean trap catch
1998	59	19 (32%)	0 – 9	0.9
1999	57	20 (35%)	0 – 11	1.4
2000	54	14 (26%)	0 – 10	0.8
2001	49	19 (39%)	0 – 20	1.8
2002	49	30 (61%)	0 – 18	1.5
2003	49	21 (43%)	0 – 12	1.3
2004	51	17 (33%)	0 – 10	1.0
2005	49	26 (53%)	0 – 20	2.4
2006	75	30 (40%)	0 – 32	2.1
2007	102	17 (17%)	0 – 7	0.4
2008	101	4 (4%)	0 – 3	0.1

In 2007, it was reported that trap catches of rusty tussock moth were lower than in any other year of monitoring for this insect no matter what measure was used for the survey be it mean trap catch, maximum moth catch or percent of positive traps. In 2008, however, all these values fell to even lower levels (Table 6). In reviewing past data, it now appears that the observed fluctuations in trap catch between years (e.g., high of 2.4 moths/trap in 2005 to a low of 0.1 moths/trap in 2008) are normal fluctuations in a stable, endemic population. Pheromone trap catches indicate that rusty tussock moth populations will remain at endemic levels throughout southern New Brunswick in 2009.

Balsam Twig Aphid

This insect is not a significant forest pest, though it can be a major problem for the Christmas tree industry. Populations are monitored in a general way throughout the province by assessing their presence on balsam fir branch samples collected for the spruce budworm L2 survey. Analyses of data from previous years indicate a tendency for balsam twig aphid populations to increase and decrease in general synchrony throughout the province (though local variations do occur).

In 2007, the number of plots with detectable balsam twig aphid decreased to 47% compared to 70% in 2006 presenting a case where it was uncertain whether populations might further decline in 2008 or rebound. As it happened, populations appeared to rebound somewhat with 66% of the plots being positive. Once again it is not clear from the year-to-year trends whether populations will increase or decrease in 2009. We expect, however, that populations will persist at levels similar to recent years. Because these data are collected at a limited number of locations widely distributed throughout the province, Christmas tree growers need to monitor conditions on their own property.

Balsam Gall Midge

This insect is also not considered a significant forest pest, but like the balsam twig aphid it can be a problem for Christmas tree growers. Populations of balsam gall midge are also monitored around the province by assessing their presence on balsam fir branch samples collected for the spruce budworm L2 survey. As with balsam twig aphid, analyses of previous years' data indicated a tendency for balsam gall midge populations to increase and decrease in general synchrony (with some local variations) throughout the province. Likewise, the data since 1984 suggest a more regular cyclical trend in populations. In this case, because balsam gall midge populations had been low for a few years (2002-2005), and we speculated that increases might soon occur if the past trend repeated.

In 2006, an increase was indeed detected as 23% of the plots had galls present (up from three consecutive years of less than 5%). In 2007, fir plots with balsam gall midge populations increased for the second straight year to 41%, and we speculated that if historic patterns repeat themselves, populations could still increase somewhat over the next few years. Because the percent of positive plots rose to 66% in 2008, we again speculate that they may slightly increase or possibly remain at or about these levels for the next few years. Again, Christmas tree growers need to monitor conditions on their own property because these data come from a limited number of samples widely distributed throughout the province.

Balsam Woolly Adelgid

This insect, of European origin, was first found in the Maritimes in the early 1900s and in Québec in 1964. It only attacks true firs of the genus *Abies*. Symptoms of attack, especially gouty tops, are noticeable in southern New Brunswick where local tree mortality, severe in some cases, has been reported in recent years. It has been speculated that populations had increased in the 1990s due to a number of milder winters. Mortality of the adelgid's over-winter dormant stage increases when temperatures reach -20°C and is complete at -37°C. Concerns by forest industry prompted distribution surveys, over-winter survival surveys and small-scale studies on growth impact in the past few years.

Surveys conducted since 2002 have revealed symptoms of attack throughout southern New Brunswick below an irregular line drawn in a general northeasterly direction from about Nackawic in the west to the City of Miramichi in the east. This southern part of the province below this general line is associated with milder winter temperatures more conducive to over winter survival of the insect and corresponds very well to Plant Hardiness Zones 4b, 5a and 5b for New Brunswick (see http://sis.agr.gc.ca/cansis/nsdb/climate/hardiness/intro.html). Curiously, this line is similar to, but a little farther south than reported in the literature (*i.e.*, Fig. 32 in Prebble, M.L. (editor). 1975. Aerial control of forest insects in Canada. Env. Can. Ottawa).

In the spring of 2003, a system to monitor annual population changes of balsam woolly adelgid was initiated at 12 locations in the southern region of the province. In the spring of 2008, branch samples were collected at these sites and processed in the lab to determine the number of adults present to compare with counts from the previous spring. The winter of 2007-08 was characterized by 19 days with temperatures below -20°C, including 5 days below -25°C (data from Fredericton Airport). Given the cold temperatures, lower populations (as measured using this survey method) were expected. In fact, 4 locations did have lower populations; however, there were 8 locations where populations increased, albeit slight in some cases. We wonder if the insulating effect of heavy snow cover on the tree branches might possibly have contributed to the high survival.

At 10 of these locations, tree damage assessments were made and compared with ratings done in 2003. No change was reported for 68% of the tress, 20% had an increase in damage, and 12% had a decrease in damage (i.e., showed signs of recovery). Overall, 86% of the trees still have damage levels of light or nil. It should be kept in mind, however, that these data come from a small sample size of 5 trees per site and only 10 sites.

Data collected over the past six years continue to indicate what an insidious pest this insect is. Populations fluctuate depending on winter and possibly other unexplored/unexplained factors. Symptoms of damage are prone to show increases and recovery. Although galling and distorted tops are common on balsam fir in southern New Brunswick, we have yet to encounter any area suffering from stem attack – a condition that is more associated with tree mortality.

Finally, branch sampling and damage assessments were done at 69 balsam fir thinnings and 12 permanent sample plots to gather data for UNB/CFS who are working towards a hazard rating system for balsam woolly adelgid.

Brown Spruce Longhorn Beetle

This non-native insect was confirmed present in Nova Scotia in the spring of 2000 and it was subsequently revealed that it had been present at least since 1990, but had mistakenly been mis-identified as a similar native species. It appears capable of killing red, white, black and Norway spruce and poses a threat to spruce forests and associated forest industry. Eradication actions, under the leadership of the Canadian Food Inspection Agency (CFIA) under the federal *Plant Protection Act*, were initiated in 2000. There is speculation that population increases and expansion could be associated with extensive wind-thrown trees from Hurricane Juan in 2003.

So far, surveys have not detected its presence in New Brunswick. However, reports from Nova Scotia confirmed a significant increase in the area over which the beetle was found in 2006, thus jeopardizing continued eradication actions. As a result, the CFIA switched to a 'slow-the-spread' policy and instituted a greatly expanded Containment Area to regulate the movement of specified high-risk spruce materials. That increased the concerns in New Brunswick because softwood from that province is sometimes delivered to mills in New Brunswick. The CFIA have maintained dialogue with government and industry representatives of both provinces, and CFS researchers, regarding the expanded management zone and conditions of treatment that would facilitate the continued movement of host spruce material.

In 2007, the New Brunswick forest industry self-imposed a voluntarily one-year moratorium on regulated spruce materials coming from the Containment Area within Nova Scotia. The CFIA also greatly increased its survey efforts within the Atlantic Provinces and Québec in 2007, but no BSLB were found outside Nova Scotia. Nonetheless, substantial increases were detected in that province, raising expectations for further expansion of the Containment Area in 2008. This did not happen, however, due to strong representation by the forest industry led by the Maritime Lumber Bureau. The New Brunswick forest industry extended its voluntary moratorium into 2008. Plans for 2009 have yet to be developed though meetings are anticipated between the CFIA and its industrial partners this winter to examine the implications of surveys and research conducted this past summer.

Pine Shoot Beetle

Since 1992, this non-native insect has gradually been found from Ontario eastward into Québec and in the Lake States, ultimately reaching Maine in 2000. In Ontario, it has been found in association with mortality in Scots, red, white and jack pines, though it is uncertain whether Scots pine must be present to enable populations to become high enough to damage the other pine species. Quarantine regulations are in place under the federal *Plant Protection Act* administered by the CFIA. So far, monitoring surveys done by the CFIA and CFS have not detected its presence in New Brunswick.

Pine Leaf Adelgid

According to the literature, the life cycle of the pine leaf adelgid extends over two years and involves five different forms and two hosts. Its primary hosts are red and black spruce and its secondary hosts are generally eastern white pine and occasionally red, Scots and Austrian pine. It occurs in all Canadian provinces as well as Maine, New Hampshire, Vermont and New York. Damage on spruce consists of the formation of cone-shaped galls that do not affect the health of the trees. On pine, damage may cause mortality of shoots and even tree death. Records indicate that this insect has on occasion been a major pest in New Brunswick, Nova Scotia and Maine. In New Brunswick, an outbreak started in 1942 and within 10 years all stands of red spruce and eastern white pine in most of the province were infested. Populations then declined unexpectedly, and have rarely been reported since.

In 2005, the pine leaf adelgid caused widespread attack on white pine generally north and south of the Miramichi River in central New Brunswick as well as eastern New Brunswick. Damage on white pine was generally much less evident in 2006.

In 2007, however, widespread damage was again apparent within the same areas, as well as other parts of the province. Given the concerns expressed by DNR Regional and industry staff, a survey was conducted in 2007 to examine the severity of damage, specifically in areas where intensive pine management is conducted. Damage was rated on a total of 1996 over-story and 1835 under-story trees in 66 representative stands. Approximately 75 to 90% of the trees had damage in the nil to trace categories (1-5% of the 2006 foliage affected), 7-10% had light damage (6-30% of 2006 foliage affected), and trees with moderate (31-70%) and severe (>70%) damage represented only 15% of the trees assessed in the under-story and 2.5% in the over-story, respectively. These results suggest that the more mature trees are less severely attacked (as reported in the literature). It remains to be seen whether populations will persist and increase, and whether the future health and growth of trees will be severely impacted.

Also in 2007, observations were made to determine the life-stage and the specific host the adelgid was feeding on within its complex two-year life-cycle. In the same stands assessed for severity of damage, no evidence of winged adults on white pine or new galls on red/black spruce were found. This suggested the insect had migrated from the white pine back to the red/black spruce in 2007. Whether populations would persist or increase in 2008 was unknown. If they persisted, it was speculated that the adelgid's life-stages would move back to white pine in 2008 with no damage apparent until 2009.

In 2008, new galls on red/black spruce and the presence of winged adults and immature life-stages of adelgid on white pine were confirmed. This also indicated that populations were still present and active in the area. Although feeding by the pine leaf adelgid on the current shoots of white pine was evident in 2008, the symptoms of damage will not be apparent until next spring. Shorter shoots and some discoloration of foliage (yellowish-green) were observed, but no widespread reddening of foliage indicating dead shoots was seen. This is in keeping with the trend of white pine being damaged in alternating years. Consequently, we expect to see damage on white pine in 2009, unless over winter mortality and natural bio-controls reduce the adelgid populations.

Hemlock Woolly Adelgid

In 2005, FPMS conducted a detection survey in New Brunswick for this non-native pest for the first time in forested areas (30 hemlock stands) but no signs of the insect or damage were found. The survey was not repeated in 2006. In 2007, 52 hemlock stands were assessed, but again no life stages or symptoms of damage were detected. No survey was conducted by FPMS in 2008.

European Larch Canker

This non-native disease was first found by the CFS in New Brunswick in 1980. It is capable of killing mature and immature larch trees. It is present mostly throughout the southern half of the province and quarantine regulations are in place administered by the CFIA under the federal *Plant Protection Act*. In 1977, the CFS found a positive site outside, but close to the known regulated area, but the CFIA have made no changes to the regulated zone. Surveys by the CFS from 1998 to 2000 did not detect any new positive sites, and no specific survey has been done since.

Scleroderris Canker of pine – European Race

The North American race of this disease seldom causes mortality to trees over 2-m tall, though branches up to this height are affected. The European race, however, is capable of killing much taller trees. It was once thought to occur at about a dozen sites in New Brunswick, but newer testing methods used by the CFS in 1998 confirmed only one site was actually positive for the European race (found on Scots pine in northwestern New Brunswick). In 1999, two nearby sites (within a few kilometres) were confirmed positive (one Scots pine and the other red pine). No new positive sites have been reported since then. Quarantine regulations are in place under the federal *Plant Protection Act* administered by the CFIA.

In 2008, a reconnaissance visit was made to two of the three known infected sites. The Scots pine plantation visited showed signs of tree mortality and trees with dead and dying tops were easily seen. The red pine plantation, however, had no obvious sign of red needles or other obvious symptoms of infection – in fact, it was remarkably healthy looking.

Sirococcus Shoot Blight on red pine

Although this fungal disease attacks many conifers, it is most damaging to red pine. It kills only the current year's shoots about 4-6 weeks after infection. Seedlings, especially container-grown stock, die quickly; older trees may die after several successive years of severe infection.

This disease is known to be widely distributed in the Maritime Provinces, but severe damage is not common in New Brunswick. Nevertheless, from time to time isolated stands of red pine have been identified with damage from Sirococcus shoot blight particularly in southwestern New Brunswick.

In 2008, two stands – one in northwestern New Brunswick (14-km east of Veneer) and one in southwestern New Brunswick (15-km south of the Town of Nackawic near Lily Lake) had mortality and damage caused by Sirococcus. Both sites are expected to be harvested.

PESTS OF HARDWOODS

Gypsy Moth

Historically, gypsy moth was reported present in southwestern New Brunswick in the mid-1930s but eradicated by 1940. It was 'rediscovered' in the same general area in 1981, and since then it has gradually expanded its range in the province. Quarantine regulations have been put in place under the federal *Plant Protection Act* administered by the CFIA. Defoliation (~ 4 ha of second-growth poplar) was first mapped from the air in 1987. Increasing populations were detected in south-central regions between 1998 and 2000. This led to three consecutive years of defoliation (from 2001 to 2003) followed by population collapse due to extremely cold winter temperatures in 2002-2003 and 2003-2004, and build-up of larval diseases (i.e., nuclear polyhedrosis virus and the fungus *Entomophaga maimaiga*), along with other natural bio-controls. Some private landowners had some of their property aerially sprayed with *Btk* in 2002 and 2003.

Annual pheromone trapping and egg mass surveys indicate that low-density populations persist in known infested areas in southern New Brunswick and at some sites distant from them (e.g., as far northeast as Miramichi City). During the years with high populations and defoliation there was an increased risk of spread of this pest, hence finding new positive sites was anticipated.

In 2005, the CFIA increased the regulated areas from the smaller parish level to the larger county level and included eight counties, plus Miramichi City. The regulated counties include: Charlotte, Carleton, York, Sunbury, Kings, Queens, Saint John, and Albert. These new regulated areas incorporated all the positive sites found outside the regulated area from 1993 to 2004. In the fall of 2005, evidence of new populations was found for the first time in Moncton and Memramcook in Westmorland County, and Bouctouche in Kent County, extending the known distribution of gypsy moth farther eastward in the province.

In 2006, new egg masses were again found in Memramcook and Bouctouche, and found for the first time in Petitcodiac and in Sackville (reported by the CFIA). This led to the addition of Westmorland County and the Town of Bouctouche to CFIA's list of regulated areas.

In the spring of 2008, egg masses were collected at four sites (from heights believed to be above the snow line) to estimate over-winter survival. A total of 50 egg masses were collected (i.e., 10 at each of 3 sites and 20 at the other site). Not unexpectedly, there was variability in survivorship between sites. Seven (14%) egg masses failed to have any eggs hatch at all; conversely, various numbers of eggs hatched from the remaining 43 (86%). Egg hatch at each site was 28%, 51%, 95%, and 99%, respectively. When all egg masses were pooled, the overall percent of eggs that hatched was 65%. This compares to 82% in 2007 and 92% in 2006 (Table 7). According to daily minimum temperature data, recorded at Fredericton Airport, the winter of 2007-08 was colder than the winter of 2006-07, and that one was colder than the winter of 2005-06 (Table 7).

<u>Table 7.</u> Mean egg hatch of gypsy moth egg masses collected in the spring of the three past winters as noted.

Winter	Overall mean % egg hatch	Number of days below -20°C *	Number of days below -25°C *
2005-06	92%	0	0
2006-07	82%	17	2
2007-08	65%	19	5

* Temperatures recorded at Fredericton Airport

No areas of defoliation were forecast for 2008 and none were detected in Provincial ground or aerial surveys. In the City of Fredericton, however, some minor tree defoliation was reported by the City Forester. The most ironic sighting, however, was very severe defoliation on most of the crown of a single ornamental blue spruce tree (about 5-m tall) in a homeowner's front yard.

Results from the 2008 pheromone trapping survey and egg mass survey reveal some apparent population increases despite the cold winter. Since 1998, an early detection pheromone trap survey has been conducted at approximately 105 sites throughout the province where gypsy moth egg masses or life stages other than male moths have not been found. Interestingly, the mean trap catch rose from 34 moths/trap to 55 moths/trap which is the highest yet reported by this survey. Most of the high catches, however, came from traps located in the general proximity of the areas known to be infested. Trapping conducted to monitor low density populations within known infested areas in southern New Brunswick also showed an increase in the average number of moths caught per trap.

Within the egg mass survey, about 75 sites have been visited each year since 1995 to give in indication of annual population change in known infested areas. Overall, new egg masses were detected at 85% of these sites compared to 46% last year and 71% the preceding year. In addition, the overall egg mass density increased from an average of 12 new egg masses/person-hour searching in 2007 up to 30 new egg masses/person-hour searching in 2008. These increases seemed to have happened despite the low minimum temperatures that occurred in the winter of 2007-08.

No areas of defoliation are forecast for 2009, but given the right circumstances of high over winter survival and lack of significant natural bio-controls next summer, it's possible that some noticeable feeding damage could occur at some isolated, localized sites.

Finally, although several new sites with new egg masses were found within currently regulated areas, no sites outside the currently regulated areas in the province were found to have new egg masses in 2008. Overall, survey results continue to indicate that large areas of northern New Brunswick still remain free of this pest.

Forest Tent Caterpillar

The last two outbreaks of this insect each lasted about 6 years (from 1991-96; and 1979-84) with a 12-year period between the start of each. The former outbreak peaked at about 0.4 million ha and the latter peaked at about 1.4 million ha. If the same trend were to repeat, a build-up of populations would have occurred about 2003. Therefore, in 2002, in anticipation of another outbreak, pheromone traps were set out in a network of locations evenly distributed throughout the province to establish baseline data for comparison in following years. From 2002 to 2005, there appeared to be a decreasing population trend as reflected in the trap catch data giving no evidence of an impending outbreak (Table 8).

Table 8. Summary of forest tent caterpillar moths caught in pheromone trap surveys conducted by FPMS in New Brunswick from 2002 to 2008.

Year	Number of traps	% of traps positive	Percent of traps in each class of moths/trap						Trap catch	
			0	1-10	11-25	26-50	51-100	>100	Maximum	Mean
2002	128	88	13%	70%	23%	2.3%	1%	0%	51	7.8
2003	125	77	23%	62%	13%	2%	0%	0%	41	5.2
2004	130	76	24%	71%	5%	0%	0%	0%	23	2.7
2005	137	59	41%	58%	1%	0%	0%	0%	16	1.7
2006	133	70	30%	67%	3%	0%	0%	0%	21	2.8
2007	137	47	53%	46%	1%	0%	0%	0%	17	1.4
2008	135	44	56%	42%	2%	1%	0%	0%	39	1.7

In 2006, trap catches increased thus leading to speculation that this might signal the start of a population rise. In 2007, however, trap catches drastically declined. In 2008, a further decrease was experienced in terms of the percent of traps that were positive; nonetheless, the overall provincial mean trap catch rose very slightly as did the maximum trap catch (Table 8). These increases appear to be mainly associated with a number of traps in the north-central part of the province. It will be interesting to see if trap catches increase there again in 2009 and if so, by how much. Nonetheless, populations remain at low levels and no defoliation is forecast for the coming year. In western Canada, the threshold for damage is >100 moths/trap. If this is applicable to New Brunswick conditions, then populations will have to increase substantially before damage is again detected in this province.

Large Aspen Tortrix

Outbreaks of this pest occur periodically throughout the range of its preferred host, trembling aspen. Fortunately, this pest has many natural controls. Outbreaks are usually characterized by very sudden surges in populations followed by sharp decreases after only two or three years.

In 2007, ground surveys and aerial reconnaissance detected small but widespread patches of trembling aspen defoliation in the northern half of the province, from Plaster Rock southwest to Arthurette, northeast of Kedgwick, south of Dalhousie, and from Nash Creek to Bathurst. The defoliator causing the damage was the large aspen tortrix. In 2008, ground surveys again detected defoliation from this pest in these areas as well as an area north of Tracy Depot.

Fall Webworm

This insect is a common defoliator of hardwood trees in late summer. The webs it makes resemble silken "nests" and these were commonly seen along the roadside around the province in 2004. Similar conditions had been reported in the early 1990s. In 2005, there were numerous incidental reports though seemingly less than the year before. In 2006, the insect was again reported and observations made at sporadic locations throughout most regions of the province but seemed much more prevalent in the lower Saint John River Valley. There were no significant reports of this pest in 2008, though it was observed.

Fall Cankerworm

This insect periodically reaches outbreak levels throughout its range in North America. Host trees include elm, oak, ash, and maples as well as many fruit trees and shrubs. In 2005, feeding damage was reported to about 15 ha along the southwest Miramichi River (near Blissfield) but no larvae were found at the time it was subsequently investigated (mid-July). Damage was evident on elm, hawthorn, alders, pin cherry, butternut and maple, and fall cankerworm was suspected.

In 2006, a visit was made in late May to the area where defoliation had been reported in 2005 and numerous larvae of fall cankerworm were found. There were no significant reports of this pest in this area in 2007. In 2008, small patches of defoliation were observed in the Grand Lake Meadows Area between McGowans Corner and Jemseg.

Butternut Canker

In the United States, this non-native disease is causing severe mortality of butternut trees throughout their range. This disease was first confirmed present in New Brunswick by the CFS in 1997 at five sites in the general vicinity of Woodstock, Carleton County, but no regulatory action was taken by the CFIA. Butternut is not a major component of our native forests, nor is it of major economic importance, but the disease could pose a threat to our natural forest biodiversity.

In 2004, the CFS confirmed six new positive sites (i.e., 4 more in Carleton County and 2 in Victoria County). In 2005, butternut trees were put on the Endangered List under the Canadian *Species at Risk Act*. No evidence of newly infected areas was reported in 2005 or 2006. In 2007, however, the CFS reported 5 new positive sites once again, this time somewhat farther south in the general vicinity of Fredericton in York County. These sites represent a significant southerly expansion of the known distribution of butternut canker in New Brunswick. The nearest finds in 1997 and 2004 were located about 60 km northwest, near Woodstock, Carleton County.

In 2008, the CFS (Ken Harrison, pers. comm., CFS-Atlantic) reported two more new positive locations one in York County and one in Sunbury County. Each location is about 35 km due north and southeast (respectively) from the previous finds above Fredericton.

MISCELLANEOUS

Results from the annual aerial survey conducted within the province found no evidence of widespread damage from any major forest pests other than a small area of hardwood defoliation suspected to be caused by large aspen tortrix as well as continued evidence of beech bark disease in the north-central and northwestern portions of the province.

Similar to 2007, patches of moderate to severe defoliation on trembling aspen caused by the aspen leaf roller were observed again in the Saint John River Valley.

In north-central New Brunswick (Big Bald Mountain/Christmas Mountain range) an extreme weather event on June 8th and 9th caused hail damage over a widespread area. Red flagging on fir and characteristic scarring on the upper sides of branches were evident on trees in this area.

ASSESSMENTS OF PLANTATIONS AND THINNINGS

Regional DNR staff, designated as Pest Detection Officers, conduct pest assessments in a sub-set of high-value plantations and thinned stands in each of DNR's four Administrative Regions, as well as general surveillance of forest pests around the province. Survey results have not yet been compiled, but no major pests or significant areas of damage were reported.

SEED ORCHARD PEST MONITORING & NURSERY PEST SUPPORT

Routine monitoring of pest conditions was conducted in DNR's first- and second-generation seed orchards (mostly located in the Fredericton area). At Kingsclear and Wheeler Cove, egg sampling for spruce cone maggot in the black spruce stands produced very low numbers, so there was no need for control measures. White spruce stands, at Queensbury and Kingsclear, produced few cones making cone maggot egg sampling unnecessary.

In one black spruce stand at Wheeler Cove and one white spruce stand at Kingsclear, yellowheaded spruce sawfly larvae were present but caused very little damage. White pine weevil was responsible for the loss of two dozen leaders on the black spruce at Wheeler Cove and more than four dozen leaders on the Norway spruce at Queensbury. Spruce budworm and jack pine budworm numbers remained low in all spruce and jack pine stands respectively.

There were no pest enquiries from DNR's Kingsclear forest tree nursery in 2008.

SESSION 3: FOREST INSECT PESTS – SPRUCE BUDWORM

SÉANCE 3 : INSECTES RAVAGEURS DES FORÊTS : LA TORDEUSE DES BOURGEONS DE L'ÉPINETTE

Spruce Budworm: What's New and Why it Matters

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Abstract

We used to think we knew what spruce budworm was doing. Then someone told us we were wrong, and that we had to start from scratch. We went back to our field and lab research, back to the basics of population dynamics and analysis of past data. Now, the results of this new wave of work are coming on line. We have seen things we expected, but also things we did not expect. Now, what do we actually know? Can we now tell what the future holds for budworm and forests in Canada? Can we tell what impacts, if any, climate change is likely to have on the course of future outbreaks, and is Canada ready to face such changes in a major boreal forest disturbance? What do we need to know in order to face these risks? What options are available to forest managers and policy makers? Canada needs to have an open discussion of the issues concerning the management of risks posed by spruce budworm, as it seems that Canada needs to brace itself for a new outbreak, at least in the East.

Résumé

Tordeuse des bourgeons de l'épinette : les dernières nouvelles et pourquoi devons-nous les prendre au sérieux?

Autrefois nous pensions savoir ce que faisait la tordeuse des bourgeons de l'épinette. Puis quelqu'un nous a dit que nous avions tort, et que nous devions repartir à la case départ. Nous sommes retournés à nos recherches sur le terrain et en laboratoire, et nous avons revu nos analyses de données du passé. Maintenant les résultats de cette nouvelle vague de travaux

paraissent dans la littérature. Nous avons vu des phénomènes auxquels nous nous attendions, mais aussi d'autres plus inattendus. Et maintenant, que savons-nous? Pouvons-nous désormais dire ce que l'avenir réserve à la tordeuse et aux forêts du Canada? Pouvons-nous estimer les impacts, s'il y en a, du changement climatique sur le cours des épidémies à venir, et le Canada est-il prêt à affronter de tels changements de régime par cette source majeure de perturbation en forêt boréale? Que devons nous savoir pour mieux faire face à ces risques? Quelles options sont disponibles aux responsables de l'aménagement et des politiques forestiers? Le Canada a besoin de tenir une discussion ouverte sur les enjeux concernant la gestion des risques posés par la tordeuse, puisqu'il semble que le pays ait besoin de se préparer à une nouvelle épidémie, tout au moins dans l'est.

SESSION 4: UNITED STATES REPORT

SÉANCE 4 : RAPPORT DES ÉTATS-UNIS

An Overview of Pest Conditions in the United States

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Abstract

An overview of pest conditions in the United States will be presented. It will include extent of the problems, management actions being taken to address the concerns and issues of a collaborative nature pertaining to Canada and the US.

Résumé

Survol des insectes et des maladies des arbres aux États-Unis

Un survol des insectes et des maladies des arbres aux États-Unis sera présenté. Il portera notamment sur les problèmes rencontrés et les mesures de lutte prises pour faire face aux préoccupations et enjeux de nature conjointe intéressant le Canada et les États-Unis.

SESSION 5: EASTERN PEST MANAGEMENT ISSUES

Cross-Country Checkup - Québec
Cross-Country Checkup - Ontario

Chair: Anthony Hopkin
Natural Resources Canada
Canadian Forest Service

Chair: Christian Hébert
Natural Resources Canada
Canadian Forest Service

SÉANCE 5 : LA RÉPRESSION DES RAVAGEURS DANS L'EST

Tour d'horizon – Le Québec
Tour d'horizon – L'Ontario

Président : Anthony Hopkin
Ressources naturelles Canada
Service canadien des forêts

Président : Christian Hébert
Ressources naturelles Canada
Service canadien des forêts

Quebec Report

Pierre Therrien

Ministère des Ressources naturelles et de la Faune du Québec

NOT AVAILABLE

Status of Important Forest Pests in Ontario, 2008

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Abstract

The Ontario Ministry of Natural Resources and Canadian Forest Service have conducted an integrated forest health research and monitoring program since 1998.

The 2008 season was characterized by relatively cool temperatures and wet weather over much of the province. Insect development was delayed, while trees experienced good growing conditions in most locations. Aerial surveys were commonly done about 2 weeks later than normal because of delayed insect phenology. Heavy and repeated rains made mapping difficult because of poor coloration of defoliated trees and the washing of damaged needles from the trees.

While spruce budworm remains relatively low at 418,767 ha concentrated near Sudbury and North Bay, mortality to white spruce and balsam fir in this infestation continued in 2008. There were 166,969 ha of defoliation by jack pine budworm mostly in Red Lake district, but with pockets near Gogama, Sudbury, and north of Parry Sound. Gypsy moth defoliation increased by about 9,000 ha from 2007, reaching 39,476 ha. Severity was much less than usual, with high larval mortality from the fungus *Entomophaga maimaiga*. Other notable events were forest tent caterpillar (42,858 ha), bruce spanworm (16,486 ha), large aspen tortrix (64,267 ha), and 8,108 ha of hemlock stands where needles were lost to unknown causes.

There were no aerial spray programs conducted in Ontario in 2008. An annual bait log program to slow the spread of pine shoot beetle was conducted on the leading edge of the infestation from Sault Ste. Marie to Sturgeon Falls. Planning is underway to determine the need for any management efforts for 2009 for the jack pine budworm infestation.

Résumé

Maladies et ravageurs forestiers d'importance en Ontario en 2008

Depuis 1998, le ministère des Richesses naturelles de l'Ontario et le Service canadien des forêts mènent un programme intégré de recherche et de surveillance de la santé des forêts.

La saison 2008 a été caractérisée par des températures relativement fraîches et un temps pluvieux dans la majeure partie de la province. Le développement des insectes a été retardé, tandis que les arbres ont profité presque partout de bonnes conditions de croissance. Les relevés aériens ont généralement été effectués environ deux semaines plus tard que la normale en raison du retard dans le développement des insectes. Les pluies fortes et fréquentes ont rendu la cartographie difficile car elles ont altéré la couleur des arbres défoliés et ont fait tomber des arbres les aiguilles endommagées.

Même si les populations de la tordeuse des bourgeons de l'épinette sont restées relativement faibles, n'infestant que 418 767 hectares concentrés principalement près de Sudbury et de North Bay, elles ont continué d'entraîner la mort de l'épinette blanche et du sapin baumier en 2008. Une défoliation causée par la tordeuse du pin gris a été relevée sur 166 969 hectares, principalement dans le district de Red Lake, ainsi que dans des îlots près de Gogama et de Sudbury ainsi qu'au nord de Parry Sound. La superficie défoliée par la spongieuse a augmenté d'environ 9 000 hectares par rapport à 2007 pour atteindre 39 476 hectares. La défoliation était beaucoup moins grave que d'ordinaire en raison du taux de mortalité larvaire élevé causé par le champignon *Entomophaga maimaiga*. La livrée des forêts (42 858 hectares), l'arpenteuse de Bruce (16 486 hectares), la tordeuse du tremble (64 267 hectares) et la chute des aiguilles de pruches provoquée par des facteurs inconnus sur 8 108 hectares sont d'autres perturbations dignes de mention.

En 2008, aucune opération de pulvérisation aérienne n'a été effectuée en Ontario. Un programme annuel utilisant des billons-appâts et destiné à ralentir la propagation du grand hylésine des pins a été mené depuis Sault Ste. Marie jusqu'à Sturgeon Falls, le long du front de l'infestation. On

s’emploie actuellement à déterminer si des mesures de lutte contre l’infestation de la tordeuse du pin gris seront nécessaires en 2009.

SESSION 6: HEMLOCK LOOPER: OVERVIEW OF THE LAST 15 YEARS

Chair: Terry Caunter
Pest Management Regulatory Agency

SÉANCE 6 : ARPENTEUSE DE LA PRUCHE : BILAN DES 15 DERNIÈRES ANNÉES

Président : Terry Caunter
Agence de réglementation de la lutte antiparasitaire

Outbreak History, Impact and Monitoring of the Hemlock Looper

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Abstract

The hemlock looper is the 2nd most damaging insect defoliator of coniferous trees in eastern Canada, behind the eastern spruce budworm. Outbreaks have been reported in several provinces throughout the 20th century but the most severe occurred in eastern Canada, mainly in Newfoundland and Quebec. Several millions of m^3 of wood were lost. Hemlock looper outbreaks begin and end very suddenly. They develop at an incredibly fast rate, and can even kill balsam fir during the first year in which damage is detected. Outbreaks are characterized by small pockets of infestation scattered over a vast area and are thus difficult to detect. In fact, until the early 1990s, aerial damage surveys and foliage beating samples taken to estimate the size of larval populations were the main methods used for detecting and making predictions about hemlock looper populations. At that time, defoliation is already severe which reduces the efficacy of protection programs. Moreover, extremely high egg parasitism has been shown to cause rapid population collapses. During the last 15 years, new methods and tools have been developed to improve outbreak detection and damage forecasting. The efficacy of four sampling methods (of which two were new) of different life stages of the hemlock looper have been compared in Quebec. The new tools provide useful estimates of egg and pupal populations and they can provide estimates natural enemy efficacy. This might lead to a new system to improve outbreak detection, population monitoring and damage forecasting of the hemlock looper.

Résumé

Historique des épidémies, impact et surveillance de l'arpenteuse de la pruche

L’arpenteuse de la pruche est le 2e insecte défoliateur de conifères le plus dommageable dans l’est du Canada, derrière la tordeuse des bourgeons de l’épinette. Des épidémies ont été rapportées dans plusieurs provinces au 20e siècle mais les plus sévères ont été observées dans l’est du Canada, principalement à Terre-Neuve et au Québec. Plusieurs millions de m^3 de bois ont été perdus. Les épidémies de l’arpenteuse de la pruche sont caractérisées par leur apparition et disparition subites. Elles se développent à un rythme foudroyant, pouvant entraîner la mort des sapins baumier dès la première année de détection des dommages. Les épidémies se caractérisent aussi par l’apparition de petits foyers d’infestation dispersés sur un vaste territoire et sont donc difficiles à détecter. En fait, jusqu’au début des années 1990, l’évaluation des dommages par voie aérienne et le battage du feuillage pour l’évaluation des populations larvaires constituaient les principales méthodes de détection et de prévision des épidémies de l’arpenteuse de la pruche. À ce moment, la défoliation est déjà sévère ce qui réduit l’efficacité des programmes de protection. De plus, on a démontré qu’un parasitisme des œufs extrêmement élevé pouvait entraîner l’effondrement rapide des populations. Au cours des 15 dernières années, de nouvelles méthodes et outils ont été développées pour améliorer la détection des épidémies et la prévision des dommages. L’efficacité de quatre méthodes d’échantillonnage (dont deux nouveaux outils) des différents stades de l’insecte a été évaluée au Québec. Les nouveaux outils fournissent des évaluations des populations de chrysalides et d’œufs et peuvent fournir des évaluations de l’impact des ennemis naturels. Ces travaux pourraient mener à un nouveau système pour améliorer la détection des épidémies, la surveillance des populations et la prévision des dommages de l’arpenteuse de la pruche.

Population Ecology of the Hemlock Looper

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Abstract

The hemlock looper, *Lambdina fiscellaria* (Guen.), has been the most important pest of coniferous forests in Quebec over the last decade. More than 1 million hectares of forest have been affected by this insect during its last outbreak (Côte-Nord), the largest ever reported for this species. Despite its importance and the fact that the hemlock looper is widely distributed, its biology and ecology remain poorly understood. To improve our knowledge of this species, eleven populations covering a large range of latitude (45 to 51°N) were reared under laboratory conditions on balsam fir (*Abies balsamea* (L.) Mill.). Results indicate that two distinct types of population exist, based on the number of larval instars. Geographically related variations were detected in larval and pupal development times, weight, fecundity and egg size. Variation in biological performance was also detected between populations within the two types of populations. Furthermore, considering that this species is largely distributed and highly polyphagous, the impact of temperature and host trees was also studied. Results indicate that populations across the latitudinal gradient are adapted to host trees available regionally. Thus, northern populations, that evolved in a homogeneous environment dominated by boreal forest trees, show adaptations on these specific host trees. Adaptation of females to exploit foliage of old balsam fir trees was also detected for the most northern population. Finally, variations between populations across the latitudinal gradient were detected when larvae were reared at different temperatures. This study helps us to understand the historical epidemiology of the hemlock looper and shows that this insect represents a more complex system than anticipated.

Foresters should take into account these population differences to improve management of this pest.

Résumé

Écologie des populations de l'arpenteuse de la pruche

Durant la dernière décennie, l'arpenteuse de la pruche, *Lambdina fiscellaria* (Guen.) a été le plus important ravageur des forêts de conifères au Québec. Plus d'un million d'hectares de forêts ont été affectés lors de la dernière infestation (Côte-Nord), ce qui représente la plus importante infestation à ce jour. Malgré l'importance du phénomène et la large distribution de l'insecte, sa biologie et son écologie demeurent peu documentées. Pour mieux comprendre cette espèce, onze populations couvrant un large gradient latitudinal (45 à 51^{o}N) ont été élevées en conditions contrôlées sur du sapin baumier (*Abies balsamea* (L.) Mill.). Les résultats indiquent que deux types de populations distinctes et caractérisées par le nombre de stades larvaires existent. Des variations géographiques de la durée du développement, du poids, de la fécondité et de la taille des œufs sont détectées. Des variations des performances biologiques sont aussi détectées entre les différentes populations. De plus, comme cette espèce est largement distribuée et hautement polyphage, l'impact de la température et des essences forestières a également été étudié. Les résultats démontrent que les populations le long du gradient latitudinal sont adaptées aux essences forestières présentes localement. Ainsi, les populations nordiques qui ont évolué dans un environnement homogène dominé par les essences boréales, montrent une adaptation sur ces essences particulières. L'adaptation des femelles à exploiter le feuillage des sapins baumiers âgés a également été détectée pour une population nordique. Finalement, des variations entre les populations le long du gradient latitudinal ont été détectées lorsque les larves ont été élevées à différentes températures. Cette étude nous aide à comprendre l'historique des épidémies de l'arpenteuse de la pruche et montre que cette espèce représente un système plus complexe que ce qui était anticipé. Les différents intervenants devraient tenir compte des différences inter-populationnelles afin de gérer plus efficacement ce ravageur.

Forest Protection and Hemlock Looper Outbreak Management: Welcome to the Twilight Zone…

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Abstract

Over the last 15 years, many hemlock looper (*Lambdina fiscellaria*) infestations have been recorded in balsam fir (*Abies balsamea*) forests located in eastern Quebec. These outbreaks were characterized by irregular patterns regarding length, spread, and damage severity. Moreover, the insect populations are mainly detected when severe defoliation and tree mortality can be seen from aerial surveys, leading forest managers to hurry up B.t.k. spraying programs and sometimes face expensive cancellation of planned protection activities when infestations collapse in early June. The *Telenomus spp*. parasitoids complex attacking hemlock looper egg stage during the spring period was mainly pointed out for population decline.

In the absence of a better knowledge of hemlock looper population dynamics, forest managers have neither the necessary information nor a decision-support system to reach optimal protection results and deal adequately with hemlock looper outbreaks in Quebec.

Résumé

La protection des forêts et la gestion des épidémies de l'arpenteuse de la pruche : une mystérieuse odyssée…

Depuis les 15 dernières années, plusieurs infestations de l'arpenteuse de la pruche (*Lambdina fiscellaria*) furent observées dans les forêts de sapin baumier (*Abies balsamea*) de l'Est du Québec. Ces épidémies se caractérisent par des patrons de comportement irréguliers en termes de durée, d'étendue et de sévérité des dommages. De plus, ces manifestations épidémiques demeurent principalement détectées lorsque une défoliation sévère accompagnée d'un certain niveau de mortalité d'arbres sont visibles lors des inventaires aériens. De ce fait, des

programmes de protection directe à l'aide du B.t.k. furent préparés rapidement par les gestionnaires forestiers et parfois annulés, en raison du déclin des populations avant la période propice aux traitements. Le complexe de parasitoïdes *Telenomus spp*. attaquant les œufs de l'arpenteuse de la pruche au printemps a principalement mis fin aux infestations.

Pour le gestionnaire forestier, le manque de connaissances concernant la dynamique des populations, ainsi que l'absence d'informations permettant d'alimenter un système d'aide à la décision afin d'optimiser la protection, rendent également difficile la gestion des épidémies de l'arpenteuse de la pruche au Québec.

Hazard Ratings for Hemlock Looper: Improving Density-Defoliation Relationships

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Abstract

The hemlock looper, *Lambdina fiscellaria* (Guenée), is a native insect that defoliates large areas of balsam fir forests in eastern Canada. Decisions concerning whether or not to spray populations of hemlock looper larvae with Bt are commonly based on fall egg density – subsequent defoliation relationships. To improve the reliability of fall egg density – defoliation relationships, we carried out field and laboratory studies in Québec and Newfoundland. more specifically, we carried out studies to determine: i) the effect of temperature and other abiotic factors needed to predict egg mortality; ii) the influence of parasitism on egg mortality; and iii) the influence of egg hatch – budburst asynchrony on mortality of first instar larvae. We also produced a day-degree model that predicts the development of hemlock looper larvae in the field based on commonly available measurements of air temperature to improve the timing of Bt applications.

Résumé

Évaluation des risques liés à l'arpenteuse de la pruche : amélioration des rapports densité-défoliation

L'arpenteuse de la pruche (*Lambdina fiscellaria* (Guenée)) est un insecte indigène qui défolie de vastes étendues de forêt de sapin baumier dans l'Est du Canada. Les rapports entre la densité des

œufs à l’automne et la défoliation subséquente sont souvent utilisés pour décider si des opérations de pulvérisation de B.t. contre les populations larvaires de l’arpenteuse sont nécessaires. Afin d’améliorer la fiabilité des rapports entre la densité des œufs à l’automne et la défoliation, nous avons effectué des études en laboratoire et sur le terrain au Québec et à Terre-Neuve. Nos études visaient plus précisément à déterminer : i) l’effet de la température et d’autres facteurs abiotiques nécessaires pour prévoir la mortalité des œufs; ii) l’influence du parasitisme sur la mortalité des œufs; et iii) l’influence de l’asynchronie de l’éclosion des œufs et du débourrement sur la mortalité du premier stade larvaire. Nous avons également élaboré un modèle des degrés-jours qui prévoit le développement des larves de l’arpenteuse de la pruche sur le terrain à partir de mesures faciles à obtenir de la température de l’air afin d’améliorer le calendrier d’application du B.t.

SESSION 7: PESTICIDE REGULATIONS, ALTERNATIVES, MINOR USE

SÉANCE 7 : RÈGLEMENTS SUR LES PESTICIDES, SOLUTIONS POSSIBLES, USAGE LIMITÉ

Environmental Risk Assessment and the Protection of Non-Target Habitats

Health Canada | Santé Canada

Your health and safety... our priority. | Votre santé et votre sécurité... notre priorité.

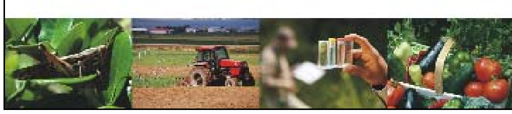
Environmental Risk Assessment and the Protection of Non-Target Habitats

Scott Kirby
Environmental Assessment Directorate
Pest Management Regulatory Agency

Canada

Overview

- Purpose of Environmental Risk Assessment
- Data Requirements
- Risk Assessment Framework
  - Exposure Assessment
  - Hazard Assessment
  - Risk Characterization
- Risk Mitigation Measures
- What Are We Trying to Protect



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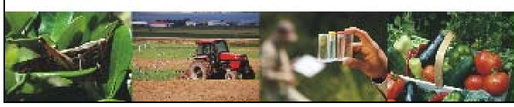
Purpose of Environmental Risk Assessment

- Evaluate the likelihood that adverse environmental effects may occur or are occurring as a result of exposure to the pesticide (active ingredients and transformation products)
- Determine whether changes to the use or proposed use of that pesticide are necessary to protect the environment



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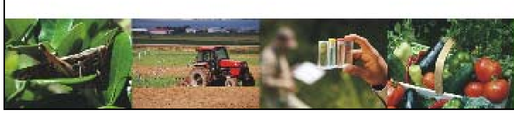
Data Requirements

- Use Site Category DACO Tables
  - Total of 33 different USCs
- Most agricultural pesticides require the studies listed under Use-site Category 14
- Forestry and Rights of Way are under Use-Site Categories 4 & 16
- Most residential type uses fall under Use-Site Categories 24 to 33



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Risk Assessment Framework

Environmental Exposure Assessment

- Estimates the potential exposure of plants and animals to pesticide residues in water, food, soil and air.
- Includes information on how often, how long and the amount of pesticide to which an organism may be exposed.
- Based on environmental fate and transport data as well as modeling and field monitoring information.

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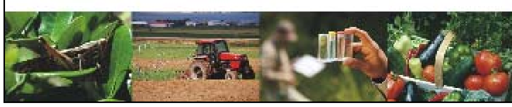
Studies to Estimate Exposure

- **Physicochemical properties**
  - Solubility, vapour pressure, K_{ow}, pKa, UV-absorption
- **Mobility**
  - Leaching, volatilization
- **Transformation (Abiotic and Biotic)**
  - Hydrolysis, phototransformation, aerobic/anaerobic biotransformation (terrestrial and aquatic)
- **Field dissipation (DIR2006-01)**
  - Fate and mobility in sites representative of use areas in Canada



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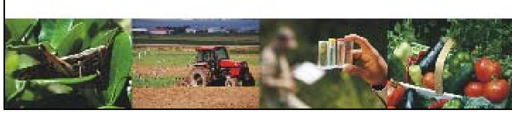
Environmental Hazard Assessment

- Describes the types of effects a pesticide can produce in organisms and how those effects change with varying pesticide exposure levels
- Based on accepted protocols with surrogate test species
- Determines effects endpoints and dose response (e.g. LD_{50}, NOEC, EC_{25})
- Identify sensitive organisms.



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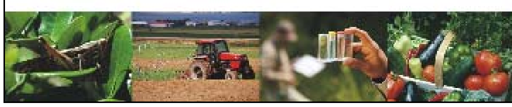
Terrestrial Species Typically Studied

- Earthworm
- Honeybee
- Beneficial Insects
  - parasitic wasp, predatory mite, ladybird beetle, lacewing, minute pirate bug, ground beetle
- Birds (Acute and Reproduction)
  - mallard duck
  - bobwhite quail
- Mammals (Acute and Reproduction)
  - rats, mice
- Terrestrial vascular plants



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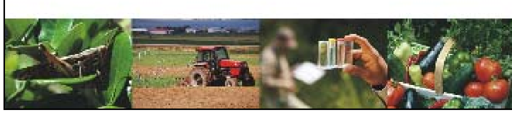
Aquatic Species Typically Studied – Freshwater

- Invertebrates (acute and reproduction)
  - *Daphnia magna*
- Fish (acute, early-life stage, life-cycle)
  - rainbow trout
  - bluegill sunfish
- Algae (acute): 3 species
  - *Selenastrum capricornutum*
  - *Anabaena* sp.
  - diatom
- Vascular plant
  - *Lemna gibba*



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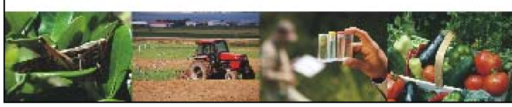
Aquatic Species Typically Studied – Estuarine/Marine

- Crustacean (Acute and chronic)
  - mysid
- Mollusk embryo larvae OR shell deposition
- Fish (acute and chronic)
  - sheepshead minnow
- Algae (acute)



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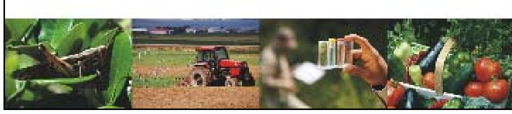
Risk Characterization

- Compare the levels of exposure (estimated environmental concentrations - EEC) expected in the environment according to the proposed or actual use pattern to those levels that produce toxic effects in laboratory and field studies
- When EEC exceeds levels expected to cause effects (level of concern - LOC), measures to mitigate the risk are examined



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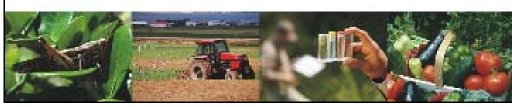
Risk Characterization – Screening vs. Refined

- **Screening Level Risk Assessment**
  - Goal to identify:
    - Pesticides that do not pose a concern
    - Group(s) of organisms that would not be at risk
    - Pesticides that have a potential for concern, and risk needs further characterization
  - Based on conservative scenarios, simple methods
- **Refined Risk Assessment**
  - Goal: further characterize the risk using more refined scenarios
  - Tiers of refinement to adequately characterize risk



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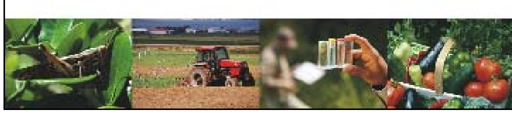
Risk Characterization – Options for Refinement

- **More realistic exposure scenario**
  - Use pattern
  - Fate/persistence information
  - Use-specific scenarios, relevant species, species-specific diets, behaviour of species
- **Consideration of off-target effects from spray drift**
  - Off-field vs on-field (terrestrial)
  - Drift vs run-off (aquatic)
- **Additional options for Registered Products/Re-evaluation**
  - Additional effects endpoints
  - Data from research and monitoring
  - Incident Reports
  - Probabilistic risk assessments



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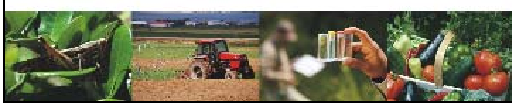
Risk Mitigation Measures - Examples

- Reduce number of applications per season
- Buffer zones to reduce drift to non-target species/sensitive areas
- Restrict against applications in consecutive years
- Restrict to ground application (no aerial use)
- Use decreased application rates (determined in conjunction with efficacy review)
- Change application conditions (time of day)
- Choose certain formulation types
- Require immediate incorporation in soil
- Restriction of certain uses or entire active ingredient
- Label advisory statements



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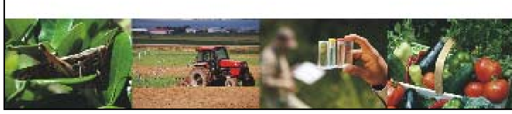
What are we trying to Protect?



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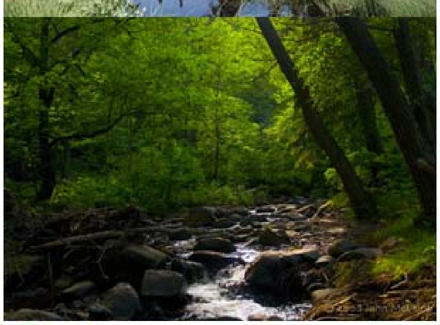
The Issue

- Over the past few years PMRA has pursued a number of consultations and initiatives on topics related to environmental protection. Discussions have ranged from assessment endpoints to buffer zones.

- It has become clear that an important challenge is to better define the habitats requiring protection so that growers/applicators can clearly identify which habitats need to be protected and which do not.

- Enter the Habitat Protection Workshop

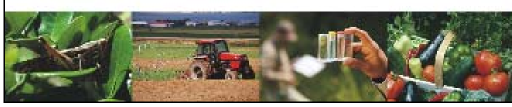
"What is it that we need to protect? Should all habitats be treated equally?"



The Habitat Workshop (April 28-29 2008)

- Participation was broad, diverse and spirited – Federal and Provincial Departments, Provinces, Academics, NGOs, Industry, Growers, Applicators.

- Presentations and discussions provided information from diverse perspectives on both the principles of habitat protection and on existing programs and policies pertaining to the protection of habitat in agricultural and forest ecosystems.



The Habitat Workshop (April 28-29 2008)

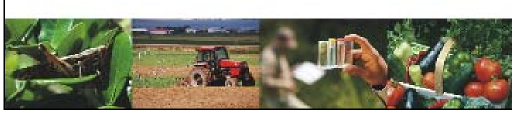
Highlights of discussion:

- Habitat protection policy should be simple, practical and enforceable, and should consider habitat type and land use

- Good coordination across jurisdictions (provincial, federal, municipal) will be essential to avoid conflicting requirements: A legislative scan would help determine what might impact PMRA policy and vice versa

- Approach should be flexible enough to take into account specific situations at the site of application – i.e, not only habitat type, but also specific spray technologies, presence of invasive species, presence of vegetative buffer strips, etc.

- Approach should encourage good environmental stewardship – and should not discourage habitat creation or maintenance.

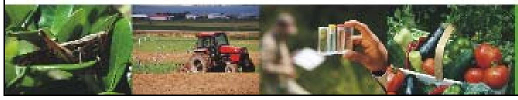


The Habitat Workshop (April 28-29 2008)

Next Steps:

- Finalize the workshop report
- Conduct a legislative scan to identify pertinent Canadian legislation/regulations/initiatives (at least at the federal and provincial level) relating to the protection of habitat
- Undertake further stakeholder consultations
- Use the information gathered at the workshop and through other consultations, and the legislative scan, to draft an effective, transparent, fair and consistent policy that will complement other federal/provincial/NGO programs and minimize the impacts of pesticides on non-target habitats and wildlife while considering land use scenarios and societal needs and values.

Questions



Health Canada’s Pest Management Regulatory Agency Update

Health Canada’s Pest Management Regulatory Agency Update

Forestry Forum 2008 - December 2, 2008

Terry Caunter
Project Manager
Facilitating Risk Reduction for User Groups Section
Value & Sustainability Assessment Directorate

Pest Management Regulatory Agency (PMRA)

Health Canada

Health Canada Santé Canada

➢ http://www.pmra-arla.gc.ca/

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What's New

- NAFTA Technical Working Group on Pesticides
  - *Proposed Five-Year Strategy 2008–2013*
    - July 23, 2008
  - Strategic Plan Framework
    - Mission
      - serves as a focal point for addressing pesticide issues arising in the context of liberalized trade among the NAFTA countries, while recognizing the environmental, ecological & human health objectives of NAFTA.
    - Goal
      - an aligned North American registration system for pesticides & products treated with pesticides & make work sharing a way of doing business

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What's New

- Science Policy Note, SPN2008-01
  - *The Application of Uncertainty Factors and the Pest Control Products Act Factor in the Human Health Risk Assessment of Pesticides*
    - 29 July 2008
  - how PMRA addresses uncertainty & variability in the mammalian toxicity database in human health risk assessments:
    - uncertainty factors to endpoints in the mammalian toxicity database ensures a protective margin between the dose levels that elicit toxicity in laboratory animal studies & the anticipated human exposure
    - addresses the additional 10-fold margin of safety required under the new Pest Control Products Act (PCPA) under certain circumstances
    - this PCPA factor is intended to provide additional protection for infants & children in the risk assessment
  - describes the relevant factors & provides a framework for the application of these factors

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What's New

- Reduced-Risk Update RR2008-01
  - *Update on Reduced-Risk Pesticides in Canada*
    - January 7, 2008
  - reduced-risk chemical active ingredients & uses currently registered in Canada
  - reduced-risk chemical active ingredients registered or pending registration in Canada & in the United States
  - biopesticides registered in Canada
  - percentage of reduced-risk chemical active ingredients currently registered or pending registration in Canada as compared to the United States

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What's New

- Regulatory Directive DIR2008-01
  - *Registering a New Source of Technical Grade Active Ingredient Under the Protection of Proprietary Interests in Pesticide Data Policy*
    - January 16, 2008
  - protection of proprietary interests in pesticide (PPIP) data maintained
  - places the onus of determining data value & compensation on the companies involved
- Fact Sheets
  - *Pesticide Program Highlights*
    - April 2008
  - highlights various pesticide programs

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What's New

- Checklist of Labelling Requirements for Pest Control Products
  - provide a summary of the required labelling elements for registered pesticide products as per the new Pest Control Products Regulations
- Compiling and Submitting Documents to the PMRA
  - Compiling a PRZ using the e-Index Builder
  - Submitting the PRZ file to the PMRA
  - questions should be directed to the PMRA's Information Service
    - 1-800-267-6315 Within Canada
    - 1-613-736-3799 Outside of Canada (charges)
    - pmra_infoserv@hc-sc.gc.ca
    - Fax: (613) 736-3798

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What's New

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What's New

- PMRA New Registration Activities 2007-2008
    - March 31, 2008
  - initiated in 2006 to meet the goals of a more open & transparent pesticide regulatory system
  - report is a summary of registration decisions concerning
    - new active ingredients
    - their associated end-use products
    - new uses for currently registered active ingredients
    - emergency registrations

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New Registration Activities 07-08

	Total	Joint Review / Work Sharing
Total New Active Ingredients	**20**	**3**
Reduced-risk biopesticides	12	0
Reduced-risk chemicals	3	1
Conventional chemicals	3	2
Antimicrobial	2	0

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New Registration Activities 07-08

		Major Crop Uses	Minor Crop Uses	Agricultural Uses	Non-Agricultural Uses
Total Food Uses	**475**	**16**	**459**	**475**	**0**
Reduced-risk biopesticides	225	1	224	225	0
Reduced-risk chemicals	131	5	126	131	0
Conventional chemicals	119	10	109	119	0
Antimicrobial	0	0	0	0	0
Total Non-Food Uses	**382**	**0**	**299**	**310**	**72**
Reduced-risk biopesticides	137	0	123	120	17
Reduced-risk chemicals	53	0	53	52	1
Conventional chemicals	145	0	123	116	29
Antimicrobial	47	0	0	22	25
OVERALL TOTAL	**857**	**16**	**758**	**785**	**72**

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Registration Highlights

- Registrations
  - Registration Decision RD2008-07
    - Spirotetramat
    - Movento 150 OD & Movento 240 SC Insecticides
    - controls whiteflies, mealybugs, some species of aphids, phylloxera, pear psylla, psyllids, San Jose scale, Lecanium scale (suppression only) & white peach scale on variety of fruit & vegetable crops
    - July 2, 2008

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Registration Highlights

- Registrations
  - Proposed Registration Decision RD2008-11
    - *Neodiprion abietis Nucleopolyhedrovirus,* Newfoundland Strain
    - Abietiv Flowable Biological Insecticide
    - virus that causes a lethal disease in larvae of the balsam fir sawfly, *Neodiprion abietis*, when ingested by feeding larvae
    - decrease populations of balsam fir sawfly & thereby reduce feeding damage to balsam fir trees
    - July 17, 2008

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Registration Highlights

- Conditional Registrations
  - Evaluation Report ERC2007-10
    - Acequinocyl
    - Shuttle 15 SC & Kanemite 15 SC Miticides
    - controls two-spotted spider mites & spruce spider mites on container-grown ornamental, floral, foliage & nursery crops
    - controls two-spotted spider mites & European red mites on field-grown ornamentals & pome fruit
    - November 19, 2007

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Registration Highlights

- Re-evaluations
  - Re-evaluation Decision RVD2008-35
    - *Metsulfuron Methyl*
    - herbicide
    - continued registration for pasture, rangeland & non-crop areas for the control of western snowberry, trembling aspen & other undesirable brush or woody plants
    - November 10, 2008
  - Re-evaluation Decision RVD2008-27
    - *Trichlorfon*
    - Insecticide
    - continued registration for ground application on Balsam fir & spruce trees in farm woodlots, rights-of way, Christmas tree plantations & municipal parks, & ornamentals
    - aerial application to be phased out
    - July 31, 2008

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Registration Highlights

- Re-evaluations
  - Re-evaluation Decision RVD2008-20
    - *(4-Chloro-2-methylphenoxy)acetic Acid [MCPA]*
    - herbicide
    - continued registration for postemergent control of broadleaf weeds & woody plants on forests & woodlots (spruce seedlings for reforestation)
    - May 22, 2008
  - Re-evaluation Decision RVD2008-11
    - *(2,4-Dichlorophenoxy) acetic Acid [2,4-D]*
    - herbicide
    - continued registration for control of broadleaf weeds, weedy trees & brush on forests and woodlots (conifer release and forest site preparation),
    - May 16, 2008

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Registration Highlights

- Re-evaluations
  - Re-evaluation Decision RVD2008-18
    - *Bacillus thuringiensis*
    - insecticide
    - continued registration for all uses; label changes for Personal Protection Equipment & application over water
    - 5 Notices of Objections received
    - under review by PMRA staff
      - not the same evaluation officers that conducted initial review
      - issues surrounding label statements regarding application over water have been resolved
    - next steps
      - determine if information/data received in objections are sufficient to warrant the creation of a review panel
    - May 6, 2008

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Registration Highlights

- Re-evaluations
  - Re-evaluation Decision RVD2008-17
    - *Imazapyr*
    - herbicide
    - continued registration for control of annual & perennial grasses, broadleaf weeds & select perennial shrubs & trees on forest sites being prepared by ground application
    - April 28, 2008
  - Re-evaluation Decision RVD2008-03
    - *Metalaxyl and Metalaxyl-M*
    - fungicide
    - Continued registration for use on nursery outdoor & greenhouse non-food crops (including conifers & ornamentals)
    - January 30, 2008

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Registration Highlights

- Re-evaluations
  - Proposed Re-evaluation Decision RVD2007-16
    - *Diazinon*
    - insecticide
    - proposed phase-out of air blast application on Christmas trees plantations
      - longer time-frames are proposed (2012), allowing for a measured phase-out and/or strategies to transition from the use of diazinon to alternative control methods
    - December 10, 2007

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Registration Highlights

- Emergency Registrations
  - Azadirachtin
    - Treeazin Systemic Insecticide, Reg. No. 28929
    - requested by Ontario & Quebec
    - emerald ash borer in ash trees
    - Bioforest Technologies Inc.
  - Imidacloprid
    - Confidor 200 SL Systemic Insecticide, Reg. No. 28132
    - requested by Alberta
    - cottony ash psyllid in Ash tree, European elm scale in elm trees
    - Bayer CropScience Inc.

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Registration Highlights

- Emergency Registrations
  - Tebuconazole
    - Folicur 432 F Foliar Fungicide
    - requested by British Columbia, Reg. No. 25940
    - *Melampsora* rusts, *Septoria* leaf spot & canker in short-rotation-intensive-culture hybrid poplar crops & hybrid poplar planting stock
    - Bayer CropScience Inc.

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Registration Highlights

- Minor Uses
  - s-metolochlor herbicide
    - weeds in Christmas trees
    - URMULE completed & use approved
  - *Bacillus thuringiensis* insecticide
    - Pale-winged gray moth in Forests, Woodlands, & other treed areas
    - URMULE completed & use approved
  - Fosetyl-al fungicide
    - *Phytophthora ramorum* (Sudden oak death) in conifers grown in nurseries
    - URMULE completed & granted

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Registration Highlights

- Minor Uses
  - Dimethomorph fungicide
    - *Phytophthora ramorum* (Sudden oak death) in conifers grown in nurseries
    - URMULE completed & granted
  - Bifenazate acaricide
    - Spruce spider mite in outdoor grown conifers
    - URMULE completed & granted

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Research Authorizations

- **Reminders**
  - Performance Standards
    - 6 months for unregistered active
    - 3 months for already registered active
    - GET THEM IN NOW !!
    - do not need detailed maps with application – can follow at a later date
  - 2 year Research Authorizations can be granted – MUST be requested in initial application
  - **NOTE**: With increased workload in the biopesticide area, RA applications need to be timely & complete
  - consult with PMRA early you have any questions

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Research Authorizations

- ALL new Biopesticides, including bacteria, viruses & pheromones MUST have the appropriate health & environmental data in order to be assessed for potential Research Authorization
- Areas of Concerns
  - public areas or areas easily accessible to public
  - aquatic habitat areas
- Remember
  - provincial & local health officials depend on PMRA expertise for advice in order to answers questions & inquiries to any potential health and/or environmental issues

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Facilitating Risk Reduction for User Groups Section

- What can we do with you?
  - Forestry liaison for forestry issues
  - Wood preservative (CSA technical committee)
  - Forestry Forum Steering Committee
  - National Forest Pest Strategy Practitioner Working Group
  - Invasive alien species & Pine beetle support
  - Miscellaneous forest pests support

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National Forest Pest Strategy

- PMRA's potential role: Goals
  1. Create a Canadian national forest pests list
  2. Prioritize the Canadian national forest pest list
  3. Create list of forest pest management products registered in Canada
  4. Create a list of forest pest management products that are registered in other countries
  5. Facilitate introduction of Foreign forest pest products in Canada

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National Forest Pest Strategy

- Canadian national forest pests list
  - NFPS WG has asked for all provinces to submit their lists
- Prioritize the Canadian national forest pest list
  - Top 3 identified:
    - spruce budworm, mountain pine beetle, sudden oak death
- Create list of forest pest management products registered in Canada
  - ongoing

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National Forest Pest Strategy

- Create a list of forest pest management products that are registered in other countries
  - using Homologa
  - unique challenges as database designed around food uses & food residues
- Facilitate introduction of Foreign forest pest products in Canada
  - future

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National Forest Pest Strategy

PMRA NCR Metaframe^6096CD2C - Citrix Presentation Server Client

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C4 BACILLUS-THUR.KURSTAKI

Y	PRODUCT_TY	PRODUCT	ACTIVE_MIX	COMPANY	CROP	PEST_GROUP	PEST	M
N	BIOLOGICAL AGENT-INS	FORAY 48BA LOW VOLUME AQUEOUS CONCENTRATE	BACILLUS-THUR.KURSTAKI	VALENT-BIOSCIENCES	FOREST	CHEWING-CATERPILLARS/LEPIDOPT.	GYPSY MOTH	G
N	BIOLOGICAL AGENT-INS	FORAY 48BA LOW VOLUME AQUEOUS CONCENTRATE	BACILLUS-THUR.KURSTAKI	VALENT-BIOSCIENCES	FOREST	CHEWING-CATERPILLARS/LEPIDOPT.	LAMBDINA FISCELLARIA	G
N	BIOLOGICAL AGENT-INS	FORAY 48BA LOW VOLUME AQUEOUS CONCENTRATE	BACILLUS-THUR.KURSTAKI	VALENT-BIOSCIENCES	FOREST	CHEWING-CATERPILLARS/LEPIDOPT.	LEUCOMA SALICIS	G
N	BIOLOGICAL AGENT-INS	FORAY 48BA LOW VOLUME AQUEOUS CONCENTRATE	BACILLUS-THUR.KURSTAKI	VALENT-BIOSCIENCES	FOREST	CHEWING-CATERPILLARS/LEPIDOPT.	MALACOSOMA DISSTRIA	G
N	BIOLOGICAL AGENT-INS	FORAY 48BA LOW VOLUME AQUEOUS CONCENTRATE	BACILLUS-THUR.KURSTAKI	VALENT-BIOSCIENCES	FOREST	CHEWING-CATERPILLARS/LEPIDOPT.	ORGYIA SPP	G
N	BIOLOGICAL AGENT-INS	BIOPROTEC AQUEOUS BIOLOGICAL INSECTICIDE	BACILLUS-THUR.KURSTAKI	AEF-GLOBAL	FOREST	INSECTS-OTHER	BAGWORMS	A NI A N
N	BIOLOGICAL AGENT-INS	BIOPROTEC AQUEOUS BIOLOGICAL INSECTICIDE	BACILLUS-THUR.KURSTAKI	AEF-GLOBAL	FOREST	INSECTS-OTHER	CANKER-WORM (GEOMETRIDAE)	A NI A N

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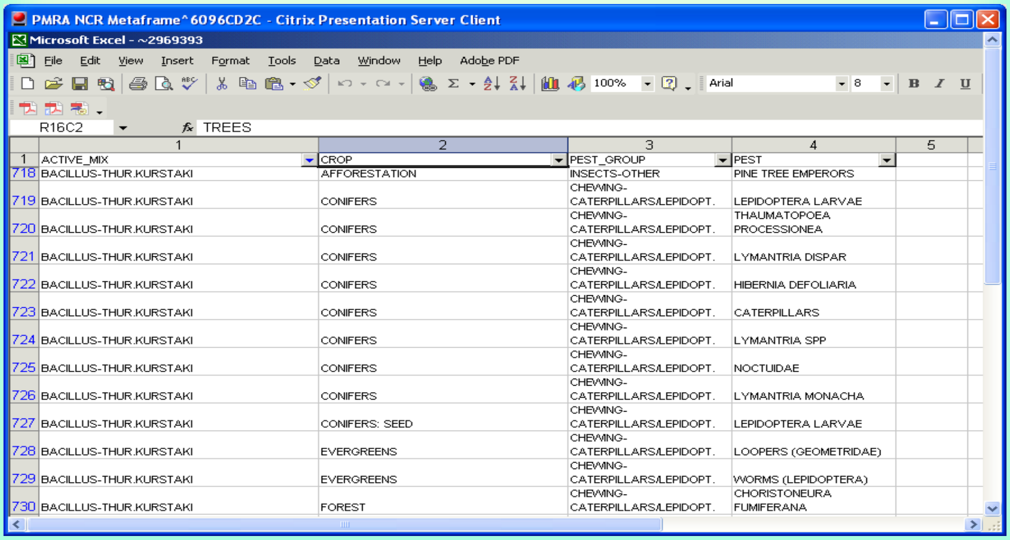
National Forest Pest Strategy



PMRA NCR Metaframe^6096CD2C - Citrix Presentation Server Client

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R16C2 TREES

1	ACTIVE_MIX	CROP	PEST_GROUP	PEST
718	BACILLUS-THUR.KURSTAKI	AFFORESTATION	INSECTS-OTHER	PINE TREE EMPERORS
719	BACILLUS-THUR.KURSTAKI	CONIFERS	CHEWING-CATERPILLARS/LEPIDOPT.	LEPIDOPTERA LARVAE
720	BACILLUS-THUR.KURSTAKI	CONIFERS	CHEWING-CATERPILLARS/LEPIDOPT.	THAUMATOPOEA PROCESSIONEA
721	BACILLUS-THUR.KURSTAKI	CONIFERS	CHEWING-CATERPILLARS/LEPIDOPT.	LYMANTRIA DISPAR
722	BACILLUS-THUR.KURSTAKI	CONIFERS	CHEWING-CATERPILLARS/LEPIDOPT.	HIBERNIA DEFOLIARIA
723	BACILLUS-THUR.KURSTAKI	CONIFERS	CHEWING-CATERPILLARS/LEPIDOPT.	CATERPILLARS
724	BACILLUS-THUR.KURSTAKI	CONIFERS	CHEWING-CATERPILLARS/LEPIDOPT.	LYMANTRIA SPP
725	BACILLUS-THUR.KURSTAKI	CONIFERS	CHEWING-CATERPILLARS/LEPIDOPT.	NOCTUIDAE
726	BACILLUS-THUR.KURSTAKI	CONIFERS	CHEWING-CATERPILLARS/LEPIDOPT.	LYMANTRIA MONACHA
727	BACILLUS-THUR.KURSTAKI	CONIFERS: SEED	CHEWING-CATERPILLARS/LEPIDOPT.	LEPIDOPTERA LARVAE
728	BACILLUS-THUR.KURSTAKI	EVERGREENS	CHEWING-CATERPILLARS/LEPIDOPT.	LOOPERS (GEOMETRIDAE)
729	BACILLUS-THUR.KURSTAKI	EVERGREENS	CHEWING-CATERPILLARS/LEPIDOPT.	WORMS (LEPIDOPTERA)
730	BACILLUS-THUR.KURSTAKI	FOREST	CHEWING-CATERPILLARS/LEPIDOPT.	CHORISTONEURA FUMIFERANA

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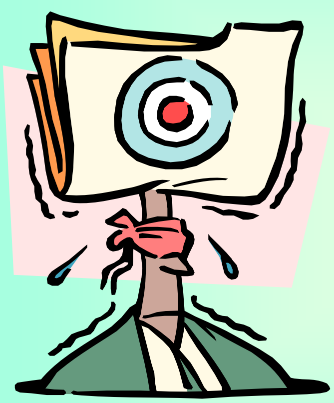
Questions?



Forestry & Wood Products Use Sectors

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SESSION 8: WESTERN PEST MANAGEMENT ISSUES

Western Canada Round-up

Chair: Sunil Ranasinghe
Alberta Sustainable Resource Development
Forest Division

SÉANCE 8 : LA RÉPRESSION DES RAVAGEURS DANS L'OUEST

Tour d'horizon de l'Ouest canadien

Président : Sunil Ranasinghe
Alberta Sustainable Resource Development
Forest Division

Forest Pests in Manitoba, 2008

I. L. Pines

Manitoba Conservation, Forestry Branch,
200 Saulteaux Crescent, Winnipeg, MB R3J 3W3

Spruce Budworm

In 2008 an operational spruce budworm, *Choristoneura fumiferana*, suppression program was implemented within the Tolko Industries Inc. Forest Management License (FML) in northwestern Manitoba. The biosynthetic insecticide, Mimic® 240 LV (tebufenozide) was applied aerially to a land base of 14,212 ha, of which 11,069 ha received a single application of 70 grams a.i. of Mimic® per ha and 3,143 ha received a double application. The product was applied by a team of two Air Tractor AT 602B fixed-wing aircraft each equipped with eight AU 4000 Micronair rotary atomizer nozzles.

Each aerial spray aircraft was equipped with the Satloc AirStar M3 real-time differential Global Positioning System (GPS) aerial navigation system. This system provided guidance over the treatment areas and allowed the pilot to boom off (cease spraying) when flying over designated exclusion zones (buffer areas and non-target sites). Second-by-second GPS and spray application data from each spray aircraft was imported into the Pesticide Application Information System. The use of this system has facilitated faster correction of spray application problems such as faulty flow controllers, as well as providing pilots with feedback on their performance after each spray session. A Cessna 337 aircraft was used for additional navigational support.

A portable, 10 meter tall, solar powered weather station was utilized in the 2008 spray project. This station was custom built using Campbell Scientific Weather monitoring components and a 1X RTT Digital Cellular modem. The weather monitoring components include temperature, relative humidity, 3-dimensional ultrasonic wind speed and direction anemometer and rain gauge. The components are of the highest accuracy so that the data collected can be directly compared to the AIMMS-20 onboard metrological sensors on the spray aircraft, thus allowing for better calibration of the AIMMS-20. The portable weather station has become an invaluable tool to fill voids in our fixed weather station network.

The 2008 spray project was successful. The mean population reduction due to treatment was 81% (Table 1). Generally, light defoliation occurred within the treated blocks, while moderate defoliation occurred in the untreated controls.

Table 1. Spruce budworm - percent reduction in larval numbers.

Northwest Region	Pre Spray Larvae[a]	Post Spray Larvae[a]	Larval Mortality	Corrected Mortality
Treated	10	0.5	95%	81%
Untreated Controls	20	15	71%	N/A

[a] Number of budworm/45-cm branch

Defoliation assessments and egg mass density surveys to predict 2009 defoliation were conducted throughout the province in August and September. See Table 2 for results.

Table 2. 2008 spruce budworm defoliation and predictions for 2009.

Location	2008 Defoliation*	2008 Egg Mass/10m^2	2009 Defoliation Prediction
Northeast	light to moderate	89	moderate
Northwest	light	13	light
Western	light	0	light
Riding Mt. Nat. Park	moderate	392	severe
Southwest	light	190	severe
Interlake	light	18	light
Eastern	light	4	light

Defoliation classes are as follows:

light - *up to 35% defoliation of current shoots*
- *based on <40 egg masses per 10 m^2 of branch area*

moderate - *35% to 70% defoliation of current shoots*
- *based on 40 to 185 egg masses per 10 m^2 of branch area*

severe - *greater than 70% defoliation of current shoots and possible feeding on old foliage*
- *based on >185 egg masses per 10 m^2 of branch area*

Spruce budworm pheromone traps were placed at 33 locations throughout the province. Three MULTIPHER® insect traps containing spruce budworm pheromone (PVC lure containing 0.3% by weight of a 95:5 blend of (E)- and (Z)-11-tetradecenal) were placed 40 m apart at each plot location in either a straight or triangular configuration. Average moth captures per trap decreased in six of the seven regions (Table 3).

Table 3. Spruce budworm pheromone trapping.

Location	2007 Moth Capture/Trap	2008 Moth Capture/Trap	% Change
Northwest Region	694	496	-29%
Northeast Region	719	347	-52%
Western Region	139	77	-44%
Southwest Region	2,632	1,747	-34%
Riding Mt. National Park	676	730	+8%
Interlake Region	350	126	-64%
Eastern Region	251	75	-70%

Dutch Elm Disease

Provincial Dutch elm disease (DED) sanitation crews removed 6,467 trees in 2007/08 (2,456 were within the Winnipeg DED buffer zone and 4,011 throughout the remainder of the province). The City of Winnipeg removed 4,409 elms and Brandon removed 185 elms. Total elm tree removals were 14,746.

The rapid removal trial continued for a fifth year. This is an operational research trial to determine whether rapid removal of current year hazard and diseased elm trees and firewood will reduce the native elm bark beetle population significantly. The expectation is a reduction in diseased trees.

In 2008, provincial survey crews marked 7,095 elms for removal (3,634 within the Winnipeg buffer zone, 760 in the City of Brandon and 2,701 in and around the 38 cost-sharing agreement communities). In addition, 221 elm firewood piles were identified for removal. In the City of Winnipeg, 4,434 elms were marked for removal and 348 firewood notices were issued.

Since 1982, Manitoba Conservation has monitored for the smaller European elm bark beetle, *Scolytus multistriatus*, with pheromone traps throughout southern Manitoba. From 1982 to 2006, eight specimens of *S. multistriatus* had been captured. In 2007, traps for *S. multistriatus* were again established along with additional pheromone traps for monitoring an invasive forest pest, the banded elm bark beetle, *Scolytus schrevyrewi*. Eleven specimens of the banded elm bark beetle were captured at one location, Otterburne, which is just south of Winnipeg. In 2008, the number of monitoring locations was expanded to 11 across southern Manitoba. Three *Scolytus* species, likely *S. schrevyrewi*, were captured at two sites; Otterburne and St. Adolphe.

Jack Pine Budworm

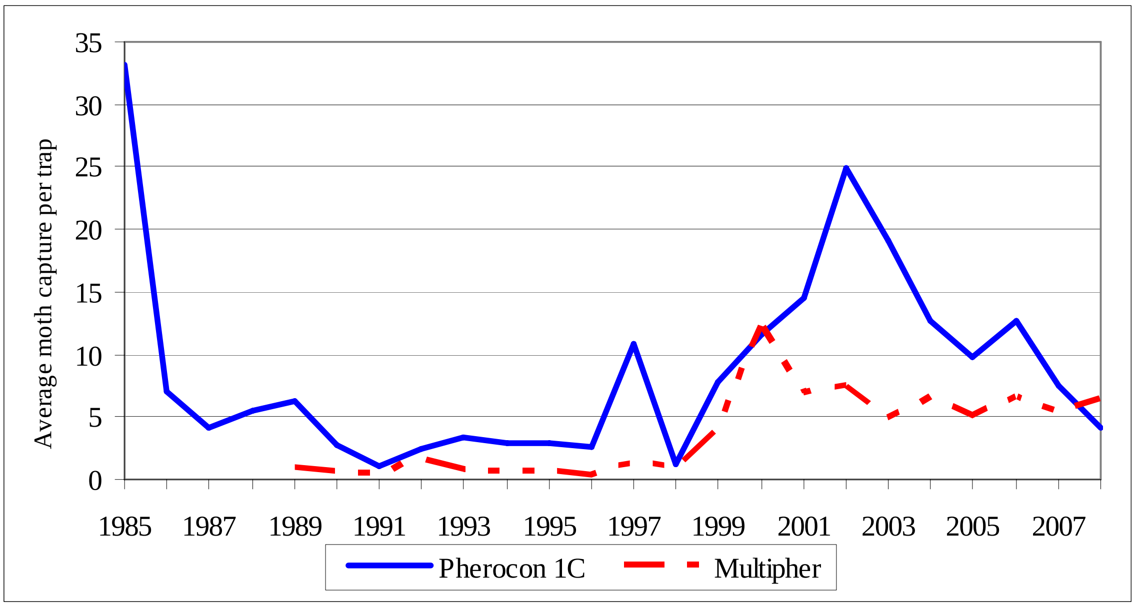
Defoliation by jack pine budworm, *Choristoneura pinus pinus*, in Manitoba, continues to be negligible and moth captures declined in the pheromone traps situated throughout Manitoba's jack pine (*Pinus banksiana*) forests. Adult jack pine budworm males have been captured with pheromone-baited traps since 1985. This trapping method is being evaluated as an early warning method for outbreaks and a supplemental technique to defoliation predictions by egg mass density surveys.

Twelve locations across Manitoba were monitored with pheromone traps in 2008. One location, Whiteshell, had to be re-established in a new stand due to blow down from a wind event in 2007. Since 1989, two trap types, Pherocon 1C and MULTIPHER®, have been field tested for capture efficiency using a 0.03% or 100 µg concentration of pheromone lure.

In 2008, the average number of male moths either decreased (Pherocon) or slightly increased (MULTIPHER) throughout the province (Figure 1). Moth numbers remained at the same level in seven locations, declined in, two and increased in two collection sites. Spruce Woods Provincial Forest and Mafeking were the only sites to show an increase in moth captures. The provincial average was 4 moths per Pherocon trap and 6 moths per Multipher trap.

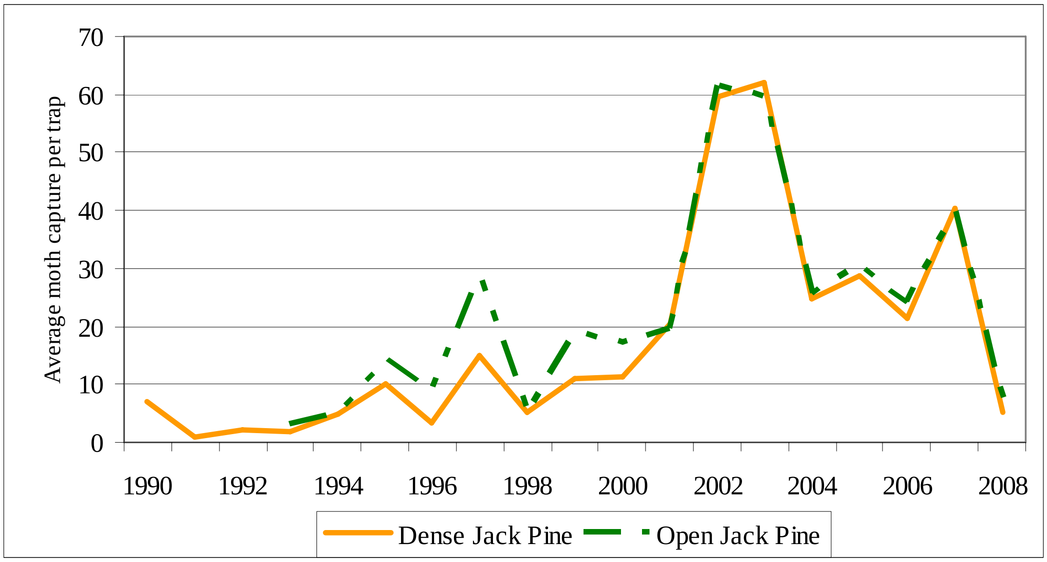
Branch assessment for shoot defoliation and egg masses were completed. No defoliation and no egg masses were recorded. Pollen cone bud levels for 2009 are predicted to be 53% on the branch tips.

Figure 1. Annual average capture of male jack pine budworm moths in two trap types.



The Sandilands Provincial Forest was designated as a demonstration site for the Jack Pine Budworm Decision Support System in 1991. Fourteen pheromone locations were established and situated in mature, dense jack pine stands with three Pherocon 1C traps per site. An additional 10 sites were established in 1993 in overmature, open-growing jack pine stands to compare jack pine budworm population levels between the two stand types (Figure 2). Until 2001, moth captures in the open jack pine stands were slightly higher than the dense jack pine stands. After that, moth capture levels have been almost equal between stand types as the population increased and decreased. The number of moths caught per Pherocon 1C trap decreased significantly in 2008. No defoliation and no egg masses were found during the branch assessment. There has been little difference in pollen cone bud levels between the dense and open jack pine stands.

<u>Figure 2.</u> Annual average capture of male jack pine budworm moths in two stand types.



Armillaria Root Disease

Armillaria root disease, *Armillaria ostoyae*, causes premature tree mortality and significant timber volume losses in upland black spruce sites in the mid boreal upland forests of western Manitoba. In October 2008, a survey was carried out in Porcupine Provincial Forest to develop a tree mortality profile for this forest type in order to determine the pathological rotation age for upland black spruce. Analysis of results from a similar survey in Duck Mountain Provincial Forest in 2007 indicate that volume losses due to root disease significantly reduces the period of operability for this forest type.

Eastern Larch Beetle

The eastern larch beetle, *Dendroctonus simplex*, infestation continued in 2008. The infestation, first detected in 2001, is now widespread throughout the Boreal Plain forests of southeastern Manitoba, the Interlake area and western and northwestern Manitoba.

Gypsy Moth

In conjunction with the Canadian Food Inspection Agency, intensive trapping of Gypsy moth, *Lymantria dispar*, adult males and egg mass surveys were continued in 2008. In the La Salle area (just southwest of Winnipeg), adult moth captures increased from 17 in 2007 to 26 in 2008 and egg mass numbers increased from 4 in 2007 to 48 in 2008. In addition, three egg masses were found at St. Germain in south Winnipeg. The presence of the egg mass stage of the life cycle in 2007 and the subsequent increase in 2008 indicates that a small population has successfully over wintered and become established in Manitoba.

Large Aspen Tortrix

The large aspen tortrix, *Choristoneura conflictana*, infestation increased in 2008. Defoliation was common throughout the Interlake region and western Manitoba.

Spruce Needle Rust

In 2008, spruce needle rust, *Chrysomyxa ledicola*, was common in natural white and black spruce stands, as well as planted Colorado spruce, throughout southeastern Manitoba.

Invasive Forest Pests and the Movement of Firewood

Invasive forest pests and diseases can be spread through the movement of firewood. Informative signs and wood disposal bins have been placed at the main entry points into Manitoba, on the Trans Canada Hwy at the Saskatchewan and Ontario borders, asking the public to deposit any wood they have with them in the bins. Campers and travelers are encouraged to leave all firewood where they bought it and to not transport it with them.

Manitoba Conservation staff surveyed campers in provincial and private campgrounds and found that the majority of campers resided in Manitoba and of those from out of province; only 2% brought their own firewood.

Forest Pest Conditions in Saskatchewan, 2008

Rory McIntosh, Robert Moore, and Jeffery Gooliaff

Saskatchewan Ministry of Environment, Forest Service Branch,
Box 3003 McIntosh Mall, Prince Albert, SK S6V 6G1

Defoliators – softwood

Spruce budworm Choristoneura fumiferana

The eastern spruce budworm *Choristoneura fumiferana* outbreak continues to decline in Saskatchewan. Aerial surveys conducted in 2007 showed an area of 89,578 hectares. In 2008 the area of moderate to severe defoliation had further declined to 12,160 hectares (Figure 1). In 2008 an area of approximately 10,000 ha around Smoothstone, Delarone and Anglin Lakes in Central Saskatchewan was treated with a double application of Foray 76B.

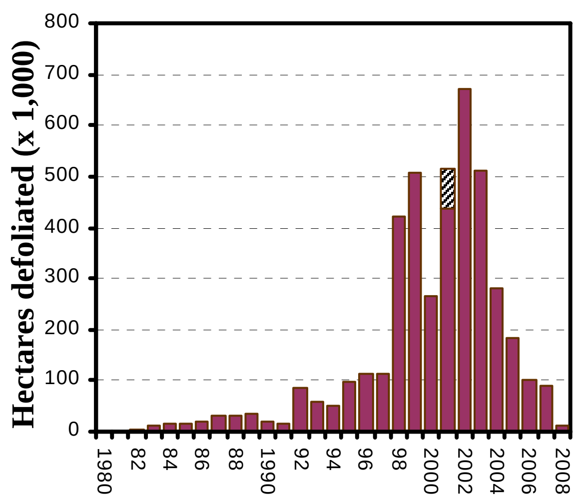


Figure 1. Area of moderate to severe defoliation caused by the spruce budworm *Choristoneura fumiferana* in Saskatchewan 1982-2008.

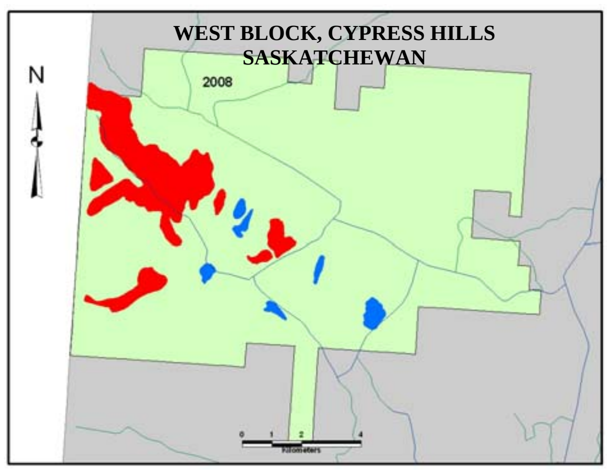


Figure 2. Area of moderate (blue) and severe (red) defoliation by spruce budworm in the west block of the Cypress Hills Inter-provincial park.

Spruce budworm defoliation has been building in the Cypress Hills Inter-provincial Park over the past few years (Figure 2). In 2006, approximately 1,000 hectares of mostly severe defoliation were detected along the Battle Creek area in the West Block. In 2007 the area remained about the same but the severity was reduced to mostly moderate. In 2008 1,172 hectares of mostly severe defoliation was detected.

Conclusions for 2008, Predictions for 2009

SBW populations continue to decline in most of the northern forests in Saskatchewan. Data from over wintering L2 surveys reveal a few small pockets of high populations throughout the southern fringe of the commercial forest. However, in the Cypress Hills Inter-provincial Park, over wintering L2 surveys lead us to predict severe defoliation again in this area in 2009. There is no spray program planned for Saskatchewan in 2009.

Research

Saskatchewan Ministry of Environment continues to support a number of Spruce budworm-related Research and Development projects including the long-term investigations into population dynamics of endemic spruce budworm populations in Armargh and Epaule, in Quebec.

Jack pine budworm

Choristoneura pinus pinus

Jack pine budworm – a periodic defoliator of jack pine has not reached outbreak levels in Saskatchewan since the 1980's. As part of an ongoing monitoring and early detection program initiated in 2006, a grid of pheromone traps has been set up across the commercial forest zone. In total, 72 pheromone-baited monitoring traps were deployed in clusters of three traps per location in mature jack pine stands across the provincial forest (Figure 3)

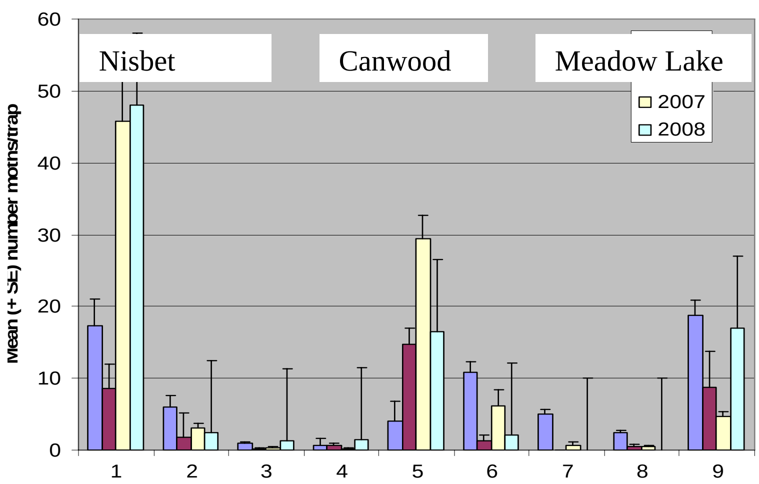


Figure 3. Jack pine budworm trap catches in each on nine regional monitoring locations (2005-08).

The monitoring has been further stratified into 9 regional locations representing similarity on the basis of relative proximity to each other.

Overall, the mean number of moths trapped in the Nisbet (#1) and Meadow Lake (#9) island forests have increased from 2008 while trap catches in the Canwood (#5) region have declined. Interestingly, these three distinct locations where moth catches remain elevated, all represent fringe or island forest areas. There was no observed defoliation detected in aerial or ground surveillance

Defoliators – Hardwood

***Large Aspen Tortrix* Choristoneura conflictana *and Forest Tent Caterpillar* Malacosoma disstria**

In, 2008 aerial surveys revealed 44,067 hectares of hardwood defoliation in the northwestern part of the province south of the Churchill River (Figure 4). Ground surveys confirm the defoliation was caused mostly by Large Aspen Tortrix (*Choristoneura conflictana*). In 2007, approximately 44,750 hectares was affected by Aspen leaf spot diseases, predominantly *Marssonina populi*. However, in 2008 this area declined significantly to just under 300 ha. Saskatchewan Ministry of Environment has set up a pheromone trapping grid at 20 locations throughout the aspen parkland and boreal transition ecoregions as part of an ongoing regional monitoring system for FTC. Many Large Aspen Tortrix adults were found in the Forest Tent Caterpillar traps.

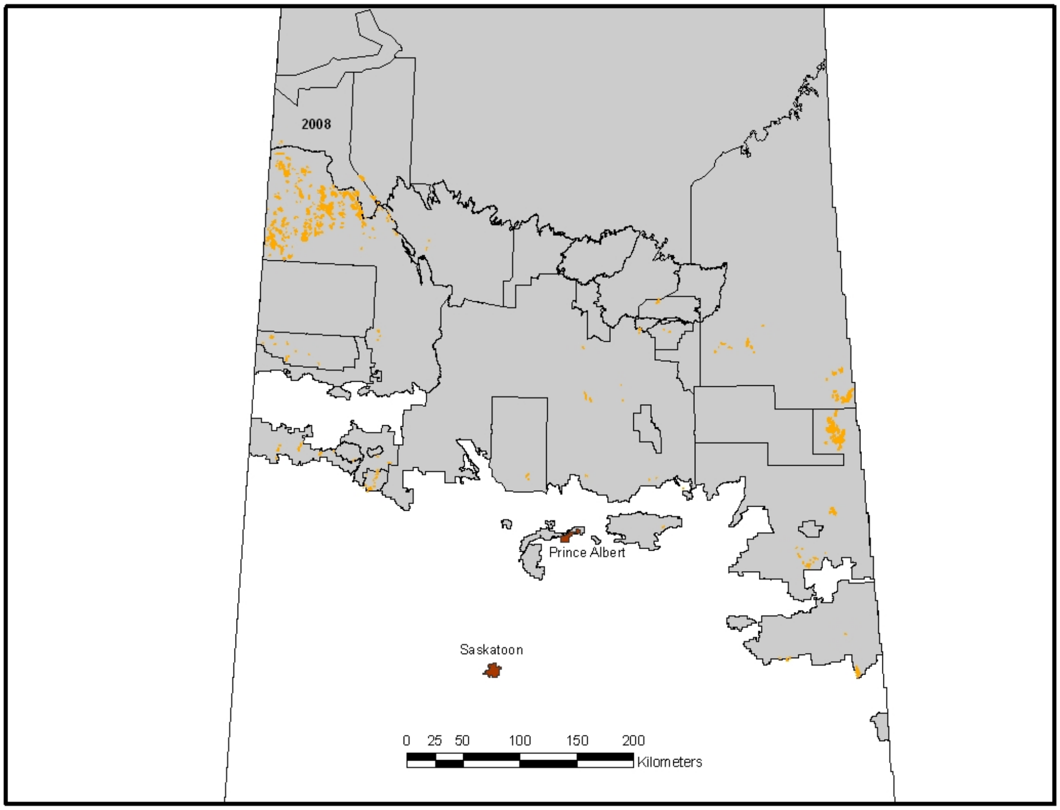


Figure 4. **Area of hardwood defoliation from Large Aspen Tortrix *Choristoneura conflictana.***

Research

Saskatchewan Ministry of Environment continues to support research to better understand Forest Tent Caterpillar pheromone trap catch data and determine their implications to management.

Invasive and non-native pests

***Dutch Elm Disease* Ophiostoma novo ulmi**

Over the past decade, Dutch elm disease (DED) has spread from a small area to the south of Estevan; along the Red Deer River valley in the North; along the Qu'Appelle valley in the east, and the Souris River area in the southeast (see Figure 5). In 2008, DED continued to spread through Saskatchewan, the disease now extends west to Moose Jaw – almost to the western-most natural range of the American elm. The movement is now along the Qu'Appelle valley and last mountain lake to the North of Regina.

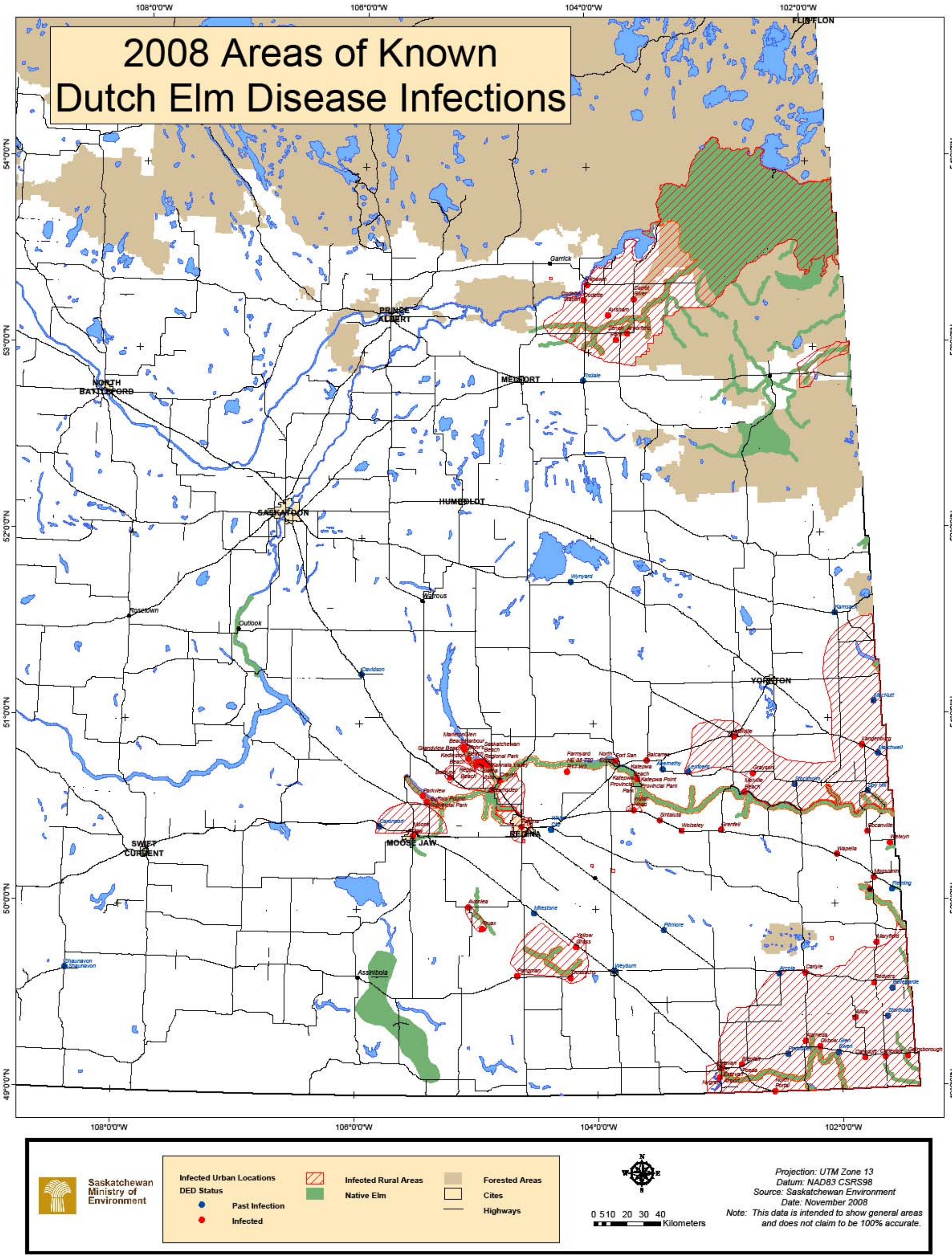


Figure 5. Extent and distribution of Dutch elm disease in Saskatchewan 2008.

DED infections were not reported in any new communities in 2008. In total there were 460 confirmed cases of DED detected during provincial surveys. The City of Regina had 5 cases with an additional case confirmed in Wascana Park. DED was confirmed in Estevan, Fort Qu'Appelle, Radville, Moosomin, Indian Head, Maryfield, Regina Beach, Lumsden, Wolsley and Grenfell. The Cities of Saskatoon, Prince Albert, North Battleford and Swift current, Yorkton and Maple Creek remain DED-free.

As compared to 2007, there was an increase of approximately 100 cases in 2008. This can be attributed to increased and improved surveillance in the management areas. In addition, buffers are set up around vulnerable communities to restrict the spread of DED into the city.

Tree surveillance and removal activities continued in Echo Valley Provincial Park. In 2007, a total of 114 infected trees were detected and removed in Echo Valley. In 2008 a further 86 trees were removed. Unless otherwise noted, all infected trees were removed in the municipalities, buffers and Echo Valley Provincial Park (Table 1)

There were 43 communities involved in the cost-share program. This program promotes shared management responsibility for DED between the community and the provincial government.

DED management activities conducted in the municipalities under the cost share program include: pruning, public education, development and improvement, equipment upgrades and forest diversification through planting.

Table 1. **Number of Dutch elm diseased elm trees removed from municipalities and buffers in Saskatchewan 2008.**

Municipalities		Buffers		Parks	
Location	**removed**	**Location**	**removed**	**Location**	**removed**
Estevan	7	Estevan	14	Echo Valley	86
Lumsden	9	Regina	137		
Regina Beach	13	Moose jaw	16		
Indian Head	9	Indian Head	21		
Fort Qu'Appelle	33	Fort Qu'Appelle	80		
Katepwa	39	Tisdale	0		
Carnduff	2				
Radville	5				
City of Regina	5				
Carlyle	3				
General public	0				
Total	**125**		**268**		**86**

[1.] Trees not removed. Infection considered too extensive in the park to contain through removals.

Research

Saskatchewan Ministry of Environment is currently supporting graduate research into *Hylurgopinus rufipes* biology and ecology at the Department of Entomology University of Manitoba.

***European Gypsy Moth* Lymantria dispar**

In 2008, the Canadian Food Inspection Agency (CFIA) continued ongoing monitoring in SK deploying 280 Trece delta traps loaded with Dispalure^{TM} in Saskatchewan. One half of these (140) were deployed in the city of Saskatoon.

While in 2007, **FIFTEEN** traps were found to be positive, only two traps were positive in 2008. 1 in the Moose Jaw and 1 in City of Swift current. An additional 4 unconfirmed catches were found in the City of Regina. There is still some uncertainty around the cause of the rapid decline in the City of Saskatoon. In 2009, the CFIA plans to continue with the increased trapping grid in the City of Saskatoon to determine the status of the outbreak in this city.

***Banded elm bark beetle* Scolytus schevyrewi**

In 2004, Saskatchewan first deployed a network of pheromone-baited monitoring traps at 15 locations across the southern extent of the province. In 2007, and in collaboration with CFIA, Saskatchewan Ministry of Environment extended the monitoring network to include 10 major communities across the southern part of the province. Sticky panel traps baited with 90-day elm bark beetle lures[1] were deployed. *Scolytus schevyrewi* were detected in traps located in **six** of the communities: Maple Creek, Assiniboia, Moose Jaw, Weyburn, Eston and Estevan. In 2008, trapping effort was expanded from 4 to 10 traps in each of these positive locations to determine the extent of the infestation and confirm if populations are establishing. Specimens collected in the 2008 trapping program have all been confirmed by CFIA (Table 2). In 2007, six communities were positive, in 2008 this number has increased to eight.

[1] Contech Inc. 7572 Progress Way, Delta, British Columbia V4G 1E9

<u>Table 2.</u> Comparison of positive trap catches of *Scolytus schevyrewi* in Saskatchewan 2007 and 2008.

	Number of traps		**Number of traps positive**		**Range +ve trap counts**			
Community	2007	2008	2007	2008	2007		2008	
					High	Low	High	Low
Assiniboia	4	10	4	6	14	1	71	9
Estevan	4	10	2	7	1	1	25	1
Eston	4	10	1	1	1	1	2	2
Kindersley	4	4	0	0	0	0	0	0
Leader	4	4	0	0	0	0	0	0
Maple Creek	4	10	4	6	many	3	36	3
Moose Jaw	4	10	3	4	many	6	5	1
Saskatoon	-	10	-	0	-	-	0	0
Swift Current	-	4	-	0	-	-	N/A	N/A
Shaunavon	4	4	0	2	0	0	12	5
SK Landing P. Park	4	4	0	3	0	0	38	1
Weyburn	4	10	4	5	many	1	28	1

Research

Saskatchewan Ministry of Environment is currently initiating graduate research at the Department of Entomology University of Manitoba., to determine the bionomics of *Scolytus schevyrewi* in the prairie region and to determine susceptible hosts, and explore interactions with DED and the Native elm bark beetle *Hylurgopinus rufipes*.

***Mountain pine beetle* Dendroctonus ponderosae**

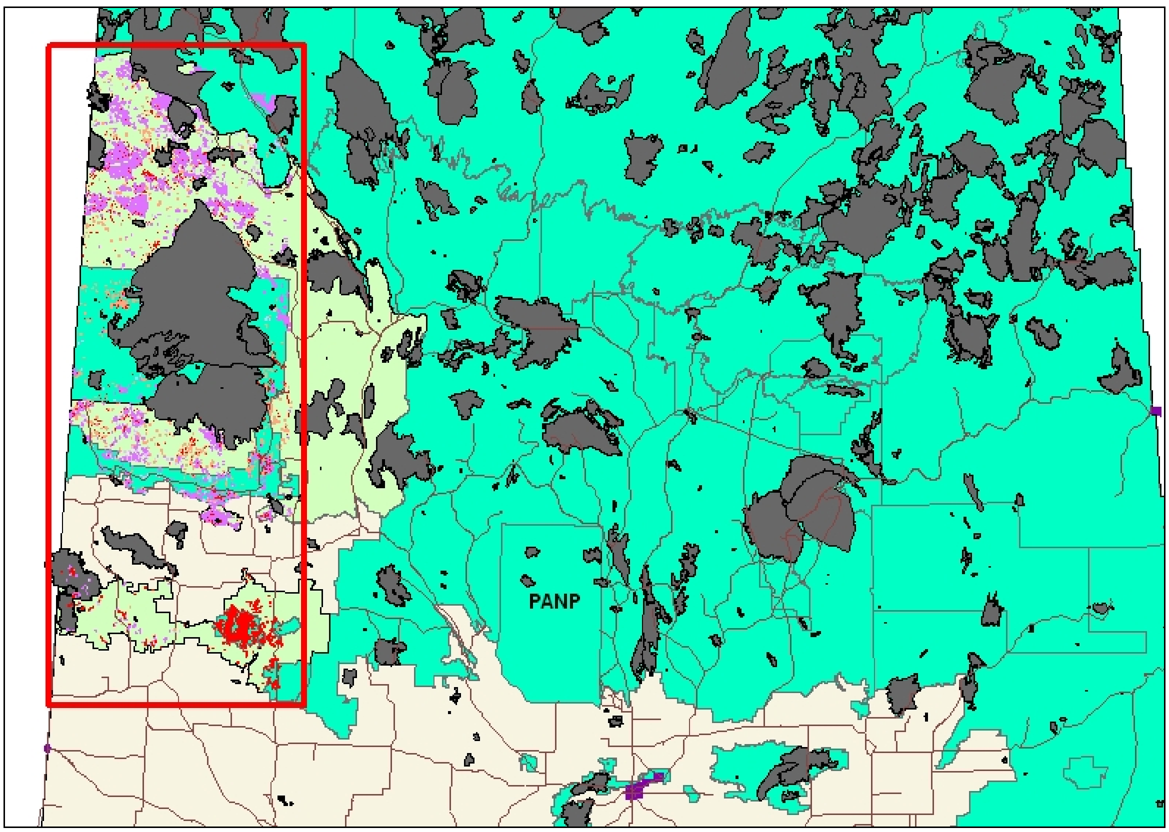
The potential spread and risk of Mountain pine beetle (MPB) establishing in Saskatchewan continues to be a major concern. In Saskatchewan there remains the opportunity to focus on proactive, **Preventive** approaches and not be forced, at this time, into active beetle-focused **Suppressive** action.

Since 2002, Saskatchewan Ministry of Environment (SK MOE) has implemented regulatory controls to prevent the long-distance, human caused, spread of MPB into the province. In July 2008, this restriction order was strengthened by designating MPB a pest under *The Forest Resources Management Act* (FRMA) and designating the lands where the moratorium is to be enforced. This designation enables greater powers of inspection and mitigative action under the FRMA. Saskatchewan, together with major stakeholders, continues to streamline the regulatory process by integrating MPB contingencies into the Forest Management Planning and tactical planning process.

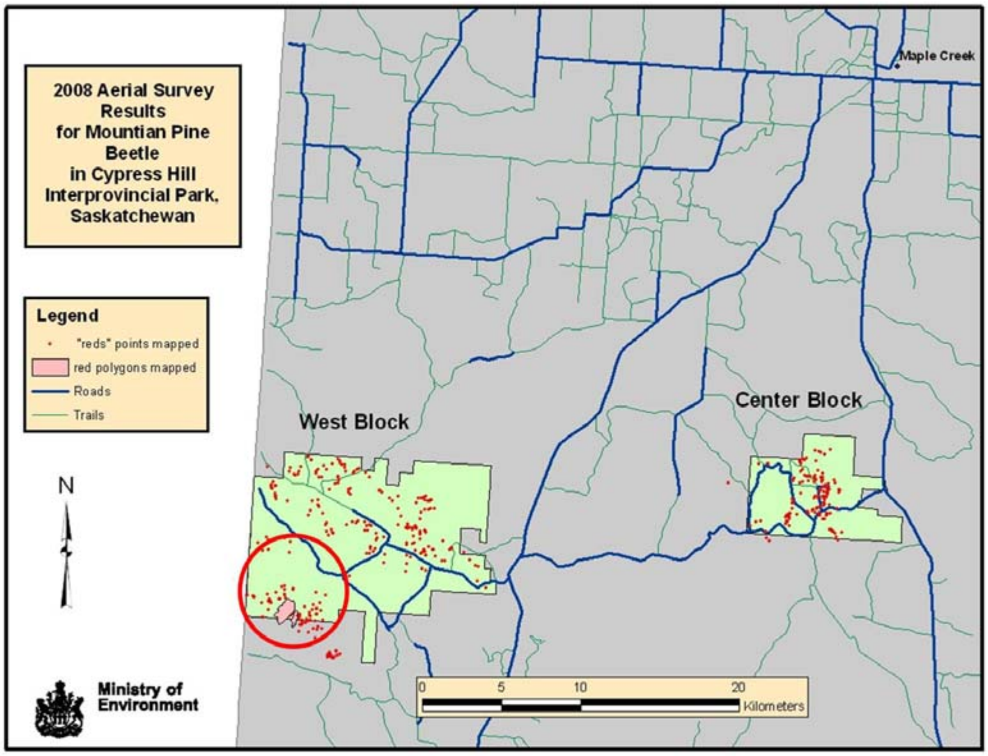
Saskatchewan's approach to the MPB threat is very similar to that of fire-fighting – that is the requirement for early detection leading to immediate, rapid and aggressive response. To help focus surveillance and detection of MPB, SK MOE has implemented risk and susceptibility mapping – forest-focused approaches aimed at determining the extent and distribution of susceptible pine in the western part of the province. The distribution of these high risk stands, coupled with the locations of recent fires (See dark gray polygons in Figure 6) enables efficient aerial and ground surveillance activities.

In 2007 and again in 2008 ground and aerial surveys historically conducted in the Cypress Hills Interprovincial park were expanded to include an area approximately 100 km wide running East of the Alberta-Saskatchewan Border and as far north as the Churchill river.

In the Cypress Hills Inter-provincial Park (CHIPP) 399 locations containing red trees were detected in aerial surveillance (Figure 7). Of these, 13 had evidence of current or past MPB activity triggering start probe surveys and resulting in ten trees marked for treatment. In the South Benson area of the CHIPP, two areas containing high concentrations of red trees were mapped as polygons, rather than as individual trees or patches of trees. One polygon was approximately 23 ha and the other approximately 112 ha. Line transect surveys were conducted to survey MPB infested trees in both polygons. These surveys resulted in another 24 trees being marked for treatment, bringing the total number of trees marked for treatment at CHIPP to 34. These trees will be cut and piled then burned in the winter 2008/09.



<u>Figure 6.</u> Map of western Saskatchewan showing distribution of susceptible pine (red and purple polygons); recent fires (dark gray polygons) and red trees (red stars). 2007 and 2008 intensive surveillance area is bounded by red rectangle.



<u>Figure 7.</u> Distribution of red trees detected during 2008 aerial surveys. The density of MPB attacked trees in the west block (inside red circle) was such that the area was represented by a polygon.

The aerial survey in the boreal forest identified 1,075 sites with over 1,700 suspect "reds" (i.e., recently dead jack pine). A proportion of these locations were ground-truthed (where access permitted). During the ground survey of the boreal forest, 53 locations with approximately 90 dead jack pine trees were examined for evidence of attack by MPB and other biotic and abiotic agents. The most common damage agents found in the "reds" in the boreal forest were engraver beetles, sawyer beetles, and root rot.

Research

Saskatchewan Ministry of Environment has supported and continues to support a number of research initiatives to aid in risk assessment and to improve knowledge of MPB ecology and epidemiology in jack pine. Saskatchewan Ministry of Environment is working in collaboration with Alberta Sustainable Resource Development working towards improving information to conduct regional risk assessment through the development of susceptibility indices and determine connectivity of forest cover to aid in spread prediction. In addition to this SK supports research aimed at elucidating the adaptation of Mountain pine beetle to the boreal environment and novel hosts.

CURRENTLY NO MOUNTAIN PINE BEETLES ARE FOUND IN SASKATCHEWAN'S BOREAL FOREST

National Regional and Provincial Pest Management Initiatives

National

Saskatchewan Ministry of Environment continues to support, in principle, the initiatives promoted through the National Forest Pest Strategy (NFPS). Saskatchewan is working together with Federal, Provincial and Territorial partners to develop a risk-based decision-making framework for dealing with forest pests. Through this framework, responses to pests – both alien and native can be coordinated; knowledge, decision support and risk analysis tools and response options can be developed and shared; and collaborations on research initiatives can be built so that we can benefit from efficiencies in investment and effort and ensure that our response is coordinated.

Regional

Saskatchewan Ministry of Environment continues to work together with Federal, Provincial and Territorial partners to develop a regional approach to mitigating the risk of Mountain pine beetle expanding its current range and spreading into the boreal forest.

Provincial

Saskatchewan Ministry of Environment has drafted a provincial insect and disease strategy outlining the scope and direction of forest insect and disease management in the province. The approach is well-aligned with that of the National Forest Pest Strategy and, like the NFPS the strategy, is strongly founded in a science-based, risk analysis model. The foundation of the strategy is in prevention and ongoing monitoring and surveillance so that early detection and timely and cost effective intervention options can be implemented.

Major Forest Pest Conditions in Alberta, 2008

Sunil K. Ranasinghe

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9920 – 108 Street, Edmonton, AB T5K 2M4

Introduction

This report contains results of forest pest surveys and pest management programs carried out under the Alberta Sustainable Resource Development's (SRD) Forest Health Program in 2008.

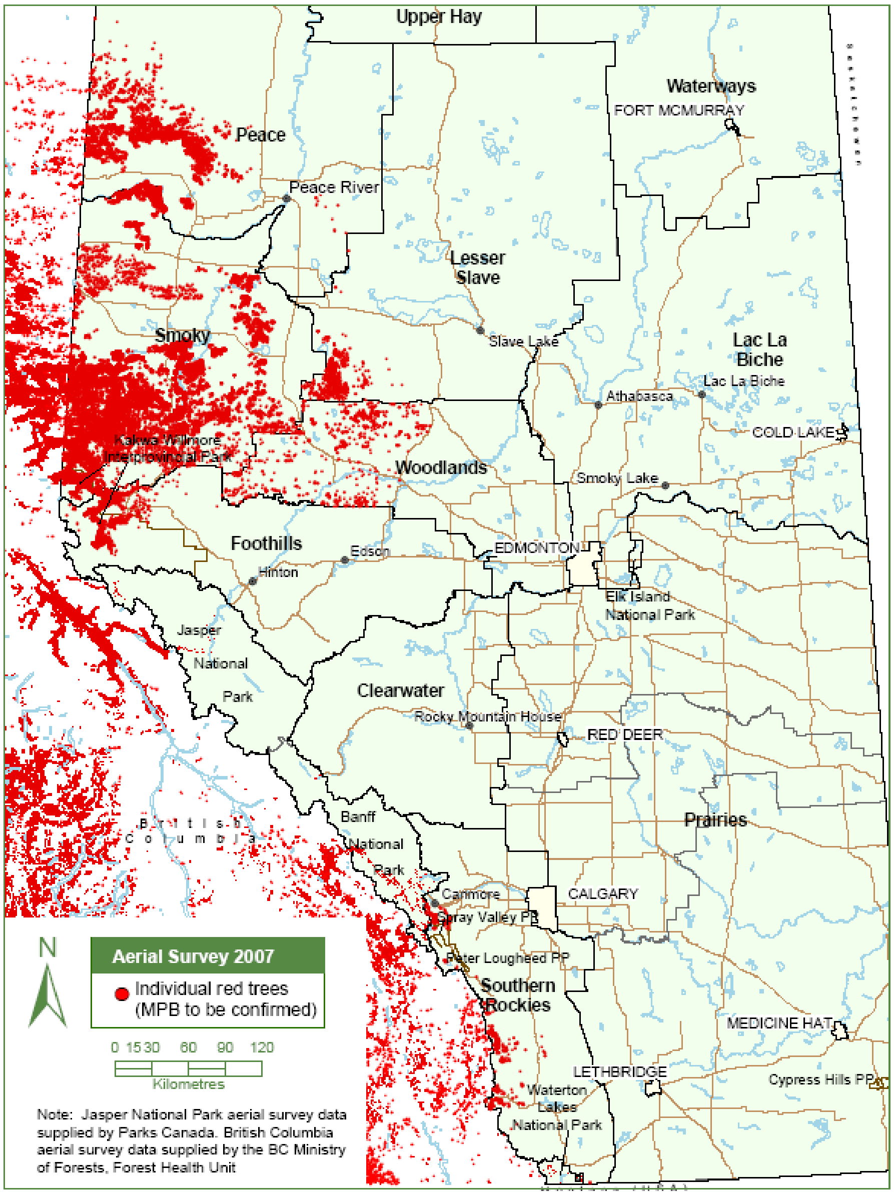
The data reported here were collected by the Forest Health Officers and Forest Health Technicians. Aaron McGill (Senior Information Management Technologist) and Brad Tyssen (Information Management Technologists) prepared the maps included in this report

In this report, the pest-related activities are reported on a calendar year basis except those of the mountain pine beetle (MPB). The MPB program is reported on a "beetle year basis, i.e., August 15, 2007 to August 14, 2008,"

The surveys reported in this document were carried out for operational purposes over the forested Crown land in Alberta. These surveys do not necessarily cover the entire provincial land base. Although every effort is made to ensure accuracy and completeness of this report, its integrity is not guaranteed by the SRD.

Mountain Pine Beetle

The mountain pine beetle (MPB) was the most important forest pest in Alberta in 2008. During the 2007/2008 beetle year (August 15, 2007 – August 14, 2008), mature pines with red crowns scattered over a wide landscape in Northern Alberta were observed during aerial surveys that were carried out in the fall of 2007 (Figure 1). These pines with red crowns (symptomatic of MPB) were the result of a massive influx of beetles from BC to Alberta in 2006 summer. It was not possible to detect most of these beetle attacks during the 2006/2007 season because the green attack trees were scattered over a wide area that was infested for the first time. As well, there were no red attacked trees associated with these green attacks to assist detection. Long-distance aerial dispersal surveys were carried out between July-October 2008 by deploying aggregation pheromones in strategic locations across the province. The results of these surveys showed no signs of the MPB spreading further in to eastern Alberta in 2008 (Figure 2).



<u>Figure 1.</u> Results of the fall 2007 aerial surveys showing locations of pines with red crowns suspected of being attacked by the mountain pine beetle in Alberta.

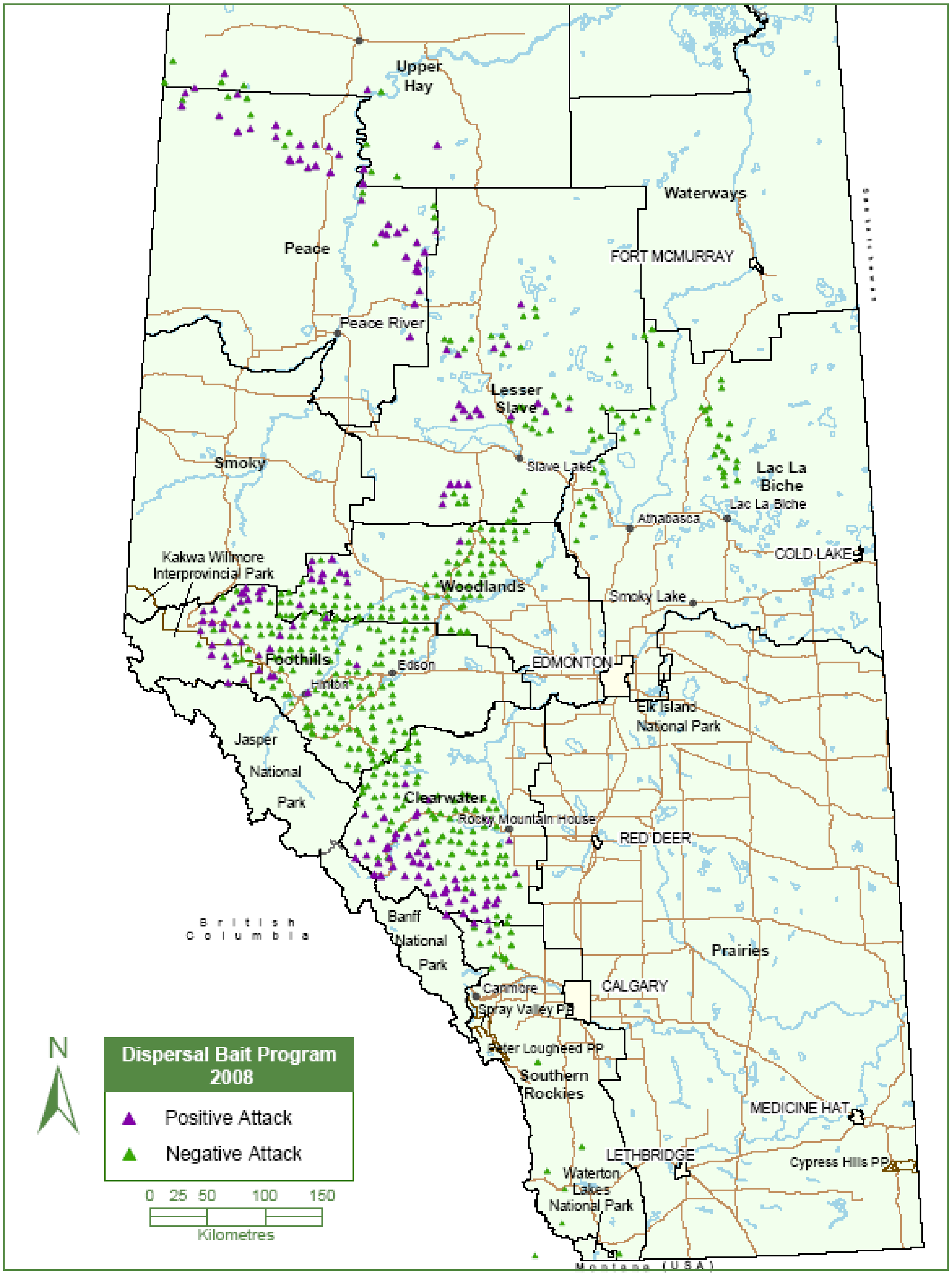


Figure 2. Results of the MPB long-distance dispersal monitoring pheromone bait program carried out in July-October, 2007 in Alberta.

Ground surveys to detect green attacks were conducted after aerial heli-GPS surveys to detect red-attacks were completed in the fall of 2007. The locations of red attacks were used to find green attacks that occur in their vicinities. During the 2007/2008 beetle year ground surveyors detected 125,054 green attack pines. There were no MPB attacks in the genetic plantations surveyed in 2008.

Surveys to determine green: red attack ratios were carried out in 2007 fall. The results of these surveys indicated mixed trends in beetle populations in Northern Alberta (Figure 3). The R-value surveys, another measure of population trends, were carried out in late spring of 2008 after all winter-caused MPB kill has occurred. The R-values confirmed some pockets of population increase in northern Alberta and in the southwest. A decreasing population trend was found in the leading edge-zone where active MPB control action was taken (Figure 4). These population trend survey results also showed high population growth in southwest Alberta and at a few pockets in northern Alberta (Figures 3 and 4).

Under the SRD’s beetle management program 125,137 infested pines were cut and burned in 2007/2008 beetle year. These included some green attacks detected by the control crews. Another 119,909 infested pines were removed by the MPB-affected municipalities operating under the SRD grant program. The forest companies removed 2,340.904 cubic metres of wood from beetle-infested stands by sanitation harvest.

Spatial distribution of pines with red crowns symptomatic of MPB was recorded during the aerial surveys carried out in the fall of 2008. The results of these surveys are shown in Figure 5. Compared to the results of the 2007 survey (Figure 1), the numbers of infested trees were lower in the areas where active control actions were taken in 2007/2008. However, more infested trees were recorded in a few pockets in the northwest The MPB infestation also increased in southern Alberta.

Lower numbers of MPB-infested trees are expected in 2009 in the 2008 Leading Edge Zone where active MPB control was carried out in 2007/2008. An increase in MPB-infested trees is expected in southern and northwest Alberta in 2009.

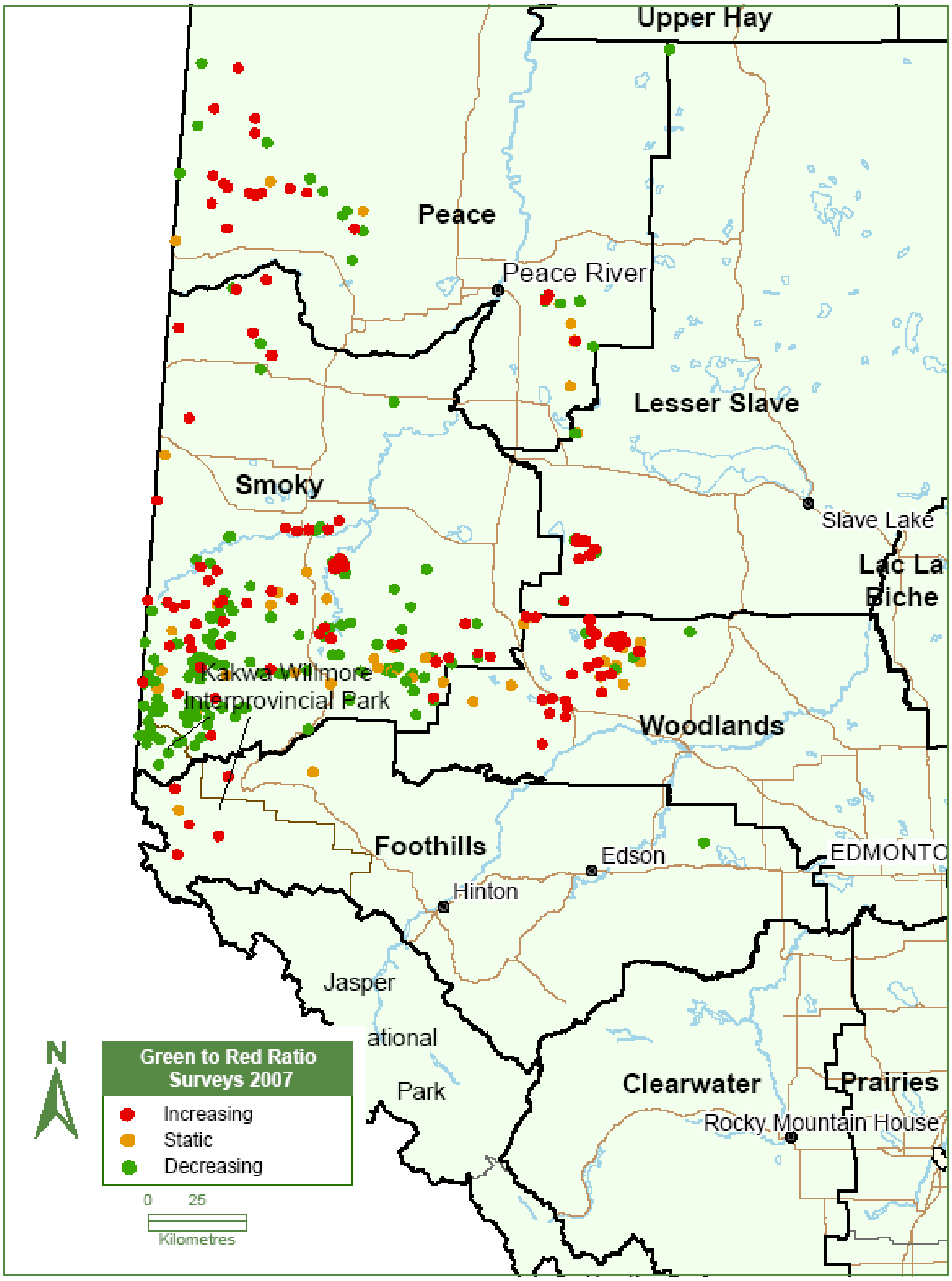
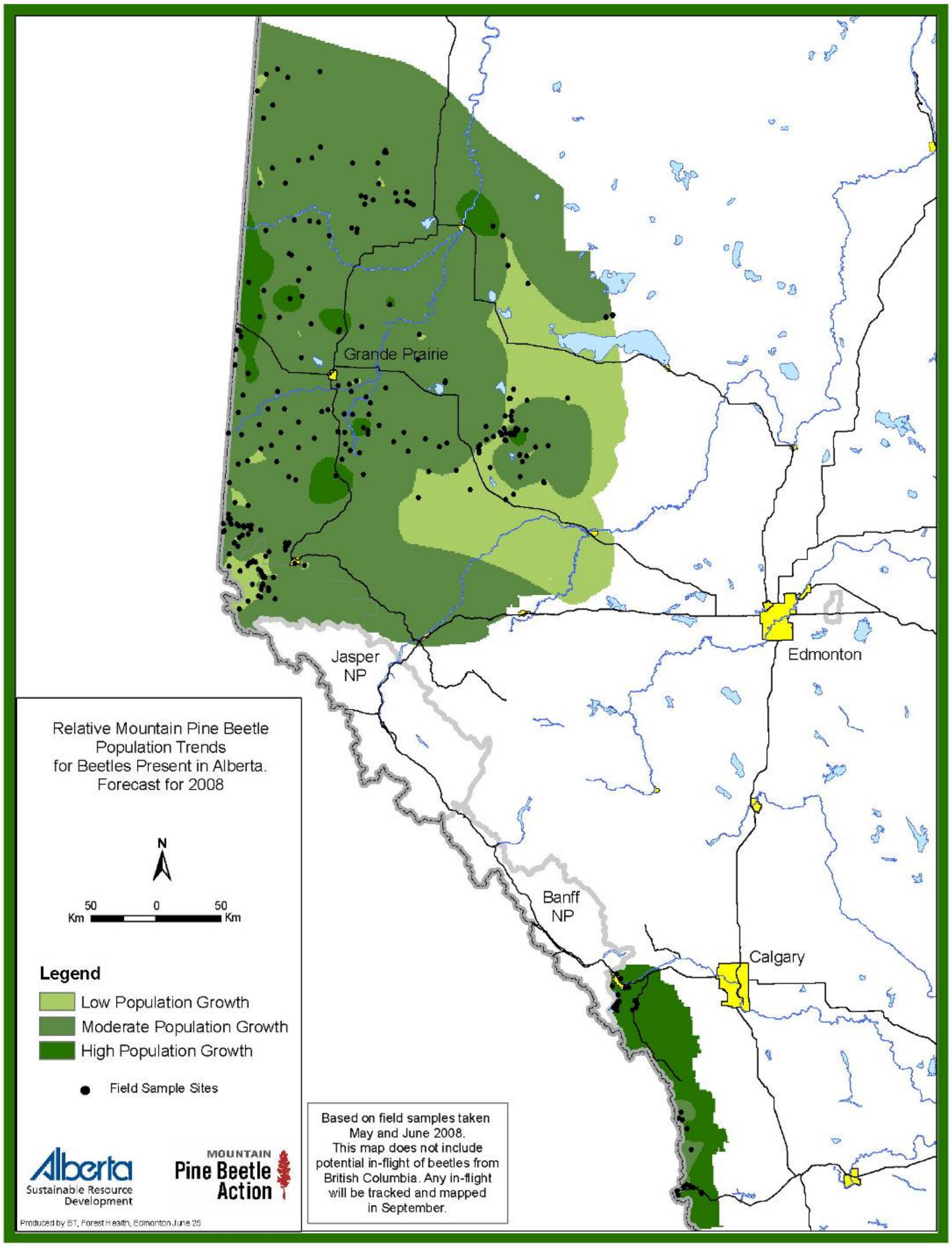
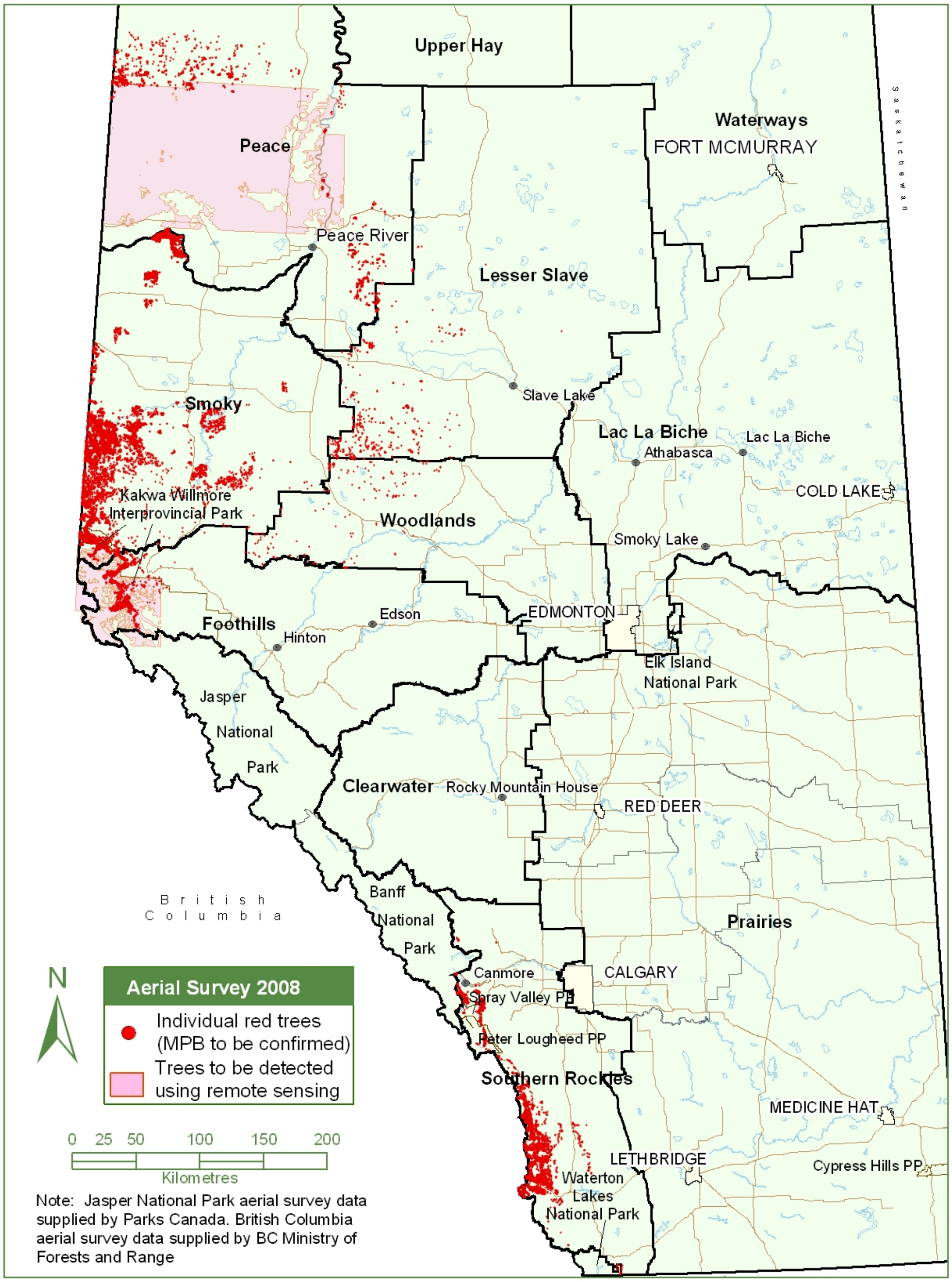


Figure 3. The results of the green: red ratio surveys carried out in northern Alberta in the fall of 2007.



<u>Figure 4.</u> R-value-based MPB population trends obtained in a survey conducted in 2008 spring in Alberta.



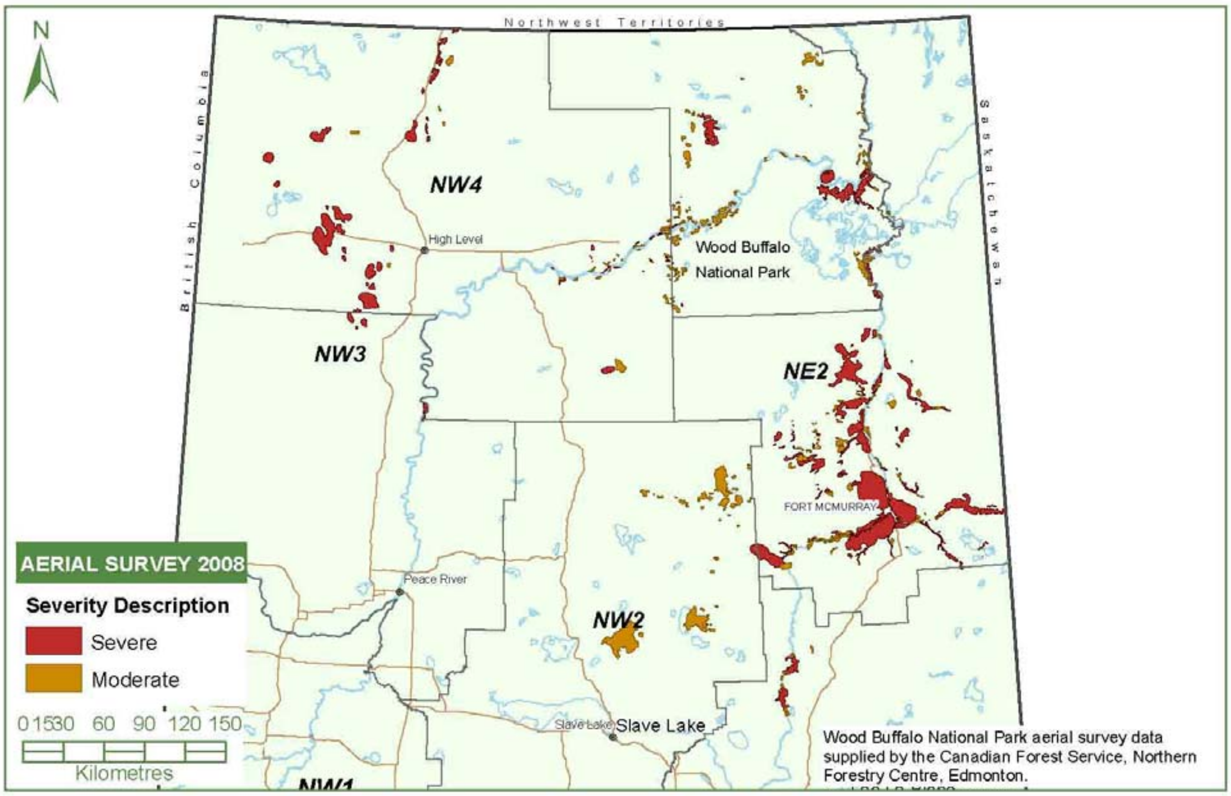
<u>Figure 5.</u> Results of the fall 2008 aerial surveys showing locations of pines with red crowns suspected of mountain pine beetle attacks in Alberta.

Spruce Budworm

The spruce budworm defoliated an estimated 160,408 hectares of spruce forest in 2008 (Figure 6). This is a 47% increase in the defoliated area compared to that in 2007. The severely defoliated area doubled in 2008 compared to that in 2007. Most of this defoliation was recorded in the northeast. There was some resurgence of budworm populations in the northwest where a 17-year budworm infestation collapsed in 2003. The forecast for 2009 calls for an increase in the risk of spruce budworm outbreaks in northeast and in northwest Alberta (Figure 7).

The western spruce budworm infestation over Porcupine Hills in southwest Alberta also spread further south and west in 2008 to reach 22,471 hectares (Figure 8). This is a 27% increase in the defoliated area. However, the severity of defoliation decreased to a moderate level in most of the infested areas. A light to moderate defoliation is expected in 2009 in the affected areas.

Forest pest caused aspen defoliation was scattered over an estimated 2.9 million hectares in 2008. This defoliation was attributed to the forest tent caterpillar. Most of this defoliation was observed in the northeast while patches of defoliated areas appeared in the northwest where the tent caterpillar populations collapsed in 2007. Bands of light aspen defoliation were observed across central Alberta and in the southwest (Figure 9).



<u>Figure 6.</u> Spatial distribution of spruce budworm defoliation by severity categories detected during aerial overview surveys carried out in 2008 in Alberta.

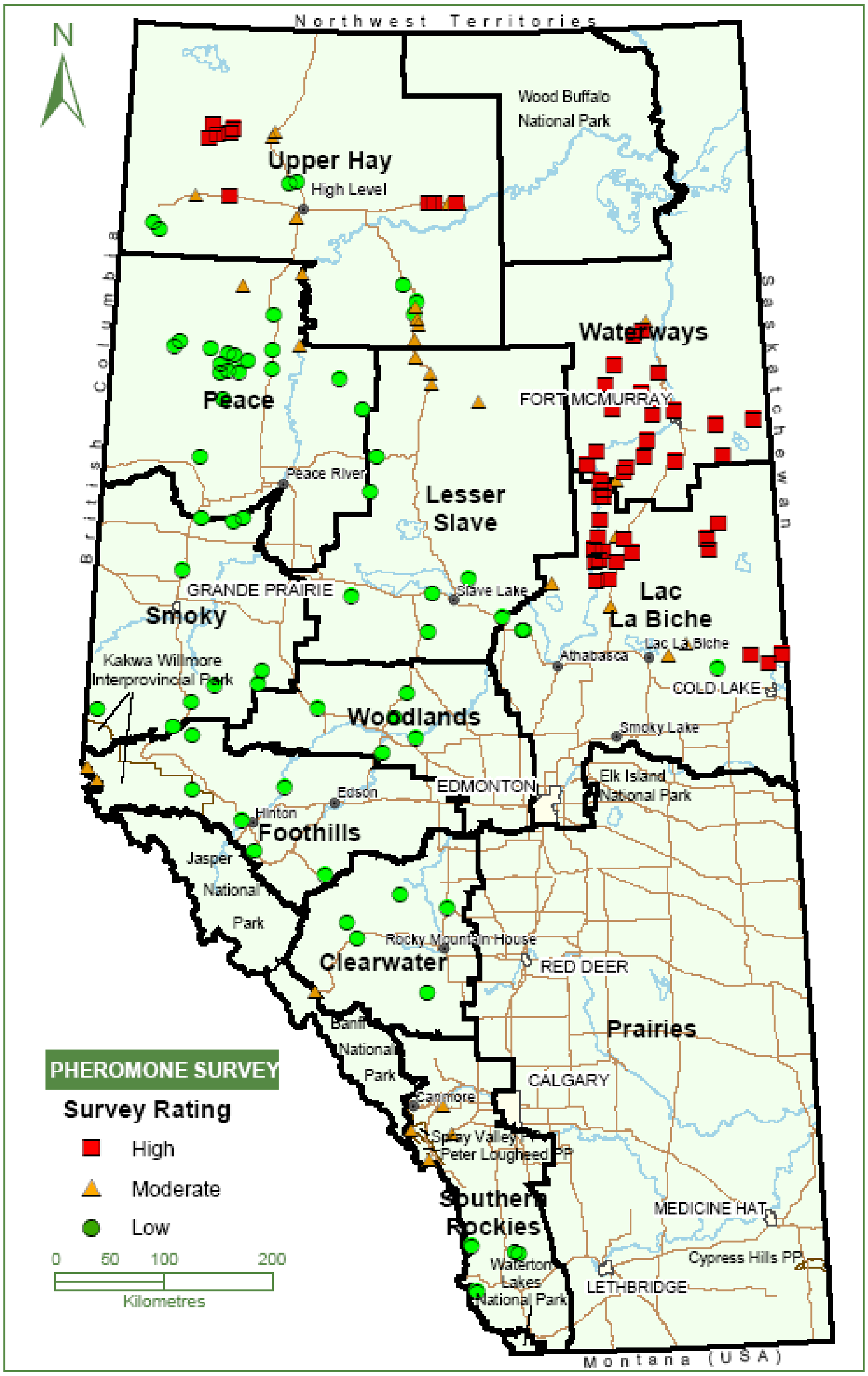


Figure 7. **Forecast based on male moth catches in pheromone-based traps in 2008 on the risk of spruce budworm infestations occurring in 2009 in Alberta.**

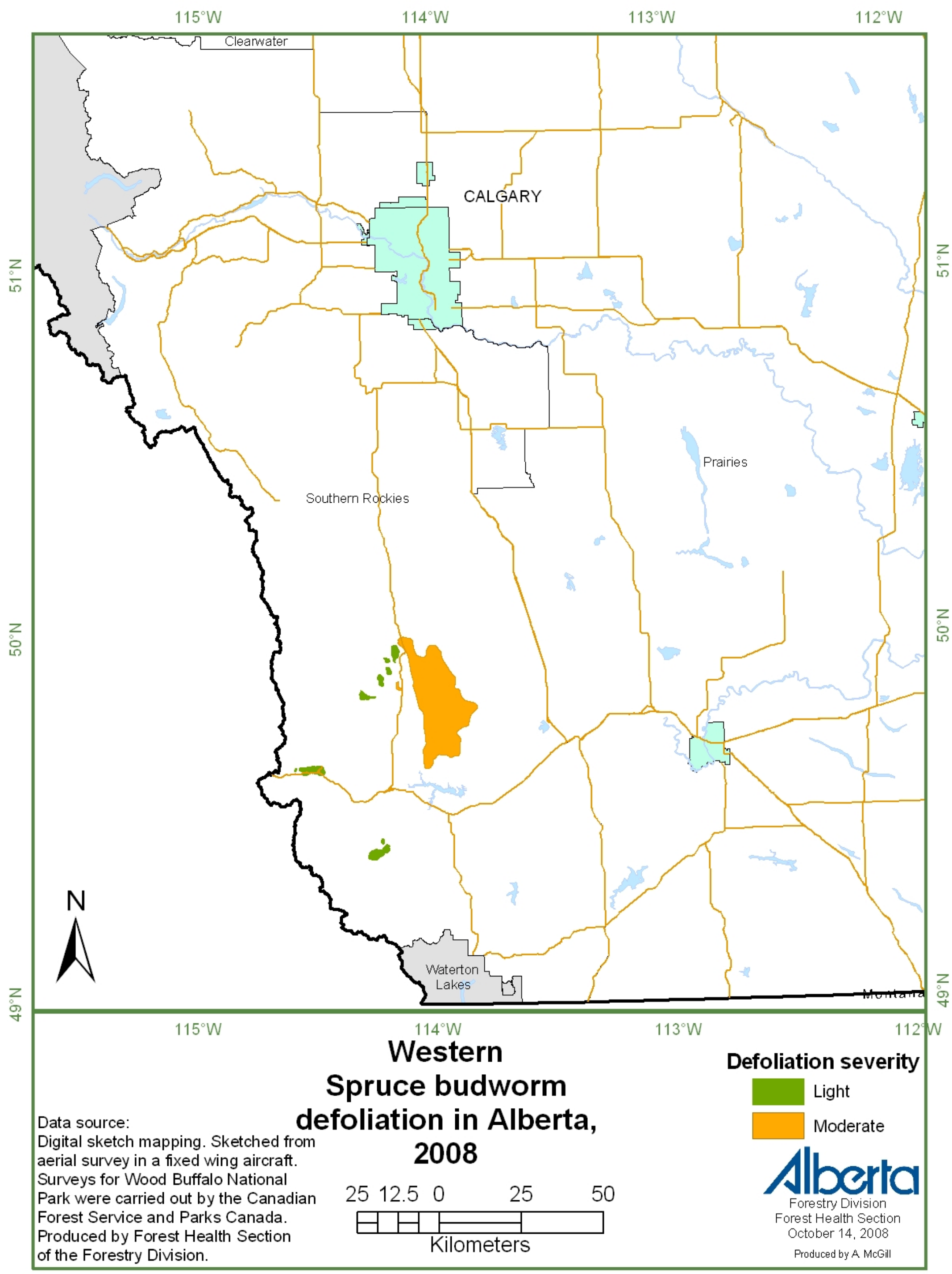


Figure 8. Spatial distribution of aerially visible western spruce budworm defoliation by severity categories in southwest Alberta, 2008.

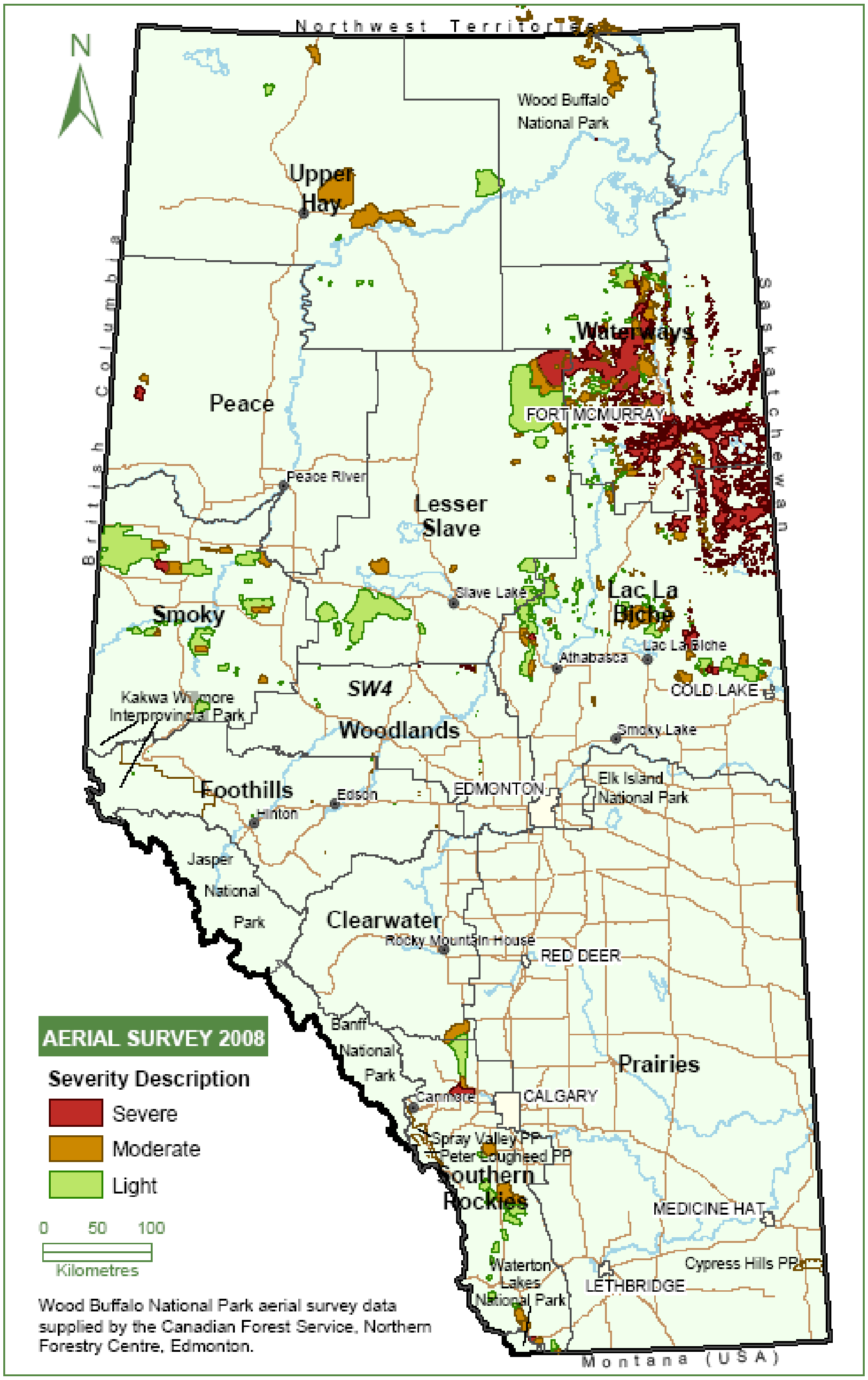


Figure 9. Spatial distribution of aerially visible aspen defoliation by severity categories in the areas surveyed in 2008 in Alberta.

British Columbia Report

Harry Kope (for Tim Ebata)

British Columbia Ministry of Forests and Range

NOT AVAILABLE

SESSION 9: POTENTIAL IMPACTS OF CLIMATE CHANGE ON FOREST PEST MANAGEMENT IN CANADA

Chair: Harry Kope
British Columbia Ministry of Forests and Range

SÉANCE 9 : EFFETS POTENTIELS DES CHANGEMENTS CLIMATIQUES SUR LA RÉPRESSION DES RAVAGEURS FORESTIERS AU CANADA

Président : Harry Kope
British Columbia Ministry of Forests and Range

Are Diseases of Young Forests in Central BC Increasing? Is it Due to Climate Change?

Alex Woods

British Columbia Ministry of Forests and Range,
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Abstract

An unprecedented *Dothistroma* needle blight epidemic in northwest British Columbia has been suggested to be linked to climate change. That epidemic first documented in 2003 continues, as do the environmental conditions that are believed to have initiated it. Periods of increased mean summer precipitation over the past four decades correlate closely with historical records of *Dothistroma* outbreaks in the northwest. The current most severe outbreak that has resulted in mature lodgepole pine trees succumbing to the disease has occurred during a prolonged period of above average summer precipitation. But *Dothistroma* needle blight is not the only foliar disease that is becoming more prevalent and the BC northwest is not the only region of BC that is affected. Throughout central BC from the northwest east to the Rocky Mountains, foliar diseases of forest tree species are increasing in incidence and severity. Obscure foliar diseases of lodgepole pine and interior spruce, rarely reported in the past, are becoming more common. The incidence of hard pine rusts also appears to be increasing. In the Morice Timber Supply area of central BC the combined incidence of western gall rust, comandra and stalactiform blister rust has more than doubled in a 10 year period based on three landscape level assessments of lodgepole pine plantations. The proportion of plantations that have greater than 20% incidence of rust attack has increased over five fold from approximately 7% in the late 1990s to over 40% in 2008. These landscape level changes in forest disease incidence in central BC coincide with significant increasing trends in both summer precipitation and overnight minimum temperature based on the Ft. St. James weather station that has a continuous daily weather record from 1895 to the present. Both of these climatic trends are consistent with predicted global climate change trends and both have considerable implications for forest pathogens in central BC.

Résumé

Les maladies des jeunes forêts sont-elles à la hausse dans le centre de la Colombie-Britannique? Le changement climatique en est-il responsable?

Il semble qu'une épidémie sans précédent de la brûlure en bandes rouges (une maladie causée le champignon *Dothistroma septospora*) qui sévit dans le nord-ouest de la Colombie-Britannique soit liée au changement climatique. Cette épidémie, documentée pour la première fois en 2003 se poursuit toujours, tout comme les conditions environnementales qui sont présumées en être à l'origine. Les périodes au cours desquelles les précipitations estivales moyennes ont été plus importantes durant les quatre dernières décennies présentent une corrélation étroite avec les mentions historiques d'épidémies de la brûlure en bandes rouges dans le nord-ouest de la province. La très grave épidémie actuellement en cours, qui a provoqué la mort de pins tordus latifoliés, est apparue durant une période prolongée de précipitations estivales supérieures à la moyenne. La brûlure en bandes rouges n'est toutefois pas la seule maladie du feuillage à devenir plus répandue, et le nord-ouest de la Colombie-Britannique n'est pas la seule région de la province à être affectée. L'incidence et la gravité des maladies du feuillage des essences forestières vont croissants dans tout le centre de la Colombie-Britannique, depuis le nord-ouest jusqu'aux Rocheuses. Des maladies peu connues du feuillage du pin tordu latifolié et de l'épinette de la zone intérieure, qui avaient été rarement signalées dans le passé, deviennent de plus en plus communes. L'incidence des rouilles des pins durs semble également être à la hausse. D'après les résultats de trois évaluations à l'échelle du paysage effectuées dans des plantations de pins tordus latifoliés de la zone d'approvisionnement en bois Morice dans le centre de la Colombie-Britannique, l'incidence conjuguée de la rouille-tumeur autonome, de la rouille-tumeur oblongue et de la rouille-tumeur de l'écorce a presque doublé en dix ans. Le pourcentage de plantations où l'incidence des rouilles était supérieure à 20 % a plus que quintuplé, passant d'environ 7 % à la fin des années 1990 à plus de 40 % en 2008. Ces changements à l'échelle du paysage de l'incidence des maladies des arbres dans le centre de la Colombie-Britannique coïncident avec les tendances à la hausse marquées des précipitations estivales et des températures minimales nocturnes enregistrées par la station de Ft. St. James qui dispose d'observations météorologiques quotidiennes continues depuis 1895 jusqu'à nos jours. Ces deux tendances climatiques concordent avec les tendances prévues de l'évolution du climat de la

planète et ont toutes deux des répercussions considérables pour les pathogènes des arbres dans le centre de la Colombie-Britannique.

Climate Change and Forest Defoliators

Jan Volney

Natural Resources Canada, Canadian Forest Service

NOT AVAILABLE

Drought and its Aftermath in Canadian Aspen Forests

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Abstract

Extensive dieback and mortality of aspen (*Populus tremuloides* Michx.) forests has been observed across parts of the west-central Canadian interior where there was a severe, regional drought during 2001-2003. Annual monitoring of aspen health was initiated in this region in 2000, as part of a CFS-led study called CIPHA (Climate Impacts on Productivity and Health of Aspen). Drought impacts were assessed using plot-based and remotely sensed measures, in combination with tree-ring analysis. Results showed a doubling of aspen mortality across the region during 2001-2005, followed by persistently high mortality (4%-5% per year) during 2005-2008. Wood-boring insects increased, especially in the most severely drought-affected aspen stands, suggesting that these insects may be amplifying and prolonging the drought's impact. Climate records show that drought is again affecting western portions of the Prairie Provinces, and surveys indicate that outbreaks of forest tent caterpillar and other insect defoliators have recently expanded. Furthermore, the changes that we have observed over the past 8 years appear to be part of a larger scale pattern of climate-related dieback episodes that have affected a wide range of forest types across western North America. These episodes point to the need for large-scale monitoring that includes early detection of climate-related damage that often occurs in combination with pest outbreaks.

Résumé

La sécheresse et ses conséquences dans les tremblaies canadiennes

Un dépérissement et une mortalité à grande échelle du peuplier faux-tremble (*Populus tremuloides*) ont été observés dans certaines parties des tremblaies de la région intérieure du

centre-ouest du Canada où une grave sécheresse régionale a sévi en 2001-2002. Un programme de surveillance annuelle de la santé du peuplier faux-tremble a été entrepris en 2000 dans cette région dans le cadre du CIPHA, une initiative de recherche dirigée par le SCF. On a évalué les impacts de la sécheresse à l'aide de mesures prises dans des placettes et obtenues par télédétection, conjuguées à l'analyse des cernes d'accroissement. Les résultats obtenus ont montré que la mortalité du peuplier faux-tremble avait doublé en 2001-2004 dans l'ensemble de la région et qu'elle s'était maintenue à des niveaux élevés (4-5 % par année) en 2005-2008. Les populations d'insectes xylophages ont augmenté, notamment dans les peuplements de peupliers faux-trembles les plus gravement touchés par la sécheresse, ce qui porte à croire que ces insectes amplifient et prolongent probablement les impacts de la sécheresse. D'après les données climatiques, la sécheresse affecte de nouveau certaines portions occidentales des provinces des Prairies, tandis que les résultats des enquêtes indiquent que les infestations de la livrée des forêts et d'autres insectes défoliateurs ont récemment gagné du terrain. De plus, les changements que nous avons observés au cours des huit dernières années semblent faire partie d'une tendance à plus grande échelle qui se manifeste par des épisodes de dépérissement dus au climat qui ont affecté un large éventail de types forestiers partout dans l'ouest de l'Amérique du Nord. Ces épisodes soulignent la nécessité d'une surveillance à grande échelle comportant notamment la détection rapide des dégâts dus au climat qui agissent souvent en même temps que les infestations d'insectes.

Background

Over the past decade, episodes of climate-related forest mortality have been reported from all of the world's forested continents (Allen 2009). Across large areas of western North America, tree mortality has increased in response to the impacts of climatic warming and drought (van Mantgem et al. 2009), in combination with climatically induced, regional-scale outbreaks of bark beetles and other pests (Breshears et al. 2005; Raffa et al. 2008). In Canada, the most well-known example of this is the ongoing outbreak of mountain pine beetle in British Columbia, which has recently expanded its range into northwestern Alberta (Carroll et al. 2004; Raffa et al.

2008). These events pose a serious concern for the future, if climate change leads to further increases in damage to Canada's forests by drought, insects, and other forest pests.

The present paper provides an update on the monitoring of another large-scale event in Canada's forests: the widespread increase in mortality of trembling aspen (*Populus tremuloides* Michx.) forests in drought-affected regions of western Canada, and more recently, in Ontario. Trembling aspen (hereafter referred to as "aspen") is the most abundant deciduous tree species in the Canadian boreal forest, where it is important both commerically and ecologically (Peterson and Peterson 1992). Aspen is also the main native tree in the aspen parkland, a climatically dry vegetation zone that represents a transition between the boreal forest and the prairie grasslands of western Canada (Hogg and Hurdle 1995). Since the 1990s, dieback and mortality of aspen forests has been recorded across areas of western Saskatchewan (Hogg and Schwarz 1999), northwestern Alberta (Hogg et al. 2002), northeastern Ontario (Candau et al. 2002) and more recently, in the western United States (Worrall et al. 2008). These events have raised public and industry concerns as to the causes of dieback, and whether global climate change might be playing a role. Furthermore, model projections indicated that aspen forests are potentially vulnerable to future climatic warming, which could ultimately lead to dry, prairie-like conditions across large areas of the boreal forest (Hogg and Hurdle 1995, Hogg and Bernier 2005).

In response to these concerns, a research and monitoring study called CIPHA (Climate Impacts on Productivity and Health of Aspen) was established in 2000 by the Canadian Forest Service, in partnership with Environment Canada and other agencies. A major component of the CIPHA study is the annual monitoring of pure aspen stands (50-90 years old) in 30 study areas across the west-central Canadian interior (Figure 1). Twelve of these study areas were established in the aspen parkland to provide a more sensitive "early warning" indicator of future climate change impacts in the adjacent boreal forest (Hogg and Hurdle 1995).

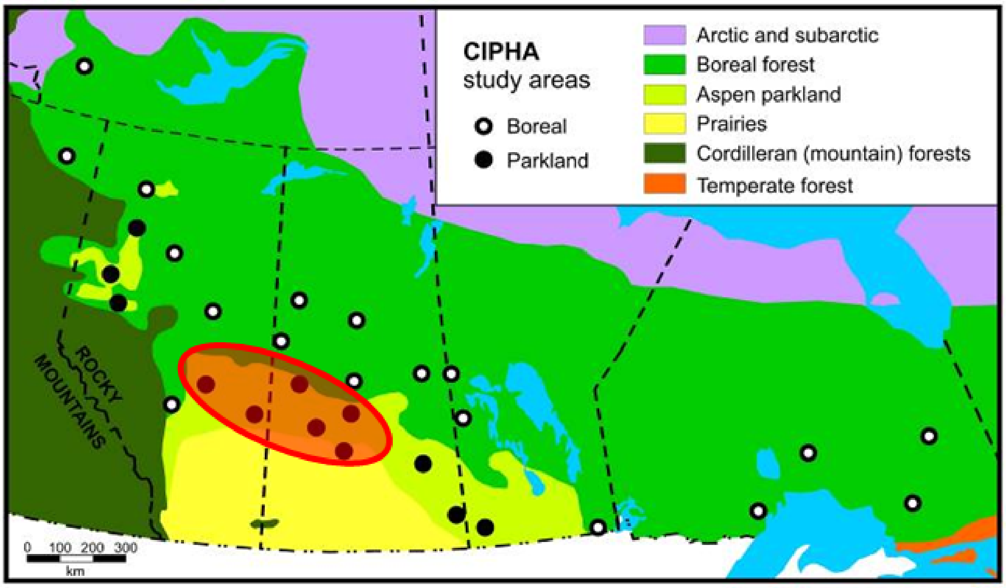


Figure 1. **Distribution of the 30 CIPHA study areas (6 plots per study area) for annual monitoring of forest health in aspen forests across west-central Canada. The area outlined in red was severely affected by the 2001-2003 drought, based on the results of aerial surveys conducted by Michael Michaelian (Canadian Forest Service) in August 2004**.

During 2001-2003, an exceptionally severe drought affected large areas of western North America, including the Canadian Prairie Provinces. More recently, severe droughts occurred during 2006-2007 across parts of northern Alberta and the upper Great Lakes region of Ontario. The prior establishment of CIPHA plots in these drought-affected regions has provided an ideal opportunity for assessing large-scale impacts of drought on aspen productivity and health, including the impact of climatic interactions with insects, diseases and other factors. Such knowledge is needed for the forecasting the risk of future impacts on Canada's aspen forests under a changing climate.

Summary of methods

The CIPHA study has a hierarchical design to enable "scaling up" of aspen responses from the tree level to the region: at the start of the study, each plot contained at least 25 living aspen trees, and there are two plots per stand and three plots per study area (total of 180 plots and 90 stands). One of the CIPHA study areas was co-located with the Southern Old Aspen Site in Prince Albert National Park, Saskatchewan, where tower-based monitoring of carbon and water fluxes has been conducted continuously since 1996 under the BERMS study (Boreal Ecosystem Research and

Monitoring Sites, see Barr et al. 2007). Tree-level assessments were conducted in each plot annually starting in 2000 for plots in 24 CIPHA study areas in western Canada and starting in 2001-2005 for the remaining study areas. These annual assessments included ratings of mortality, percentage crown dieback and defoliation, and incidence of damage by insects, diseases and other agents. Every 4 years (2000, 2004, and 2008), the trees in each plot were measured (including stem diameter at 1.3-m height and stem height), and sampling was conducted (on off-plot stems) for tree-ring analysis of past growth responses to climatic variation and insect defoliation for the period since 1950 (Hogg et al. 2005). Stand-level estimates of aboveground biomass, productivity and mortality losses were made by applying the equations of Lambert et al. (2005) to field-based measurements of tree DBH and height, in combination with tree-ring analysis (Hogg et al. 2008). Analyses of drought impacts were assessed using a climate moisture index (CMI) that is calculated from basic monthly climate data (Hogg 1997). Further details on the analysis are given by Hogg et al. (2008), and a methods manual for the plot-based measurement and monitoring component of CIPHA is available upon request (Michaelian et al. 2002).

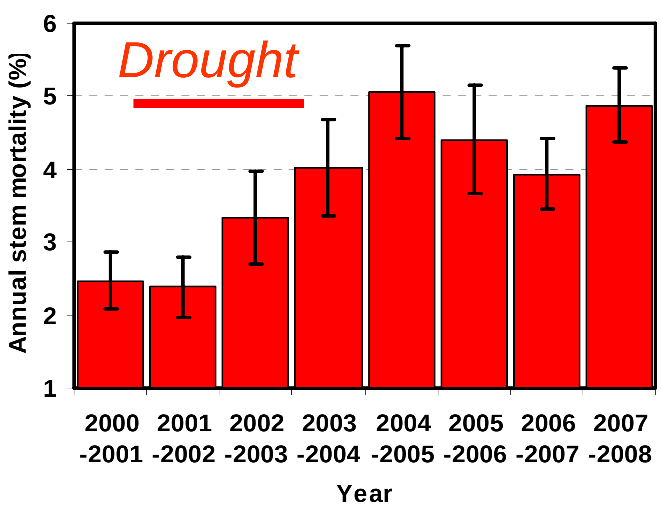
Although annual, plot-based measurements provide a good measure of changes in aspen forests over time, they are less well-suited for assessing the patchy, spatial distribution of forest dieback and mortality across the landscape. To address this, we expanded the scope of CIPHA to include aerial surveys and networks of temporary ground plots in the most severely drought-affected region (Figure 1), as well the development and application of satellite remote sensing methods for the detection and mapping of aspen dieback severity (Arsenault et al. 2007, Hall et al. 2008).

Highlights of results to date

- Tree-ring analysis showed that there have been major regional-scale collapses in the producitivity of western Canadian aspen forests during the period 1951-2000. These were caused primarily by the combined impact of drought and simultaneous, large-scale defoliation by forest tent caterpillar (Hogg et al. 2005), notably during the early 1960s and the period 1978-1982.

- The drought of 2001-2003 was the worst in more than 80 years across a large area of Saskatchewan and Alberta, but unlike previous droughts, it was not accompanied by large-scale insect defoliation. Nevertheless, massive mortality of aspen and other trees was recorded, especially in the most severely drought-affected areas of the parkland. In some areas, drought operated as a major disturbance type that resembled stand-replacing fire in terms of its impact.

- An analysis of CIPHA plot measurements showed that drought was the main factor causing mortality of western Canadian aspen forests over the period 2001-2005 (Hogg et al. 2008). During this period, average mortality of aspen across the region doubled, from about 2.5% to 5% per year (Figure 2). Despite the return to moist conditions in 2004, regional aspen mortality has remained high (4.8% in 2007-2008).



<u>Figure 2.</u> Changes in average (± SE) aspen mortality in 24 CIPHA study areas (144 plots) in western Canada during 2000-2008.

- Annual health assessments of CIPHA plots in western Canada showed a regional increase in the incidence of stem damage by wood-boring insects, notably poplar borer (*Saperda calcarata* Say). The average incidence has increased from less than 10% of stems affected in 2000-2001 to 26% in 2008. In general, the incidence of damage was greater in the more severely drought-affected parkland sites. Based on these results, wood-boring insects and associated fungal pathogens may be contributing to the observed, multi-year continuation of high mortality in drought-affected aspen stands.

- Preliminary results from monitoring at the 5 CIPHA study areas in Ontario and eastern Manitoba (initiated in 2005) indicate that aspen mortality increased from 3% per year during 2005-2007 to about 10% during 2007-2008. The average incidence of damage by wood-boring insects was comparable to that in the western CIPHA study areas, increasing from 21% in 2005 to 31% in 2008. During 2006-2007, severe drought affected a large area around Lake Superior, and may have contributed to the recent episodes of increasing aspen mortality and dieback that have been documented recently, both in Ontario (M. Francis, Ontario Ministry of Natural Resources, Northwestern Region, pers. comm., November 2008) and in adjacent areas of Minnesota (Minnesota Department of Natural Resources 2007).

- Results of tree-ring analysis from the CIPHA study were used for the validation of a satellite-based model showing that since the late 1990s, severe droughts have led to marked decreases in net primary productivity across much of the boreal forest (Zhang et al. 2008).

- A preliminary analysis indicates that in the areas most severely affected by the 2001-2003 drought in Saskatchewan and Alberta (Figure 1), the total mass of dead aspen was about 40-50 megatonnes. Drought severity, based on the climate moisture index (CMI), was a good predictor of the percentage dead mass at the stand level, suggesting that it should be possible to use near-real time mapping of the CMI as an early warning tool to assist in the early detection of drought-induced mortality.

- An emerging issue for the future is the question of how drought-stressed forests may respond to future insect outbreaks. For example, climate records show that there was an exceptionally severe drought in the Fort McMurray area of northeastern Alberta during 2006-2008, which coincided with extensive defoliation of both aspen (by forest tent caterpillar) and white spruce (by spruce budworm). In such cases, forests are at high risk of accelerated mortality and future decline caused by the combined impact of drought, insects and other stressors.

Conclusions, challenges and opportunities

- Severe drought during 2001-2003 led to extensive dieback and mortality of aspen forests, especially in the parklands of western Canada, and it appears likely that drought impacts have been amplified by stem damage by insects and other agents.

- More recently, there have been exceptionally severe droughts across parts of western Ontario and northern Alberta, which poses a concern for the future health of aspen and other forest types in these regions.

- The CIPHA study has provided 9 years of annual monitoring and reporting of aspen forest productivity and health from a network of plots across the west-central Canadian interior (2000-2008). Current funding levels, however, will likely preclude the continuation of annual monitoring across the full CIPHA network beyond 2008.

- The CIPHA study demonstrates the value of a multi-scale approach that includes both ground-based and remote sensing methods for monitoring large-scale changes caused by climatic and biotic factors. Furthermore, this study shows the potential value of near real-time mapping of drought indicators such as the CMI for predicting and assessing the risk of future dieback events.

- During forest health surveys, it is often difficult to identify the precise causes of forest dieback and mortality, because extreme climatic events such as drought typically operate in combination with stem damage and defoliation by insects and diseases. Given the growing concerns about potential impacts of climate change, there is an emerging need for a more integrated approach to forest health monitoring that includes early detection and mapping of climate-related dieback and mortality.

Acknowlegements

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SESSION 10: FOREST PATHOLOGY

SÉANCE 10 : PATHOLOGIE FORESTIÈRE

Abiotic and Biotic Factors Associated with Red Pine Mortality in Southern Ontario

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Abstract

Recent unprecedented rates of mortality in maturing southern Ontario red pine plantations are challenging forest managers in their attempts to achieve management objectives. Mortality has been observed as renewed and rapid expansion of old mortality centres, appearance of new mortality centres, and windthrow of living trees with decayed roots.

This study investigated abiotic and biotic factors associated with mortality. Two-metre-deep trenches were dug next to healthy and dying or recently dead trees in plots on healthy and diseased sites. Several soil physical properties were measured. Soil horizon and tree rooting depths were also mapped. Tree size and growth were compared at the site, plot and individual tree levels, and foliar nutrient status at the site and plot levels.

Iron deficiency, root diseases, and drought stress combined with insect opportunists were the most commonly encountered mortality factors. An alkaline C horizon was strongly correlated with mortality and significantly shallower rooting depth. It is hypothesized that sites with an alkaline C horizon are predisposed to drought stress and subsequent mortality.

Résumé

Facteurs abiotiques et biotiques associés à la mortalité du pin rouge dans le sud de l'Ontario

Les récents taux de mortalité sans précédent observés dans les plantations de pins rouges en voie de maturation du sud de l'Ontario posent d'importantes difficultés aux aménagistes qui tentent d'atteindre leurs objectifs de gestion. La vague récente de mortalité a été observée sous diverses formes : réactivation et expansion rapide d'anciens centres de mortalité, apparition de nouveaux centres de mortalité et renversement par le vent d'arbres vivants atteint de pourriture des racines.

Cette étude s'est penchée sur les facteurs biotiques et abiotiques associés à cette mortalité. On a creusé des tranchées de deux mètres de profondeur à côté d'arbres en santé et moribonds ou morts récemment dans des placettes établies dans des sites sains et infectés. On y a mesuré plusieurs propriétés physiques du sol ainsi que cartographié les horizons du sol et la profondeur d'enracinement des arbres. On a comparé les dimensions et la croissance des arbres au niveau du site, de la placette et des arbres individuels et les teneurs en éléments nutritifs du feuillage au niveau du site et de la placette.

Les facteurs de mortalité les plus fréquemment rencontrés étaient une carence en fer, des maladies des racines et le stress dû à la sécheresse, conjugués à des insectes opportunistes. L'alcalinité de l'horizon C a été étroitement corrélée à la mortalité et à un enracinement beaucoup plus superficiel. On pense que les sites à l'horizon C alcalin sont prédisposés au stress dû à la sécheresse et à une mortalité subséquente.

Biology of Tar Spot of Maple in Canada

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Abstract

Tar spot of maple has a worldwide distribution wherever maples are found. In the last decade, this disease was particularly abundant in the Great Lakes region, with leaves of Norway maple (*Acer platanoides*) bearing multiple disfiguring black round splotches in the later half of the growing season. Tar spot disease was not as common on native maples such as silver (*A. saccharinum*), sugar (*A. saccharum*), or red (*A. rubrum*) in this region. We were able to obtain DNA from tar spots on Norway maple and silver maple locally, as well as from big-leaf maple (*A. macrophyllum*) in British Columbia and from sycamore maple (*A. pseudoplatanus*) in Germany and England. Based on analyses of DNA sequences of ribosomal DNA, we found that the Norway maple tar spot is the same species (*Rhytisma acerinum*) as that which occurs in Europe on various European maples, whereas our native tar spot which occurs on silver and red maples is a separate species (*R. americanum*), as previously delineated (Mycotaxon 68:405) based on morphology and DNA-RFLP. However, our results are the first proof of species distinction based on full DNA sequence evidence. A third species, *R. punctatum*, with distinct small black spots, was found on big-leaf maple. Some previous sightings of *R. acerinum* have probably been confused with *R. punctatum*, because in its early stages, the European species has a similar punctate appearance.

In 2007 and 2008, we found tar spots on sugar maple trees. We sequenced a chloroplast gene to ensure that these leaves were indeed from sugar maple, and determined that the tar spot was caused by the European species, *R. acerinum*. As well in 2008, tar spot was found on Manitoba maple (*A. negundo*), and it was also confirmed to be *R. acerinum*. The occurrence of the European species of tar spot on native maples and the potential for adaptations to new hosts needs further study.

To examine the epidemiology of this disease, fallen Norway maple leaves were gathered weekly from multiple locations in Southern Ontario, Canada from March through August in 2006, 2007 and 2008. We found that ascospore dispersal period started usually in mid to late May and continued for four to six weeks afterwards depending on weather (wetter, shorter; drier, longer). The practical implication of this result is that fungicide protection against tar spot, if necessary, needs only to be applied during a very short period requiring one or two sprays, and this period starts near the end of full leaf expansion in Norway maple in this region.

Résumé

Biologie de la tache goudronneuse de l'érable au Canada

La tache goudronneuse de l'érable est répandue dans toute l'aire de répartition de ses hôtes, les érables. Au cours de la dernière décennie, cette maladie était particulièrement répandue dans la région des Grands lacs, les feuilles de l'érable de Norvège (*Acer platanoides*) étant défigurées par de multiples taches circulaires noires durant la deuxième moitié de la saison de croissance. La maladie des taches goudronneuses n'était pas aussi répandue chez les essences indigènes d'érables de cette région, comme l'érable argenté (*A. saccharinum*), l'érable à sucre (*A. saccharum*) ou l'érable rouge (*A. rubrum*). Nous avons réussi à obtenir de l'ADN provenant de taches goudronneuses présentes sur des feuilles d'érables de Norvège et d'érables argentés locaux ainsi que d'érables à grandes feuilles (*A. macrophyllum*) de la Colombie-Britannique et d'érables sycomores (*A. pseudoplatanus*) de l'Allemagne et de l'Angleterre. Nos résultats d'analyse des séquences d'ADN ribosomique ont révélé que c'est la même espèce (*Rhytisma acerinum*) de tache goudronneuse qui infecte l'érable de Norvège et les essences européennes d'érable, tandis que l'espèce à l'origine de notre tache goudronneuse indigène chez l'érable argenté et l'érable rouge est distincte (*R. americanum*), tel qu'établi précédemment (Mycotaxon 68:405) à l'aide des caractères morphologiques et de marqueurs RFLP (ADN). Ces résultats nous ont d'ailleurs permis d'établir pour la première fois une distinction entre les espèces fondée sur le séquençage complet de l'ADN. Une troisième espèce, le *R. punctatum*, qui provoque l'apparition de petites taches noires distinctes, a été découverte chez l'érable à grandes feuilles. Lors de certaines observations antérieures, le *R. acerinum* a probablement été parfois confondu avec le *R. punctatum*, car au cours des premiers stades, l'espèce européenne a un aspect ponctué similaire.

En 2007 et 2008, nous avons découvert des taches goudronneuses chez des érables à sucre. Nous avons séquencé un gène chloroplastique pour nous assurer que ces feuilles provenaient réellement d'un érable à sucre et nous avons établi que la tache goudronneuse était causée par l'espèce européenne, le *R. acerinum*. En 2008, la tache goudronneuse a également été découverte chez l'érable à Giguère (*A. negundo*) et s'est avérée le *R. acerinum*. Il faut étudier davantage la fréquence de l'espèce européenne sur les érables indigènes et le potentiel d'adaptation de cette espèce à de nouveaux hôtes.

De mars à août 2006, 2007 et 2008, nous avons recueilli chaque semaine des feuilles tombées d'érables de Norvège dans de multiples localités du sud de l'Ontario (Canada) afin d'examiner l'épidémiologie de cette maladie. Nous avons constaté que la période de dissémination des ascospores débutait habituellement entre le milieu et la fin de mai et se poursuivait durant quatre à six semaines, selon les conditions météorologiques (période plus courte lorsque les conditions étaient humides, et période plus longue lorsque les conditions étaient plus sèches). Dans les faits, cette constatation signifie que les traitements fongicides contre la maladie des taches goudronneuses ne devront être appliqués, le cas échéant, qu'à une ou deux reprises durant une très courte période qui débute vers la fin du déploiement complet des feuilles de l'érable de Norvège dans cette région.

Outbreak of *Scleroderris* Canker, European Race, in Central Newfoundland: Escape from Quarantine

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Abstract

Scleroderris canker, European race (EU), was first detected on Austrian pine in St. John's Newfoundland (Nfld) in 1979. To prevent spread of this exotic disease, a quarantine zone was established in 1980 to all areas north of the Witless Bay. Later, red pine mortality near Torbay (1981), Upper Island Cove and along Salmonier Line (1996) resulted in extending the quarantine zone in 1998 to all areas east of Route #202 at the isthmus of the Avalon Peninsula. Infection on these pines was tracked back to planting stock produced at the Back River nursery on Salmonier Line. These seedlings were planted on the Avalon and Bonavista Peninsulas from1937 to1952. Low rate of spread and natural quarantine boundary limited this disease to the Avalon Peninsula for over 60 years. Until 2007, when Scleroderris canker EU was detected in an isolated red pine plantation in central Nfld. at Berry Hill Pond, 100 km down the Bay D'Espoir Highway. Field observations showed that conducive conditions for the pathogen were always present in the area, explaining rapid development of the epidemic compared to slow progression in plantations on the Avalon Peninsula. Failure to publicize and enforce the quarantine and apply preventative control measures has now resulted in threats to native red pine stands and plantations established throughout central Nfld. Pruning red pines in that region will prevent any new outbreak. We cannot rely on quarantine measures alone to prevent spread of this disease.

Résumé

Épiphytie de chancre scléroderrien, race Européenne, au centre de Terre-Neuve : échappée de la quarantaine

Le chancre scléroderrien, race Européenne (EU), fut détecté pour la première fois à Terre-Neuve (TN) sur des pins noirs d'Autriche, à St. John's en 1979. Afin de prévenir la propagation de cette maladie exotique, une zone de quarantaine fut établie en 1980, couvrant toute l'aire au nord de Witless Bay. Suite à la mortalité de pins rouges près de Torbay (1981), à Upper Island Cove et le long de Salmonier Line (1996), la zone de quarantaine a été élargie en 1998 à toute l'aire à l'est de la route # 202 au niveau de l'isthme de la péninsule d'Avalon. L'historique de l'infection de ces pins remonte aux semis produits à la pépinière de Back River près de Salmonier Line. Ces semis ont été plantés sur les péninsules d'Avalon et de Bonavista de 1937 à 1952. Un taux de progression de la maladie relativement bas et une barrière naturelle de la zone de quarantaine ont limité cette maladie à la péninsule d'Avalon pendant plus de 60 ans. Mais en 2007, le chancre scléroderrien EU a été détecté dans une plantation isolée de pin rouge au centre de TN, à Berry Hill Pond, à près de 100 km vers le sud sur la route allant à Bay D'Espoir. Des observations dans la plantation montrent que des conditions favorables au champignon pathogène sont présentes dans ce secteur, ce qui explique le développement rapide de l'épiphytie en comparaison à la progression lente dans les plantations de la péninsule d'Avalon. L'échec de l'information et de la mise en application de la quarantaine de même que le manque de mesures de contrôle préventif de cette maladie causent maintenant une menace aux peuplements indigènes, ainsi qu'aux plantations de pin rouge du centre de TN. L'élagage des pins rouges de cette région va prévenir une nouvelle épiphytie. On ne peut pas se fier seulement sur les mesures de quarantaine pour empêcher la propagation de la maladie.

Introduction:

- scleroderris canker is a serious disease of hard pines, causing seedling blight, branch dieback, stem cankers and tree mortality
- two races of the disease affect pines in North America, the native North American (NA) race and the introduced European (EU) race
- the NA race causes lower branch dieback and mortality in pines less than 2 m in height
- the introduced EU race is a very serious disease which causes branch dieback, stem cankers and mortality of mature trees
- red pine is very susceptible to this disease, Scots and Austrian pine are moderately affected while jack pine is the most resistant

2

- easily identifiable symptoms and signs of Scleroderris canker

- basal needle yellowing

- leader candles

- stem canker

3

- black pycnidia

- buried cryptopycnidia

- multi-celled spores

4

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- 1979, first record of Scleroderris canker EU in Nfld. on Austrian pine in St. John's

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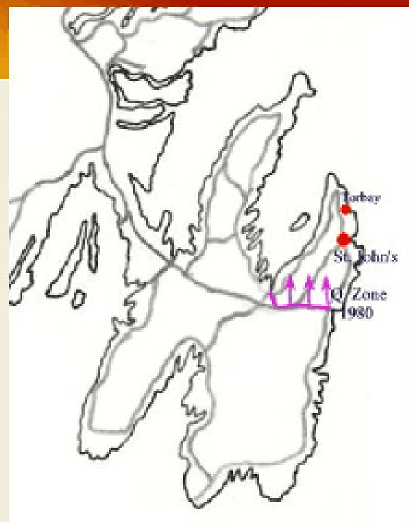

- 1980, quarantine zone established, no movement of conifer stock from area north of Whitless Bay Line
- information pamphlet produced on identification, hazard and quarantine zone for Scleroderris canker

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- 1981, severe infection and total mortality of red pine in Torbay plantation, 15 km north of St. John's (within quarantine zone)

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- research into the Back River Nursery provided information on the source of planting stock and plantations established

- report by A.J. Doyle, 1967 "Reforestation in Newfoundland 1937-1952" summarized, the establishment of the Back River Nursery, details of planting stock produced and identified 16 plantations established on the Avalon, Burin and Bonavista Peninsula between 1938 and 1951

- this report indicated all stock at the Back River Nursery was produced from seed, white spruce, white pine and balsam fir of local origin and Norway spruce, red pine, Scots pine and jack pine from Ontario

- Scleroderris canker cannot be transmitted by seed

- another report by M. Baker and J. Miller-Pitt, 1998 "By Wise and Prudent Measures: The Development of Forestry on Salmonier Line" provided a detailed historical account of the Back River Nursery

- in 1939 the Nfld. Forestry Div. received 30,000 seedlings of red, white, jack and Scots Pine, free from the Ontario Government 11

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- in early 1990's Scleroderris canker infection and limited mortality was observed in a number of mixed pine plantations along the southern shore of Conception Bay
- in 1996 major red pine mortality was observed at Upper Island Cove plantation

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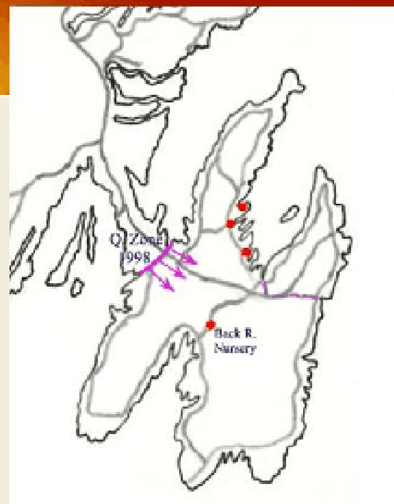

- Back River nursery and Conception Bay plantations were outside the quarantine zone
- planting stock for all affected plantations came from the Back River nursery
- 1998, quarantine zone was extended to all areas east of Route #202, a natural barrier for the Avalon Peninsula, but no public information pamphlet produced

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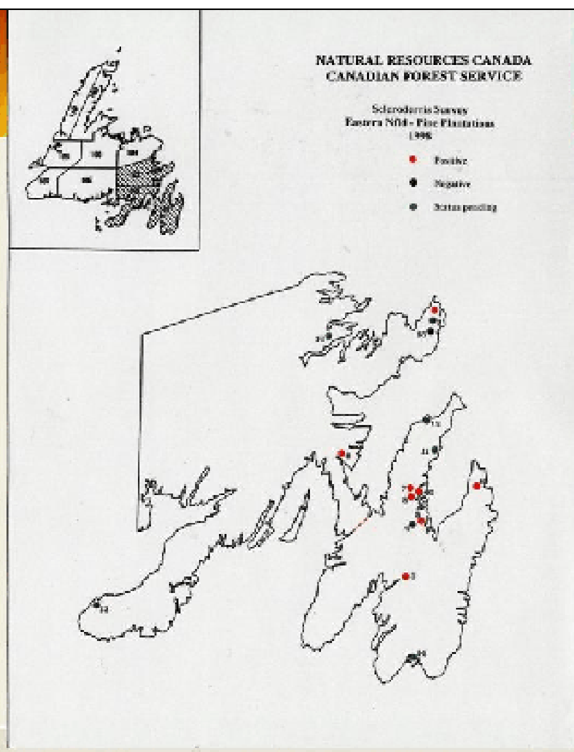

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- 1998 survey of 16 plantations established with Back River Nursery stock, revealed most plantations in very poor shape, but Scleroderris canker EU was still present in a number of them

- majority of red pine had died but the disease was still present and viable in the surviving Scots and jack pine

- jack pine is resistant to the disease, whereas Scots pine is moderately susceptible and persists as an endemic carrier until it finally succumbs to the disease

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- infected plantations at Sunnyside and on the Bonavista Peninsula were sanitized with expectations of limiting the disease to the Avalon Peninsula and keeping the 1998 quarantine zone in place
- the quarantine and natural barrier at the isthmus of the Avalon Peninsula was successful in limiting the spread of Scleroderris canker EU for over 65 years

UNTIL

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- severe red pine mortality was reported in a plantation at Berry Hill Pond 90 km down the Bay D'Espoir highway from the Trans Canada Highway, about 400 km outside the quarantine zone

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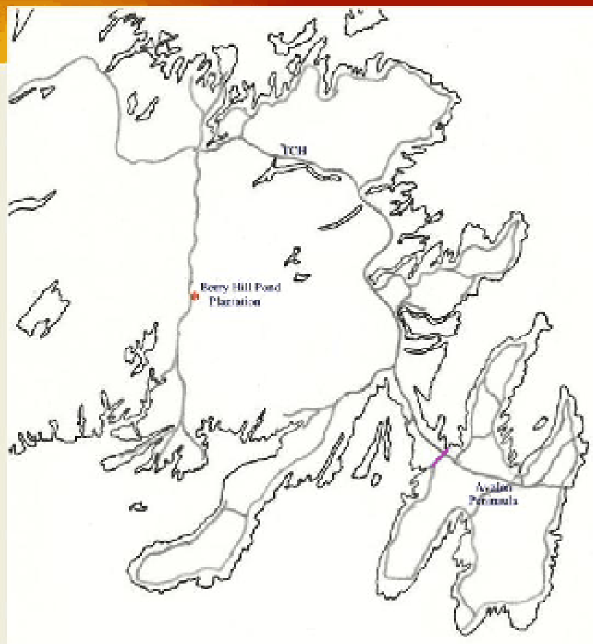

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- tests have proven the disease to be Scleroderris canker EU
- damage assessment revealed the disease had been present for 7-8 yr, and optimum conditions conducive for spore release, dispersal and infection occurred 2-3 years prior to 2007 resulting in the severe damage
- forestry personnel from the Bay D'Espoir office commented that locations along the road through the plantation were common camp sites for moose hunters from the Avalon Peninsula in the late 1980's early 1990's
- two tall communication towers along the road to the plantation were easy landmarks for hunters to locate the campsites
- it is suspected that hunting groups from the Avalon Peninsula brought their own firewood/kindling with them, which would have been readily available from recently killed red pine in the infected Conception Bay plantations

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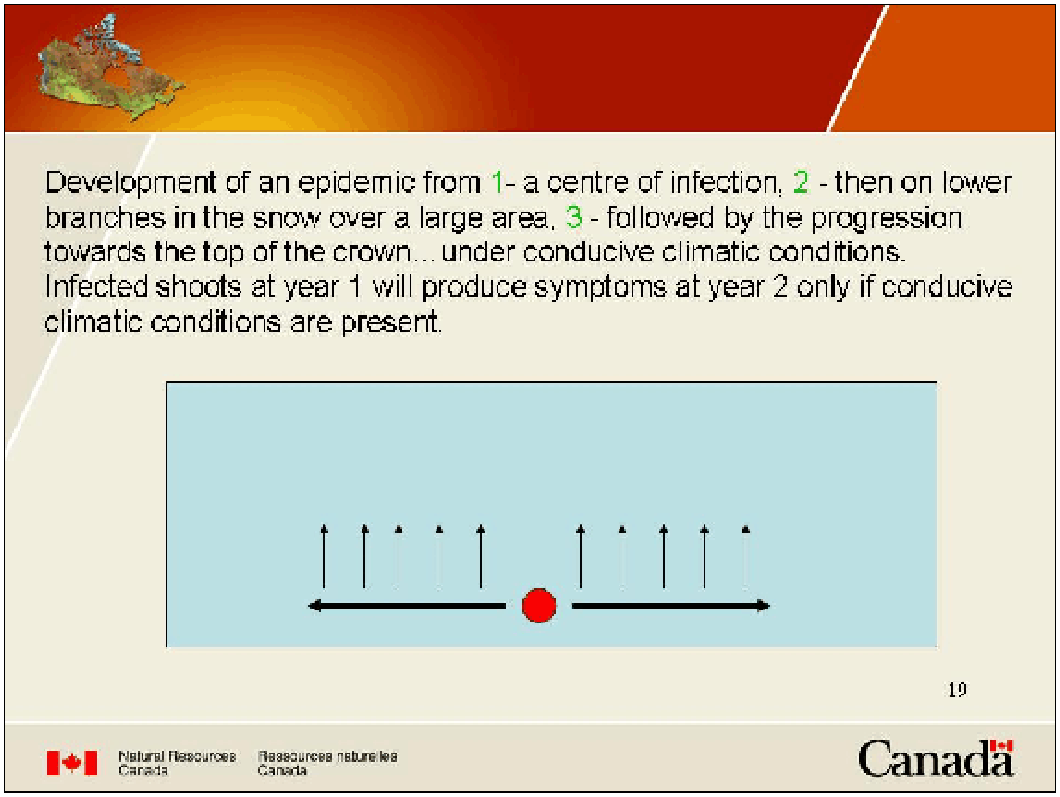
Development of an epidemic from 1- a centre of infection, 2 - then on lower branches in the snow over a large area, 3 - followed by the progression towards the top of the crown… under conducive climatic conditions.
Infected shoots at year 1 will produce symptoms at year 2 only if conducive climatic conditions are present.
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A = 4 YEARS
B = 1 YEAR
B
A
20
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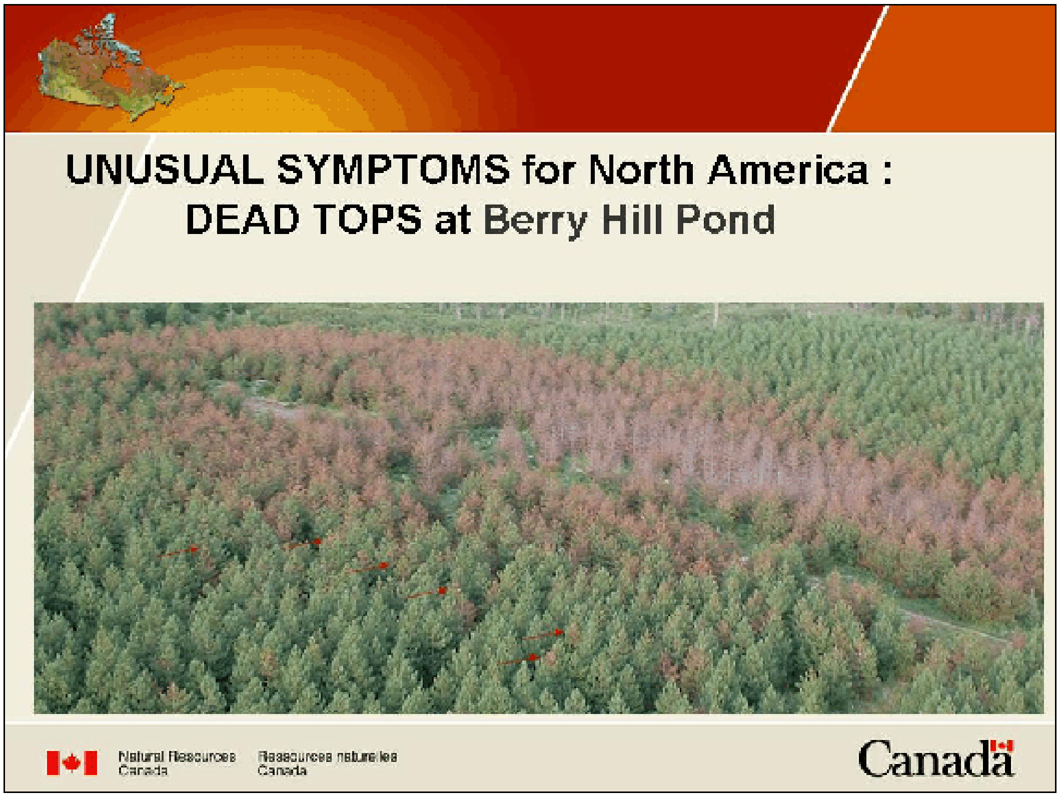
UNUSUAL SYMPTOMS for North America :
DEAD TOPS at Berry Hill Pond
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multiple cankers on leaders
22
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Great number of pycnidia on a single tree, each containing thousands of conidia. Results: extremely high rate of inoculum !

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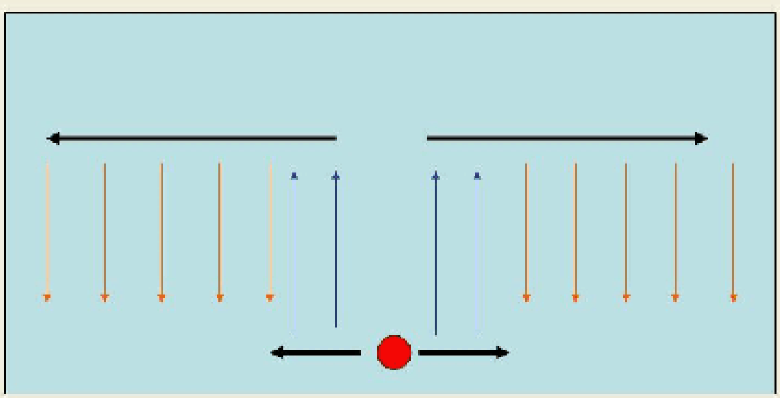
The spread of the disease showed a new pattern: instead of spreading on lower branches over a large area, it quickly spread towards the top of pine in the centre of infection and spread over the top, and down on lower shoots.



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Similar damages in Sweden: 400,000 ha

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- If multiple cankers on the trunk = slow progression of the disease
- Conducive climatic conditions are not frequent.

  Ex.: Slow spread and mortality of red pine, Upper Island Cove, Avalon Peninsula.

- If no canker on the trunk = fast progression of the disease.
- Conducive climatic conditions are frequent.

  Ex.: Rapid spread and mortality of red pine, Berry Hill Pond, North Central Newfoundland

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RECOMMENDATION

- breach of the quarantine zone now places the natural red pine stands and numerous, recently planted, plantations at a serious risk of extinction
- preventive pruning of red pine is necessary in central Newfoundland because conducive climatic conditions for scleroderris canker, European race, are frequently present
- communication to the public through information pamphlets, display notices, roadside signage etc., is necessary to maintain the Scleroderris canker quarantine
- the isthmus of the Avalon Peninsula is a natural barrier with limited alternate access, where quarantine notices, signage and material deposition depots can be setup

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Thanks to all students and teachers from the College of North Atlantic for their assistance

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Phytophthora in Forest Pathology – Is Sudden Oak Death Just the Tip of the Iceberg?

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Abstract

DNA sequencing put an end to the debate about the placement of oomycetes in the tree of life and explained better why they had been considered somewhat different from the true fungi (eumycetes). Plant pathogens belonging to genera like *Phytophthora* or *Pythium* are now unequivocally outside the eumycetes and considered to be closer to brown algae even though they still have several common features with fungi (e.g. filamentous growth). Molecular taxonomy and phylogeny have confirmed for the most part the traditional classification within oomycetes. The DNA sequencing of ex-types or reference strains of all available species of genera such as *Phytophthora* or *Pythium* helped consolidate the existing taxonomy and provided an opportunity to more easily recognize and characterize new species. The causal agent of Sudden Oak Death (SOD) in California was matched to a new disease of rhododendrons in Europe while the species was still being formally described. The utilization of DNA sequences for strain comparison accelerated drastically the work required to make unambiguous matching between the European and North American isolates and helped to identify both populations as *P. ramorum*. The description of *P. ramorum* was one of the first of a wave of new species descriptions that occurred after the publication of comprehensive DNA sequence databases of all known species. Prior to that, the vast majority of the 60 known *Phytophthora* species were plant pathogens causing diseases of agricultural crops. The number of species of *Phytophthora* is growing exponentially, it doubled in less than 10 years, and most of the new described species have been found on trees. For example, *P. pinifolia* is devastating *Pinus radiata* plantations in Chile. We do not know when the number of species will reach a plateau or how many species pathogenic to trees are yet to be described. Why is it that we see such an increase in *Phytophthora* species causing diseases of trees? DNA sequencing became so much easier and

affordable at the same time that the sequence databases of all known *Phytophthora* species came out. Unique isolates that would have been previously lumped by plant pathologists or taxonomists into already known species are now quickly identified as new and described as such. It is also possible that combined to this technological advance are starting to see *Phytophthora* disease problems from species that would not have been noticed before because we grow our trees more and more like crops, making the boundary between agriculture and forestry *Phytophthoras* not as clear cut anymore. The same rapid growth of the number of species has started in *Pythium* and it is possible that we will also see more tree diseases coming from new species of this genus.

Résumé

Le *Phytophthora* en pathologie forestière – l'encre des chênes rouges n'est-elle que la partie visible de l'iceberg?

Le séquençage de l'ADN a mis fin au débat concernant la place des oomycètes dans le règne du vivant et a révélé pourquoi les oomycètes avaient été jugés quelque peu différents des champignons vrais (eumycètes). Les pathogènes des plantes appartenant à des genres comme *Phytophthora* ou *Pythium* ne font maintenant clairement plus partie des eumycètes et sont considérés plus apparentés aux algues brunes, même s'ils partagent plusieurs caractéristiques communes avec les champignons (comme un thalle filamenteux). La taxonomie moléculaire et la phylogenèse ont en grande partie confirmé la classification traditionnelle des oomycètes. Le séquençage de l'ADN des ex-types ou des souches de référence de toutes les espèces connues de genres comme le *Phytophthora* ou le *Pythium* a contribué à faire la synthèse de la taxonomie existante et a permis de reconnaître et de caractériser plus facilement de nouvelles espèces. L'agent responsable de l'encre des chênes rouges en Californie a été apparié à l'agent d'une nouvelle maladie des rhododendrons en Europe au moment même où l'espèce était en voie d'être décrite. L'utilisation des séquences d'ADN pour comparer les souches a accéléré considérablement la tâche d'apparier sans équivoque les isolats européen et nord-américain et a contribué à déterminer que les deux populations appartenaient au *P. ramorum*. La description du *P. ramorum* a été la première d'une vague de descriptions de nouvelles espèces qui s'est produite après la publication de bases de données détaillées sur les séquences d'ADN de toutes les espèces connues. Auparavant, la vaste majorité des 60 espèces connues de *Phytophthora* étaient des

agents phytopathogènes des plantes cultivées. Le nombre d'espèces de *Phytophthora* augmente de manière exponentielle : il a doublé en moins de 10 ans, et la plupart des nouvelles espèces décrites ravageaient des arbres. Ainsi, le *P. pinifolia* dévaste les plantations de *Pinus radiata* du Chili. Nous ne savons pas à quel moment le nombre d'espèces plafonnera ou combien d'espèces pathogènes des arbres restent encore à décrire. Pourquoi observons-nous une telle augmentation du nombre d'espèces de *Phytophthora* pathogènes des arbres? Le séquençage de l'ADN est devenu à la fois tellement plus facile et abordable que des bases de données sur les séquences de toutes les espèces connues de *Phytophthora* ont été mises sur pied. Des isolats uniques que des phytopathologistes ou des taxonomistes auraient autrefois regroupé avec des espèces déjà connues sont maintenant identifiés rapidement comme de nouvelles espèces qui sont décrites comme telles. Dans la foulée de ces progrès technologiques, il est aussi possible que nous commencions à observer des affections causées par des espèces pathogènes de *Phytophthora* qui n'auraient pas été décelées auparavant parce que nous gérons de plus en plus nos arbres comme des cultures, rendant moins claire la ligne de démarcation entre les espèces de *Phytophthoras* nuisibles aux espèces cultivées et forestières. Le nombre d'espèces de *Pythium* a également commencé à augmenter tout aussi rapidement, et il est aussi probable que le nombre de maladies des arbres causées par de nouvelles espèces de ce genre augmentera.

Armillaria Root Disease – A Hidden Enemy Exposed by Dendrochronology

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Abstract

Root diseases are one of the most important pests affecting overall average growth and yield in Boreal spruce-fir forests. Their importance is neglected primarily due to their obscurity, where there are few if any external indicators to the problem. Roy Whitney reviewed the major root diseases of Ontario in "The Hidden Enemy" publication. Root diseases can be classified as pathogens and/or decayers. Armillaria Root Disease (ARD) is one of the most important diseases in the Boreal forest, with *Armillaria ostoyae* the primary disease causing agent. *A. ostoyae* is a moderately aggressive opportunistic pathogen. It infects roots of stressed trees by fungal rhizomorphs, killing the roots resulting in growth loss and eventual tree mortality. Tree stress is a key factor to successful penetration and infection of rhizomorphs. Dendrochronological analysis of tree growth rings can detect biotic and abiotic stress related phenomena and subsequent growth responses, exposing successful infection of ARD. Forest management practices in regenerating forests have focused on pre-commercial thinning and plantations, based on expectation of significant gains in piece size and merchantable volume at a reduced rotation age, with little to no concern for tree susceptibility to root diseases. Current studies are showing significant growth losses and mortality from ARD in these treated stands. A stem analysis disk or increment core taken at breast height can provide information revealing the status of ARD in a stand prior to the advanced stages when mortality occurs. Impacts of ARD upon tree growth can be determined through full stem dendrochronological analysis.

Résumé

Le pourridié-agaric – un ennemi caché révélé par la dendrochronologie

Les pourridiés figurent parmi les plus importants ravageurs affectant la croissance et le rendement des peuplements sapin-épinette de la forêt boréale. On leur attribue peu d'importance parce qu'ils sont peu visibles et que les indicateurs externes de leur présence sont rares. Roy Whitney a passé en revue les pourridiés d'intérêt majeur en Ontario dans sa publication "L'ennemi caché". Les pourridiés peuvent être classés comme champignons pathogènes ou de carie. Le pourridié- agaric (PA) est le plus important de la forêt boréale et *Armillaria ostoyae* est l'agent causal. *A. ostoyae* est un champignon pathogène opportuniste, modérément agressif. Il produit des rhyzomorphes qui infectent des racines d'arbres stressés, ce qui ré duit la croissance des arbres et éventuellement cause leur mort. Le stress des arbres est un facteur clé pour que les rhyzomorphes puissent percer et infecter les racines. L'analyse dendrochronologique des cernes annuels des arbres permet de détecter des phénomènes reliés à des stress biotiques et abiotiques qui agissent sur la croissance des arbres et les rendent vulnérables aux infections par PA. Les pratiques d'aménagement de régénération forestière se sont concentrées sur l'éclaircie pré-commerciale et sur la plantation, en espérant des gains significatifs en diamètre et en volume marchand sur une plus courte rotation, mais sans se préoccuper de la susceptibilité de ces arbres aux pourridiés. Des études en cours dans des peuplements ainsi traités montrent des pertes significatives de croissance et de mortalité par le PA. Une analyse de tige à l'aide d'un disque ou d'une carotte prélevée à hauteur de poitrine peut fournir de l'information sur le PA dans un peuplement et ce, avant que débute la mortalité. L'impact du PA sur la croissance de l'arbre peut être déterminé par une analyse dendrochronologique complète de la tige.

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Root Diseases

- one of most important pests affecting overall growth and yield in Boreal spruce-fir forests
- importance neglected primarily due to their obscurity
- their activity primarily underground with few if any external indicators
- Roy Whitney reviewed major root diseases of Ontario in publication "The Hidden Enemy"

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- root diseases classified as either pathogens and/or decayers
- pathogens infect and kill roots causing growth loss and tree mortality
- decayers infect dead, wounded or broken roots, decay main root and tree butt heartwood resulting in windthrow of living trees

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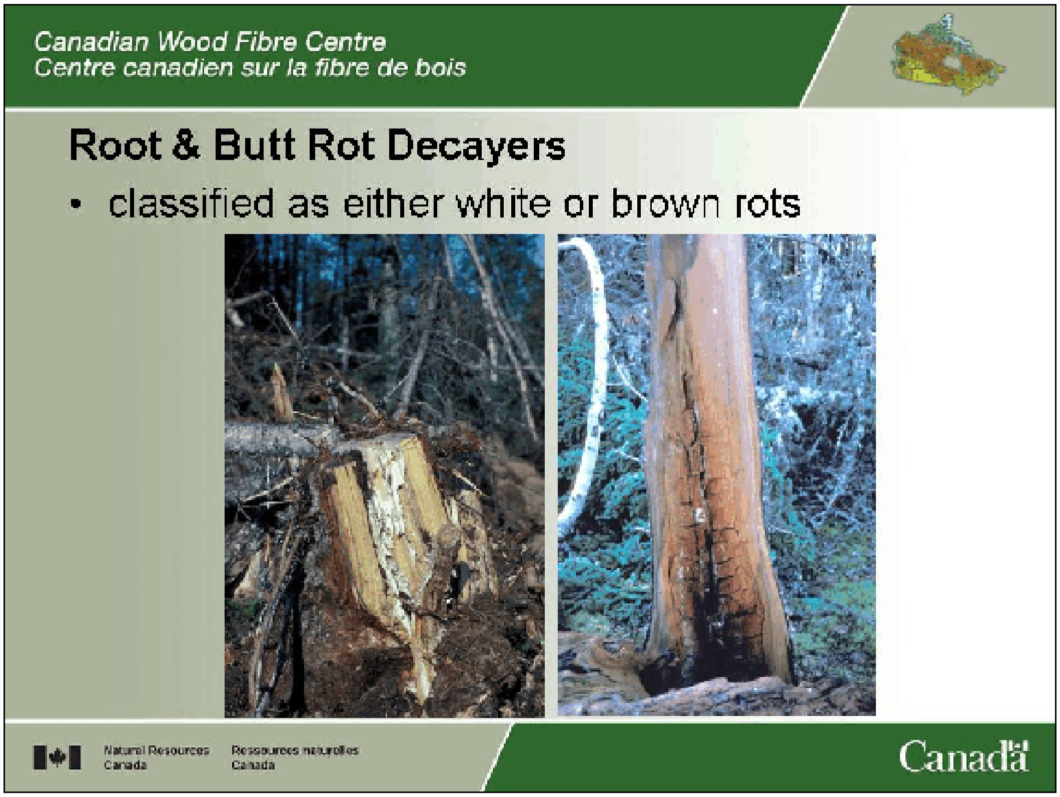
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Root & Butt Rot Decayers
• classified as either white or brown rots
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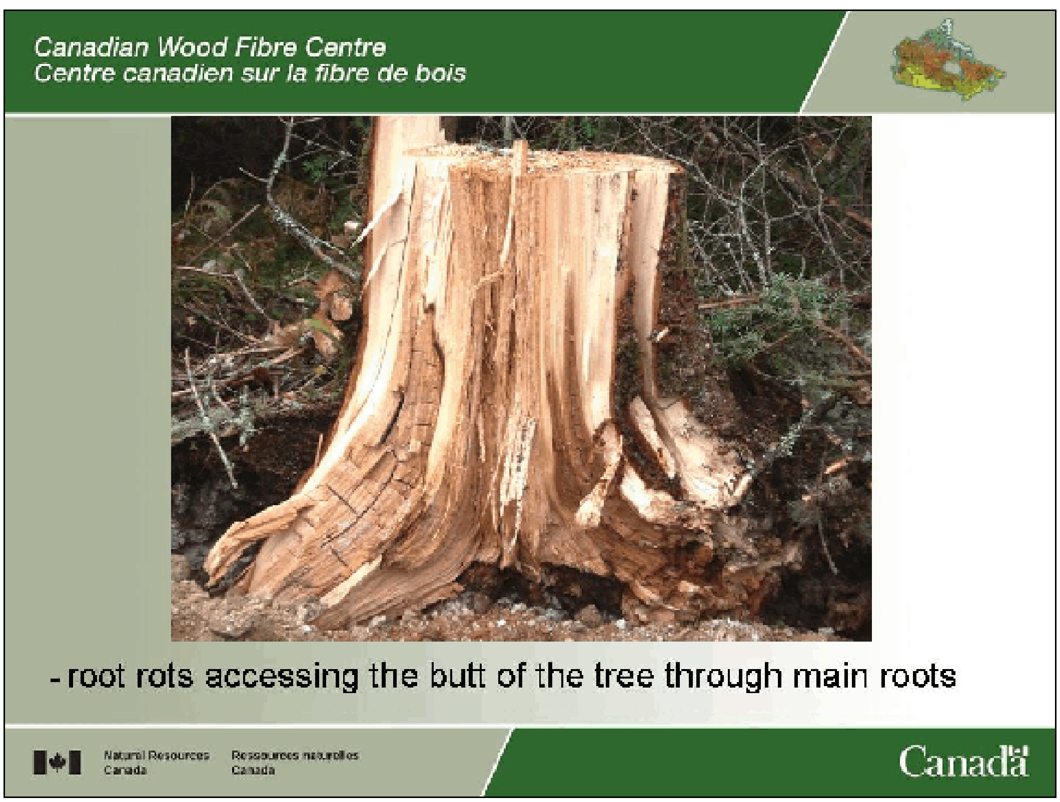
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- root rots accessing the butt of the tree through main roots
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- resulting in windthrow tipups and butt snaps

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Root Disease Pathogens

- transfer from an infected tree into a healthy tree through root graphs and rhizomorphs
- 3 major root diseases in boreal conifer forests
  - > Armillaria root disease (*Armillaria ostoyae)*
  - > Tomentosus root disease (*Inonotus tomentosus)*
  - > Annosus root disease (*Heterobasidion annosum)*

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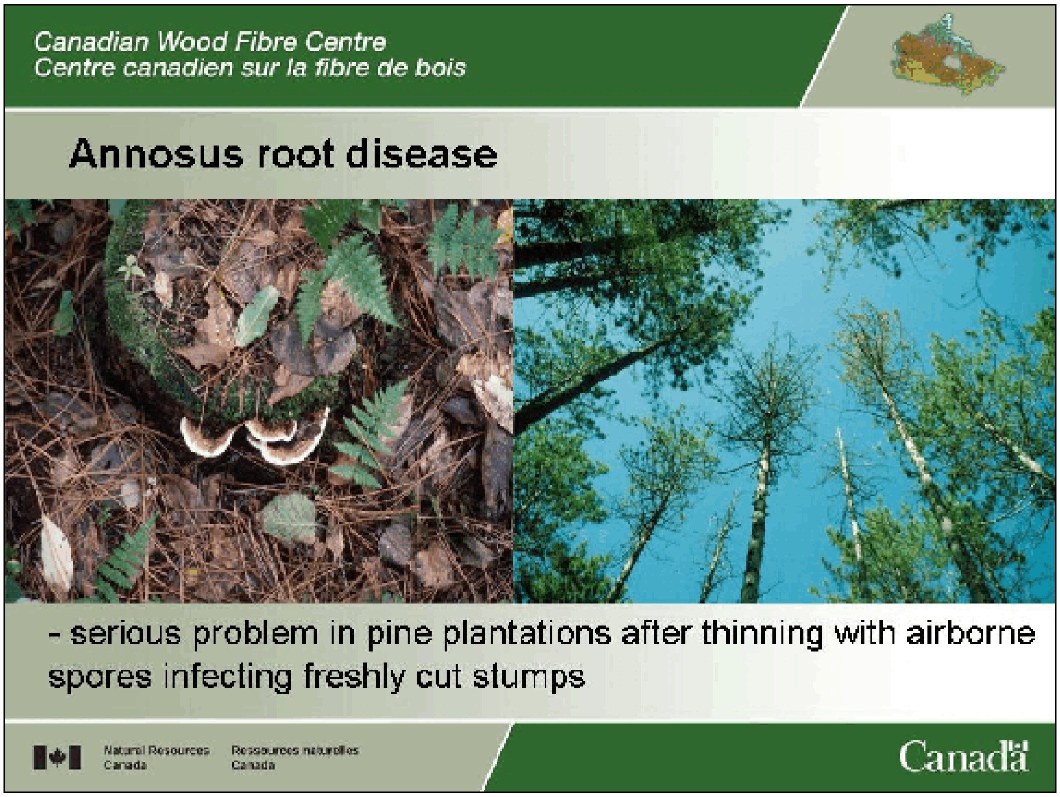
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Annosus root disease
- serious problem in pine plantations after thinning with airborne spores infecting freshly cut stumps
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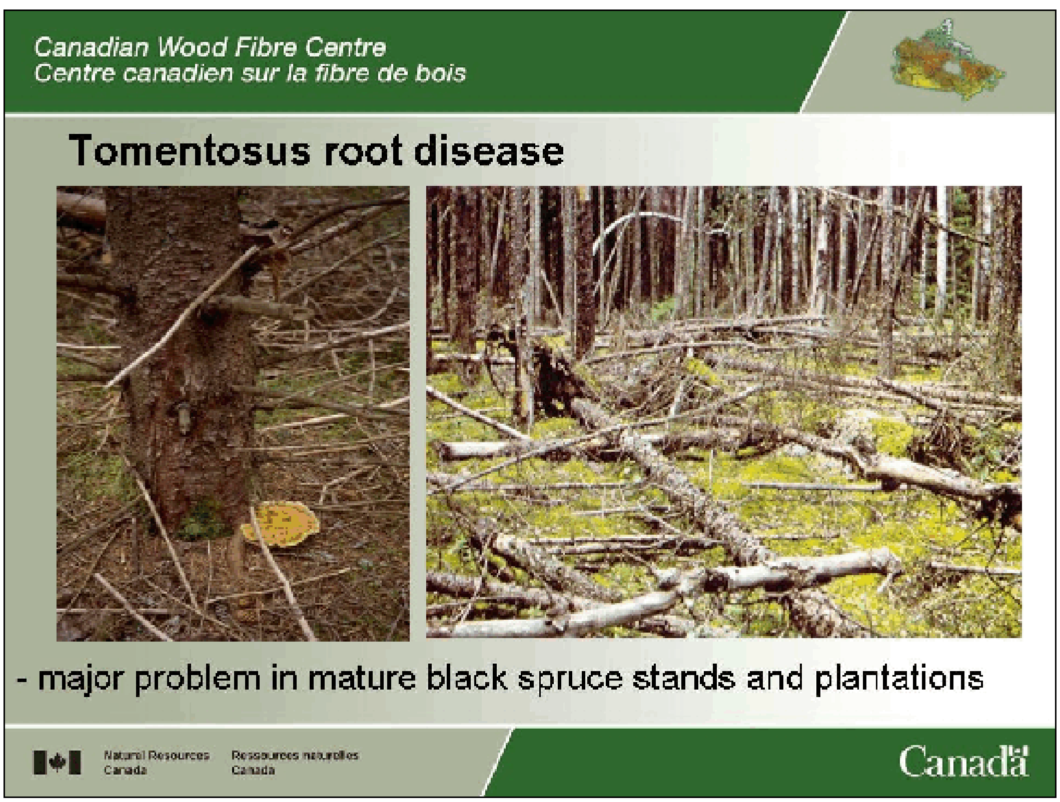
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Tomentosus root disease
- major problem in mature black spruce stands and plantations
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Armillaria root disease (ARD)

- a cosmopolitan pathogen commonly found on a wide variety of conifer, hardwood and mixedwood stand types throughout North America
- *Armillaria ostoyae,* a moderately aggressive opportunistic pathogen
- infects lateral tree roots primarily by subterranean rhizomorphs originating from dead roots & stumps
- can remain on a site in root & stumps for 15-20 yr as saprophyte

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- Armillaria friuting bodies occurring in the fall 2-3 yr after, harvesting on stumps or base of insect killed trees

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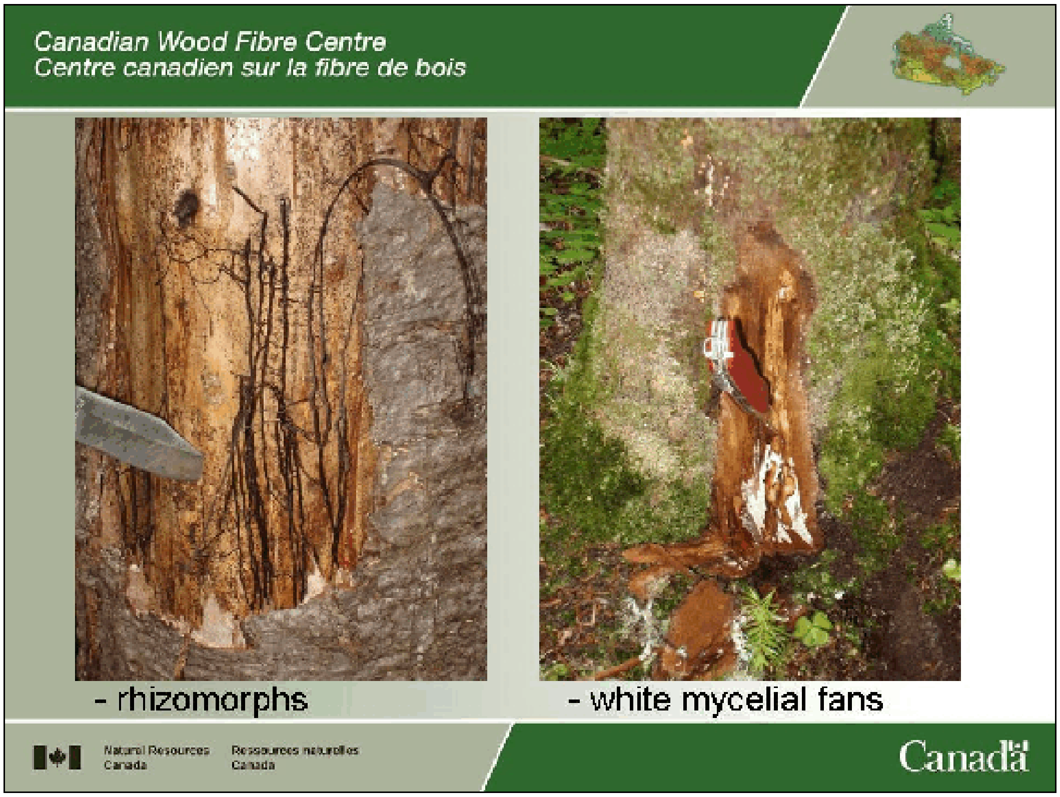
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- rhizomorphs
- white mycelial fans
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- dead standing trees
- stand openings
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Dendrochronology

- a method of scientific dating based on the analysis of tree-ring growth patterns
- tree ring patterns reflect the biotic (insect/ disease) and abiotic (weather) conditions during which the tree was growing
- capable of building a comprehensive historical record or sequence of events
- used WinDendro Tree-Ring Image Analysis system and software developed by Regent Instruments Inc.

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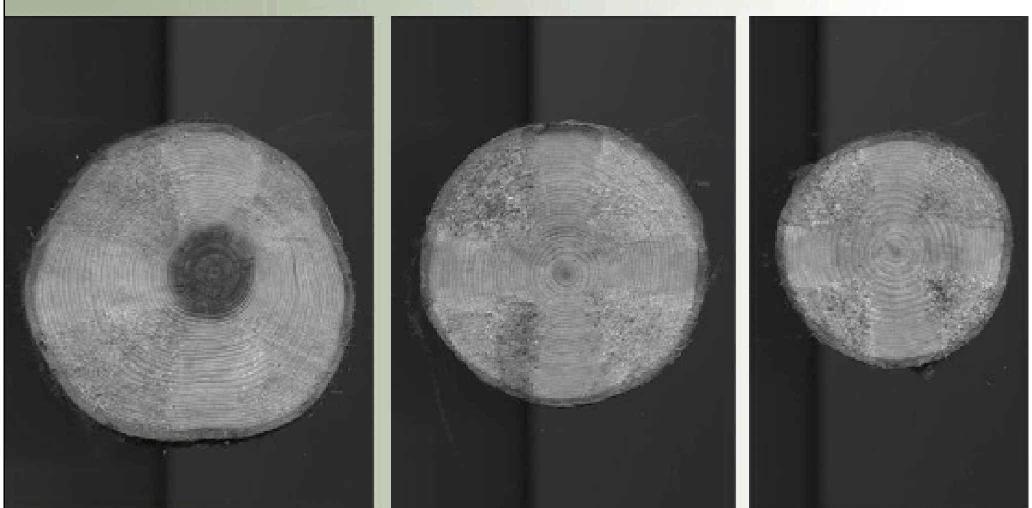

- tree stem analysis disks

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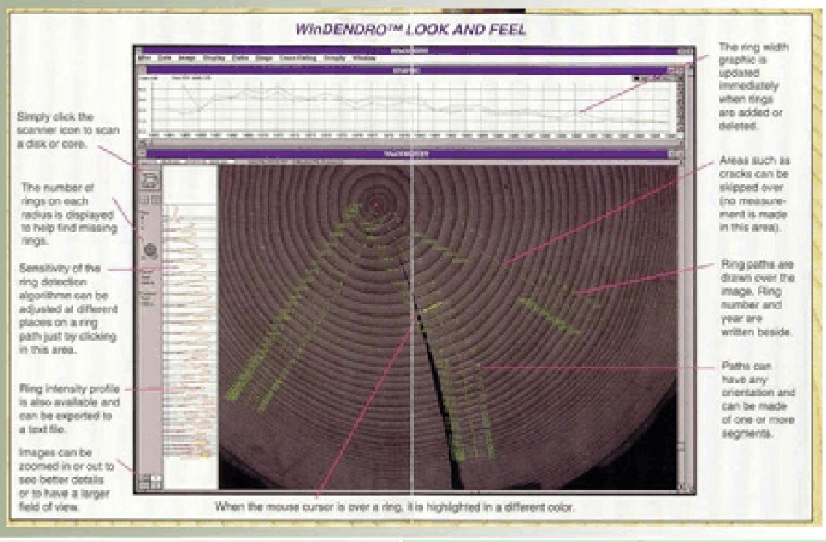
- WinDendro image analysis for growth ring measurements



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Name	***Content***
"Original name"[1]	WinDENDRO™ raw (unprocessed) measurements
Ri	Radius (incremental)
Rc	Radius (cumulative)
Di	Diameter (incremental)
Dc	Diameter (cumulative)
Ai	Area (incremental)
Ac	Area (cumulative)
Hi	Height (incremental)
Hc	Height (cumulative)
Vi	Volume (incremental)
Vc	Volume (cumulative)
Results	Basal and tree summary information

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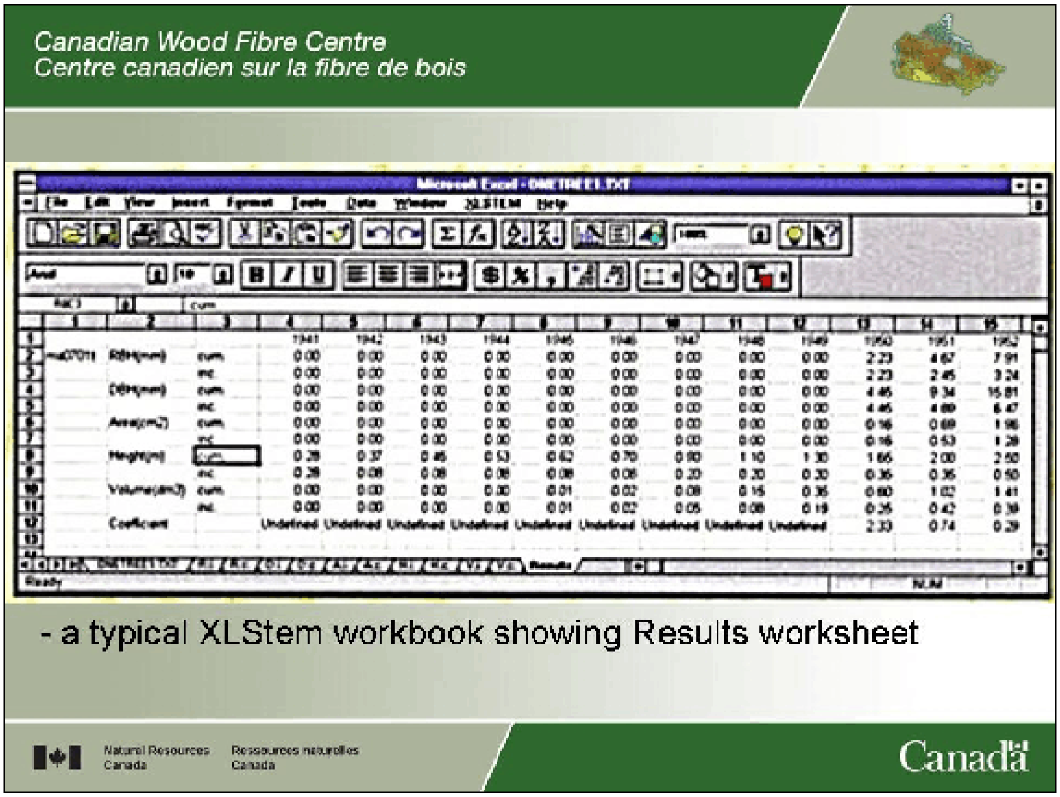
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Microsoft Excel
- a typical XLStem workbook showing Results worksheet
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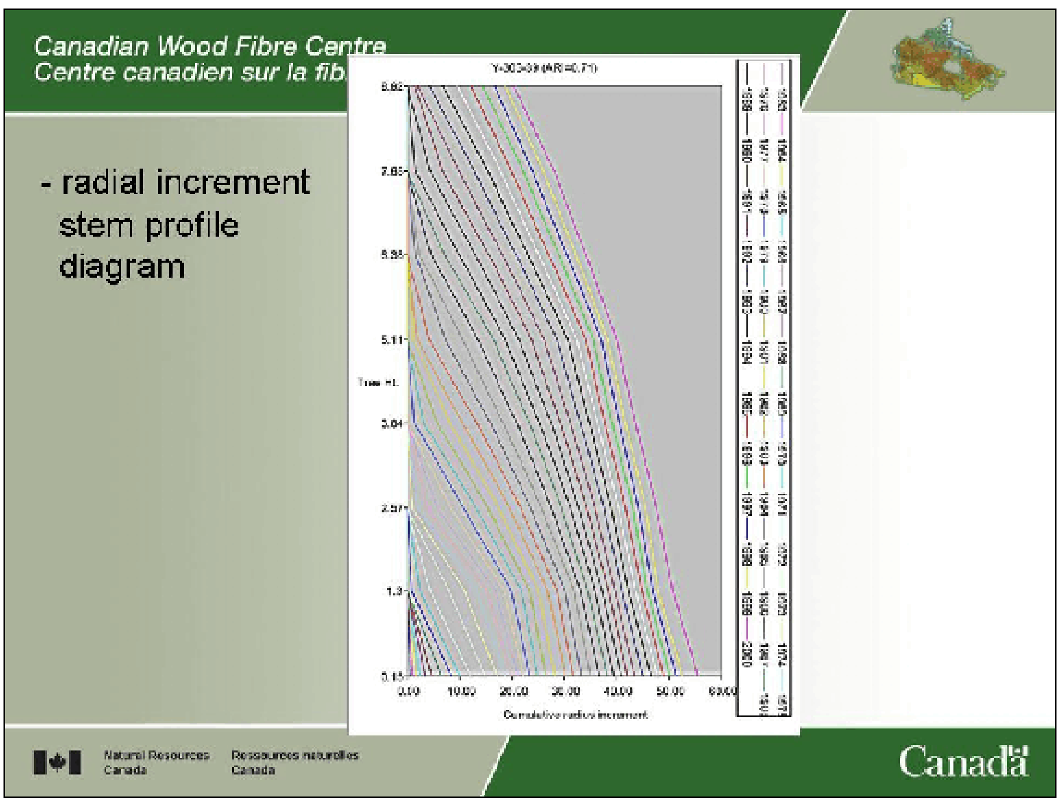
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- radial increment stem profile diagram
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ARD and Dendrochronology

- ARD is an moderately aggressive opportunistic pathogen waiting for tree stress conditions to occurr, allowing infection into the lateral roots
- healthy trees can resist and wall off ARD attack
- stressed trees become susceptible to infection from rhizomorphs and white hyphal mycelium which becomes established in the cambium
- root regions distal to the infection zone are killed affecting water and nutrient absorption by the tree, contributing to reduced growth

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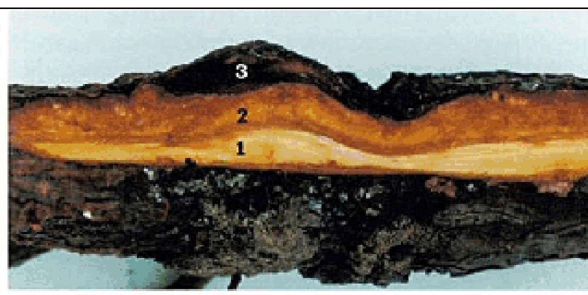

FIGURE 5.2 — *Armillaria ostoyae* lesion on a Douglas-fir root in which secondary bark has isolated the infecting mycelium (1-xylem; 2-bark; 3-infected bark). (D.J. Morrison)

FIGURE 5.8 — *Armillaria ostoyae* infection spreading along a Douglas-fir root (1- mycelial fan in outer bark; 2- bark necrosis in advance of the mycelial fan; 3- cambial necrosis). (D.J. Morrison)

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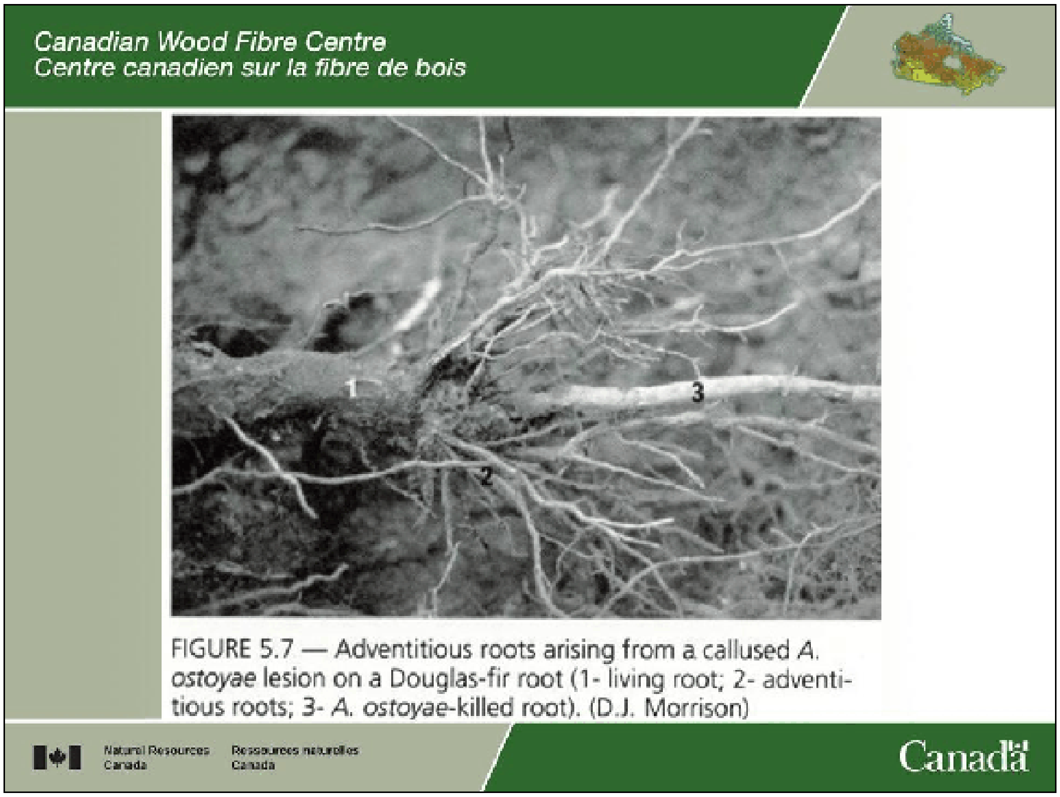
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1
2
3
FIGURE 5.7 — Adventitious roots arising from a callused A. ostoyae lesion on a Douglas-fir root (1- living root; 2- adventitious roots; 3- A. ostoyae-killed root). (D.J. Morrison)
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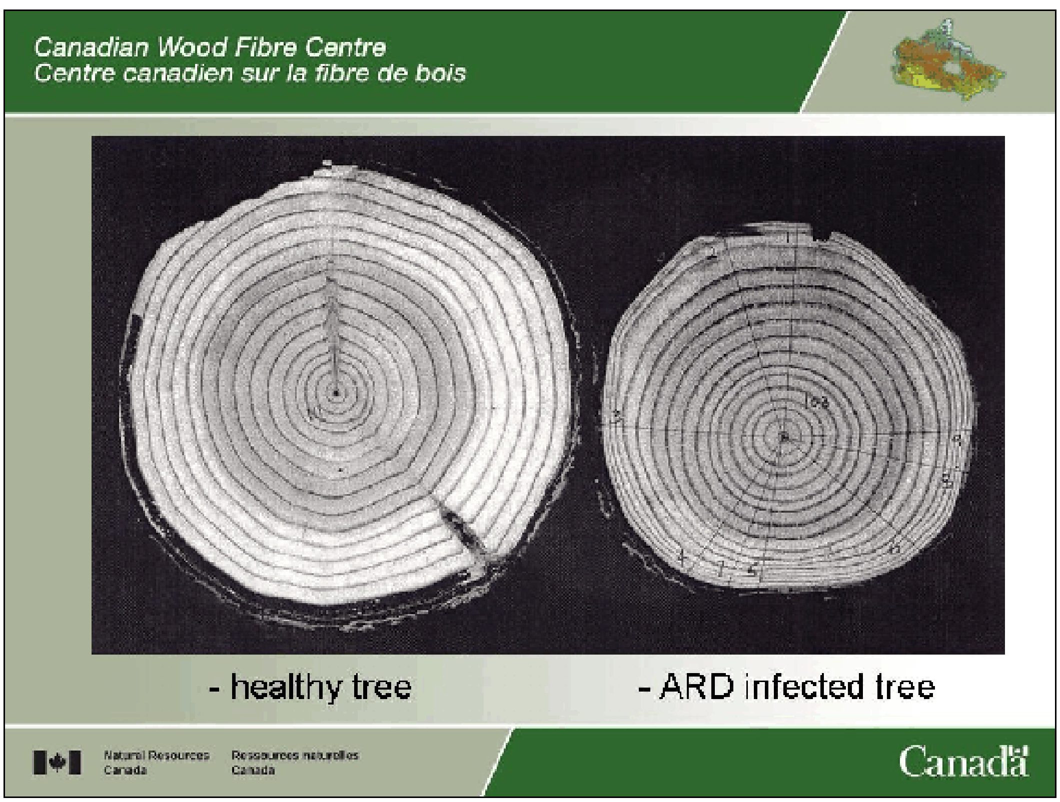
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- healthy tree
- ARD infected tree
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- Green River Spacing Trial , Edmundston N.B. an opportunity to apply dendrochronology to impacts of ARD in the treatment plots (stand age 60 yr, 44 yr since thinning)
- revealed ARD problem in a number of plots with characteristic; root disease centres, dead standing trees and mycelial fans at base of dead trees
- 120 trees were sampled for verifying volume equations in 2004, prior to 2008 partial harvest
- applied dendrochronological assessment to breast height disks for assessment of ARD damage

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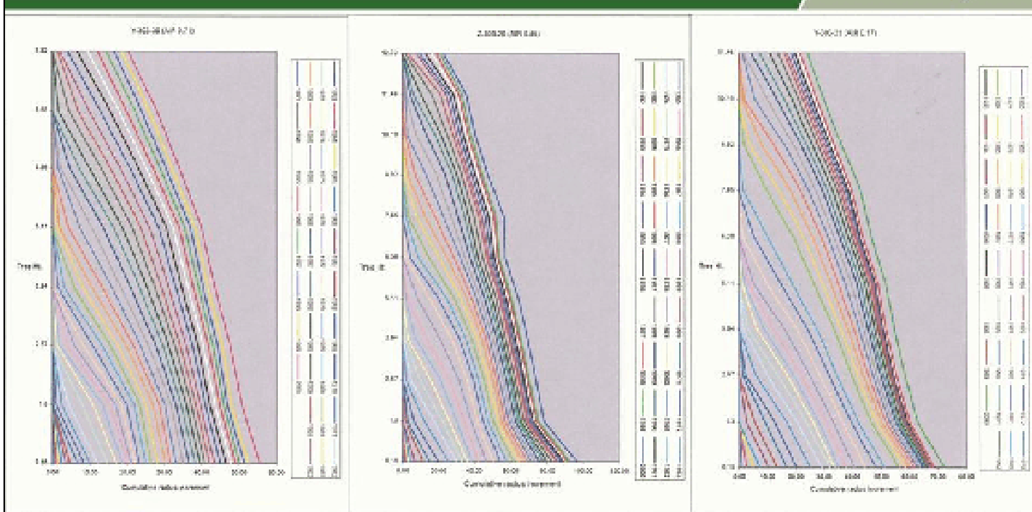

- stem profile diagrams have shown breast height to be the optimal location for assessing ARD impacts

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- a range of tree conditions related to ARD were observed, the major ones being:
  - > healthy
  - > suppression
  - > 1977 impact, good recovery
  - > 1977 impact, poor recovery
  - > 2 impacts, 1989 & 1996
  - > 3 impacts, 1977, 1989 & 1996

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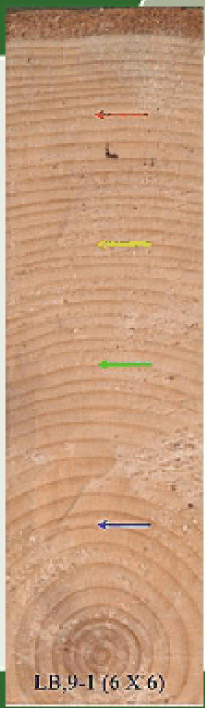
- normal growth



- coloured arrows at 10 year intervals

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- suppression
- coloured arrows at
10 year intervals
UC.20-1A (4 X 4)
LC.94-1A (6 X 6)
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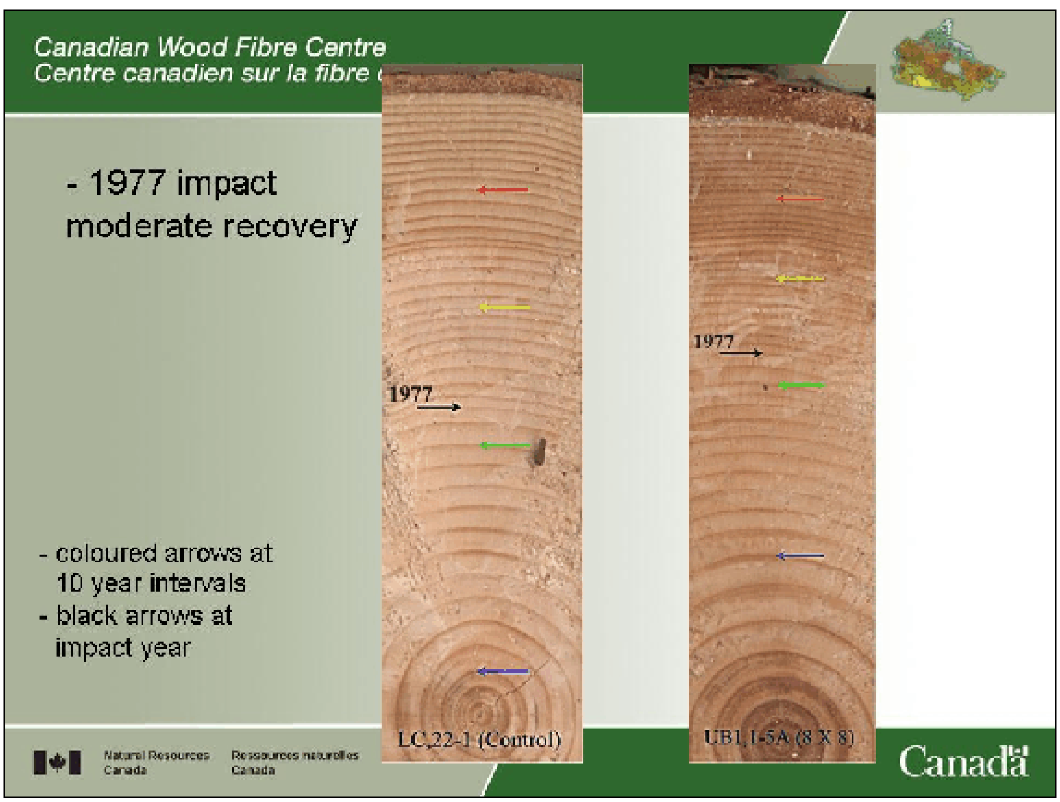
Canadian Wood Fibre Centre
Centre canadien sur la fibre
- 1977 impact
moderate recovery
1977
1977
- coloured arrows at
10 year intervals
- black arrows at
impact year
LC.22-1 (Control)
UBL1-5A (8 X 8)
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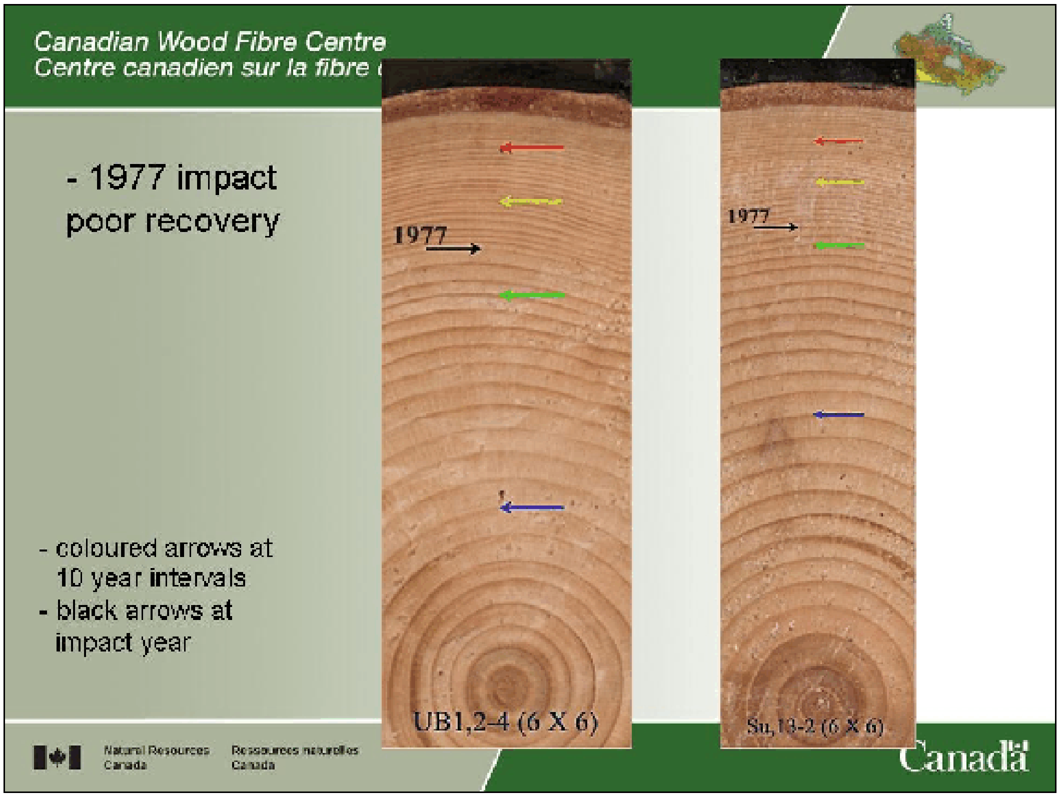
Canadian Wood Fibre Centre
Centre canadien sur la fibre
- 1977 impact
poor recovery
- coloured arrows at
10 year intervals
- black arrows at
impact year
1977
UB1,2-4 (6 X 6)
1977
Su,13-2 (6 X 6)
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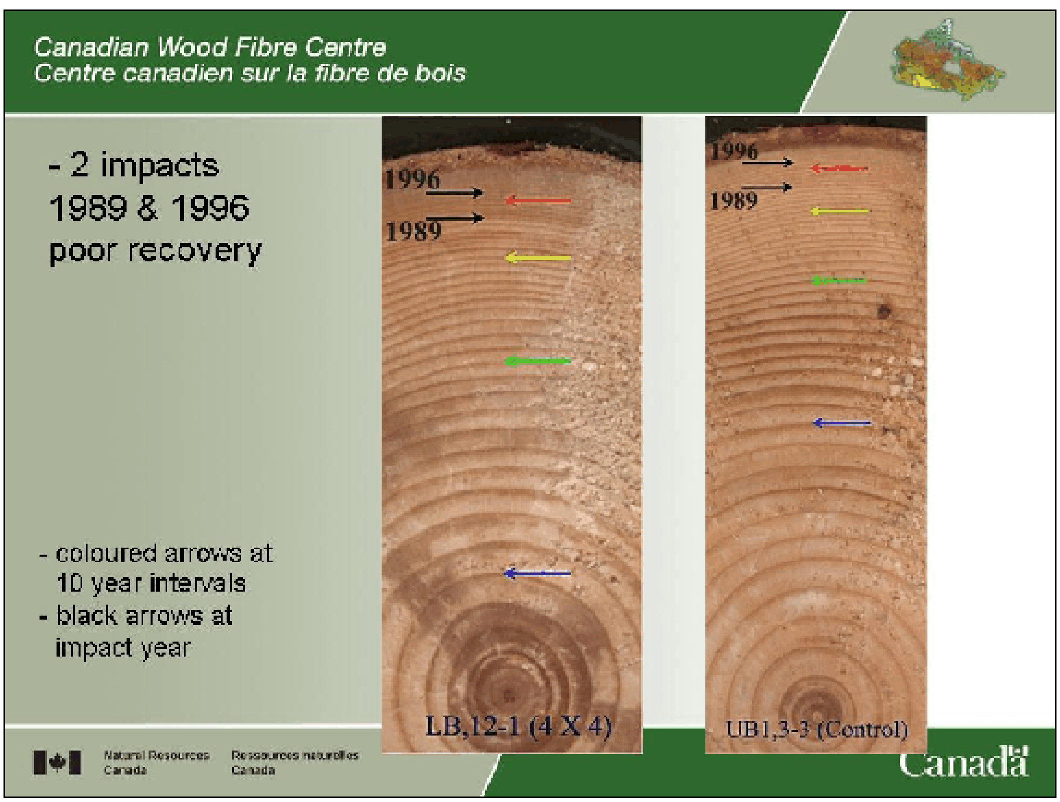
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- 2 impacts
1989 & 1996
poor recovery
- coloured arrows at
10 year intervals
- black arrows at
impact year
1996
1989
LB,12-1 (4 X 4)
1996
1989
UB1,3-3 (Control)
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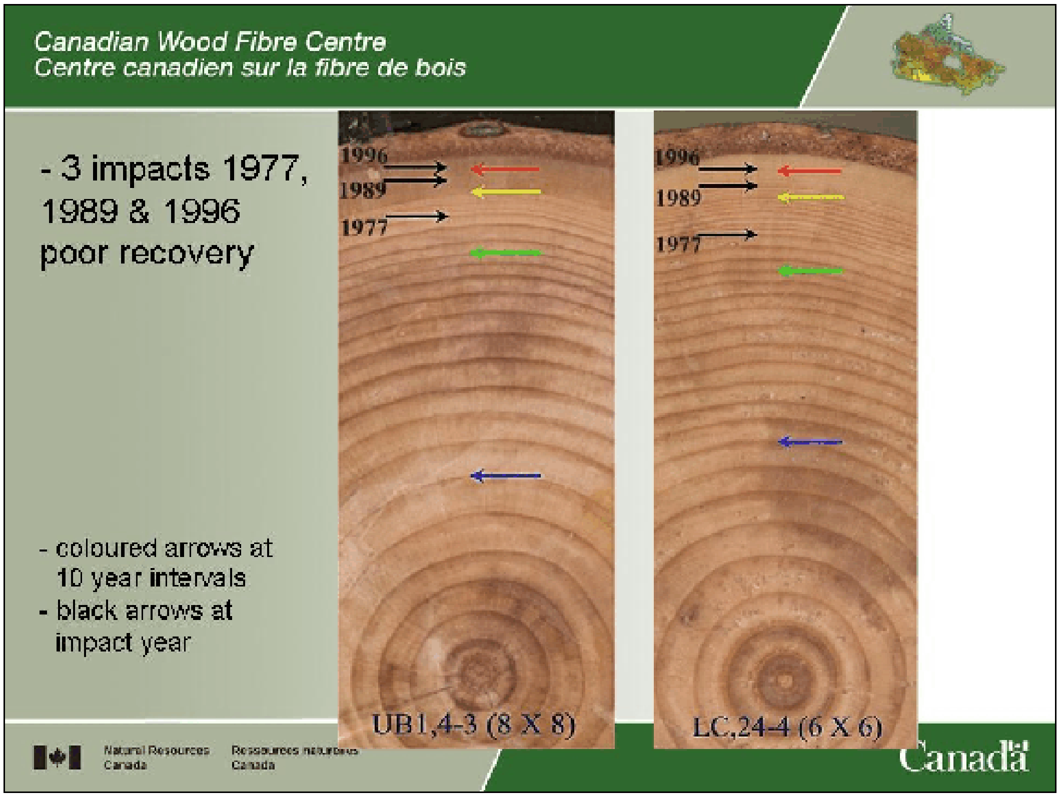
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- 3 impacts 1977, 1989 & 1996 poor recovery
1996
1989
1977
1996
1989
1977
- coloured arrows at 10 year intervals
- black arrows at impact year
UB1,4-3 (8 X 8)
LC,24-4 (6 X 6)
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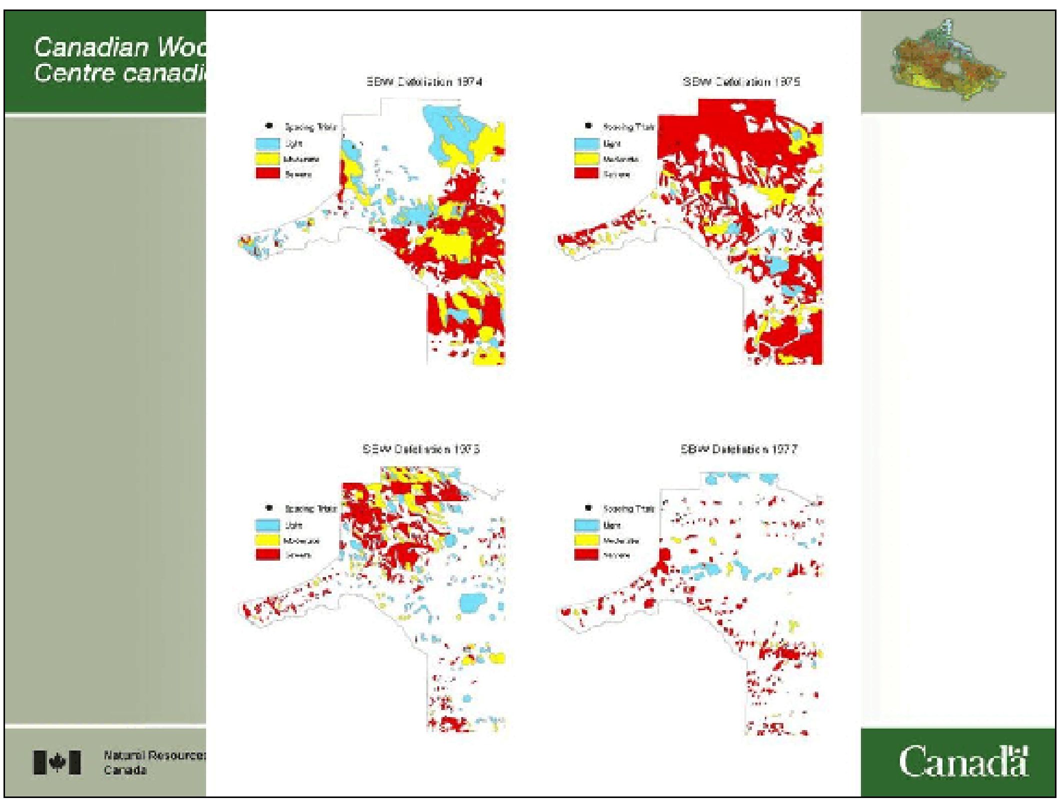
Canadian Woo
Centre canadi
SBW Defoliation 1974
SBW Defoliation 1975
SBW Defoliation 1977
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Monthly Precipitation Data Report
Source: Environment Canada (http://www.climate.weatheroffice.ec.gc.ca/climateData/monthlydata_e.html)
Location: St Leonard New Brunswick — Lat: 47° 9.600' N — Long: 67° 49.800' W
Data Range: 1985-2005 — Climate ID: 8104928 — WMO ID: 71703

Year	Month												Yearly		
	April	+/- Ave	May	+/- Ave	June	+/- Ave	July	+/- Ave	August	+/- Ave	Sept.	+/- Ave	Aver.	St. Dev.	+/- Ave
1985	79.2	~	71.3	-	80.8	-	192.4	++	52.3	- -	70.6	-	91.1	50.7	~
1986	89.8	+	70.4	-	52.8	- -	137.6	+	188.2	++	110.2	+	108.2	49.2	++
1987	59.3	-	59.7	-	135.8	++	98.8	-	112.8	+	108.6	+	95.8	30.7	~
1988	51.3	-	64.8	-	94.9	~	67.1	- -	158.4	++	67.7	-	84.0	39.1	- -
1989	63.2	-	117.7	+	87.4	-	100.4	-	141	+	125.2	+	105.8	28.1	+
1990	59.4	-	82.4	~	82.6	-	100.6	-	109.6	~	109	+	90.6	19.5	-
1991	74.2	-	106.8	+	41.4	- -	41.2	- -	203.4	+++	102.4	+	94.9	60.2	~
1992	71.4	-	45	- -	133.8	++	141.6	+	92.6	-	54.8	- -	89.9	40.5	-
1993	95	+	99.6	+	117	+	88.8	- -	65.6	-	133.6	++	99.9	23.5	~
1994	116.8	+	128.8	++	127.4	++	106.6	-	90.4	-	103.6	+	112.3	14.9	++
1995	77.8	~	94.5	+	56.9	- -	99.8	-	45.4	- -	48	- -	70.4	23.7	- - -
1996	96.2	+	82.6	-	110.2	+	124.2	+	86.4	-	99	~	99.6	15.4	~
1997	65.2	-	153.2	+++	93	~	74.4	-	111.3	+	65.8	-	93.6	34.1	~
1998	66	-	83.6	-	107.6	+	178.6	++	68.4	-	97.8	+	103.7	39.3	+
1999	40.8	- -	43.4	- -	89.2	-	109.4	-	114.2	+	180.8	+++	96.3	52.1	~
2000	139	++	113	+	140.4	++	123.8	+	88.2	-	43.2	- -	107.9	37.1	++
2001	42.8	- -	63.6	-	104.4	+	121.6	+	53.4	- -	106.2	+	82.0	32.7	- -
2002	83	+	86.6	~	68.8	-	101.2	-	58	- -	116.8	+	85.7	21.3	- -
2003	39	- -	86.4	~	103.1	+	225.8	+++	135.9	+	37.2	- -	104.6	70.5	+
2004	86	+	70.1	-	93	~	122.3	+	112.5	+	80	-	94.0	19.9	~
2005	142.4	+++	103.6	+	51.8	- -	76.9	-	121.8	+	144.6	++	106.9	37.0	++
Ave	78.0		87.0		93.9		115.9		106.2		95.5		96.1		
St. Dev.	28.6		27.3		28.6		42.7		42.6		36.0			10.3	

+++	between 2 and three standard deviations over the average precipitation
++	between 1 and 2 standard deviations over the average precipitation
+	within 1 standard deviation over the average precipitation
~	within 5mm of the average precipitation
-	within 1 standard deviation less than the average precipitation
- -	between 1 and 2 standard deviations less than the average precipitation
- - -	between 2 and three standard deviations less than the average precipitation

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- red pine mortality in 45 yr old plantation at Arundel, Quebec 2006

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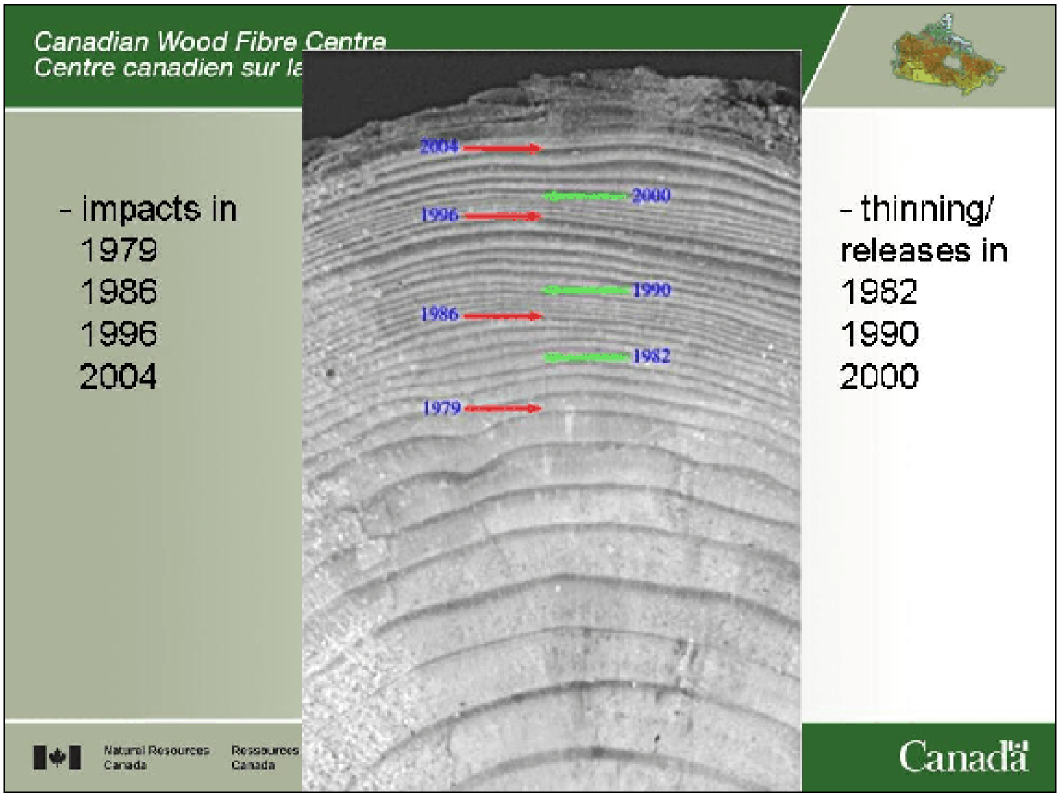

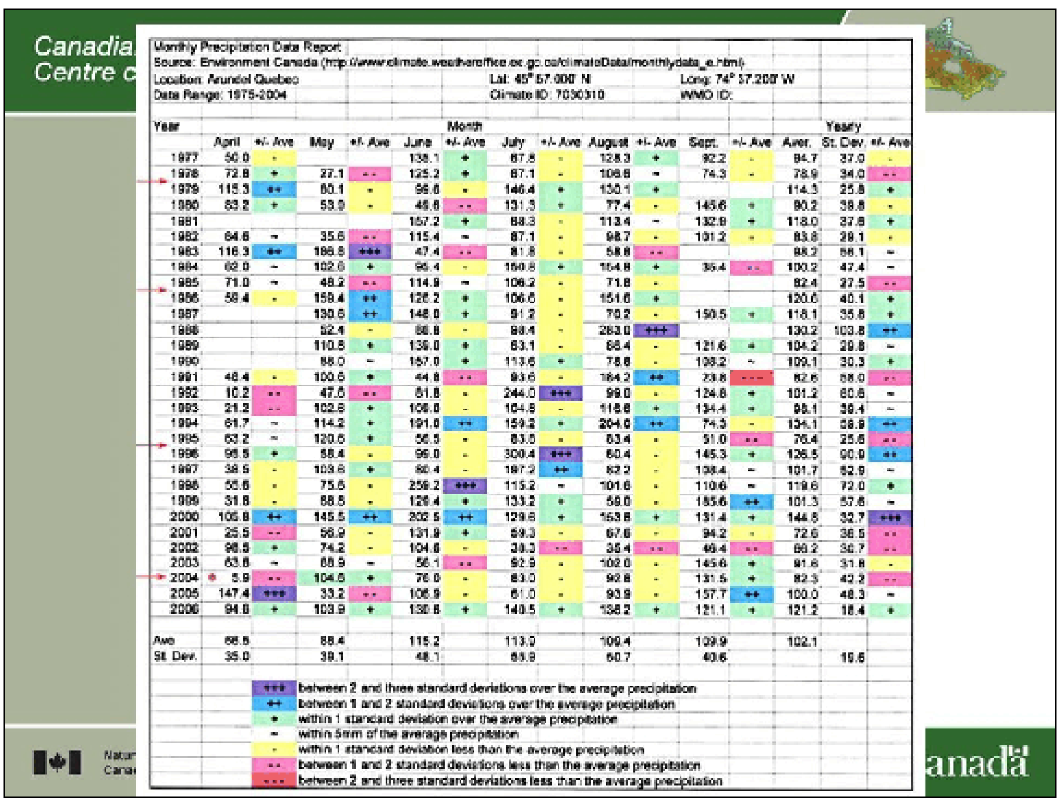

Monthly Precipitation Data Report
Source: Environment Canada (http://www.climate.weatheroffice.ec.gc.ca/climateData/monthlydata_e.html)
Location: Arundel Quebec Lat: 45° 57.000' N Long: 74° 37.200' W
Data Range: 1975-2004 Climate ID: 7030310 WMO ID:

Year	Month												Yearly		
	April	+/- Ave	May	+/- Ave	June	+/- Ave	July	+/- Ave	August	+/- Ave	Sept.	+/- Ave	Aver.	St. Dev.	+/- Ave
1977	50.0	-			138.1	+	67.8	-	128.3	+	92.2	-	84.7	37.0	-
1978	72.8	+	27.1	--	125.2	+	67.1	-	108.8	~	74.3	-	78.9	34.0	--
1979	115.3	++	80.1	-	96.6	-	146.4	+	130.1	+			114.3	25.8	+
1980	83.2	+	53.9	-	46.8	--	131.3	+	77.4	-	145.6	+	90.2	38.8	-
1981					157.2	+	88.3	-	113.4	~	132.8	+	118.0	37.8	+
1982	64.6	~	35.6	--	115.4	~	87.1	-	98.7	-	101.2	-	83.8	28.1	-
1983	116.3	++	186.8	+++	47.4	--	81.8	-	58.8	--			98.2	56.1	~
1984	62.0	~	102.6	+	95.4	-	160.8	+	164.8	+	36.4	--	100.2	47.4	~
1985	71.0	~	48.2	--	114.9	~	106.2	-	71.8	-			82.4	27.5	--
1986	58.4	-	159.4	++	126.2	+	106.6	-	151.6	+			120.6	40.1	+
1987			130.6	++	148.0	+	91.2	-	70.2	-	150.5	+	118.1	35.8	+
1988			52.4	-	88.8	-	98.4	-	263.0	+++			130.2	103.8	++
1989			110.8	+	136.0	+	63.1	-	66.4	-	121.6	+	104.2	29.8	~
1990			88.0	~	157.0	+	113.6	+	78.8	-	108.2	~	109.1	30.3	+
1991	48.4	-	100.6	+	44.8	--	93.6	-	184.2	++	23.8	---	82.6	58.0	--
1992	10.2	--	47.6	--	61.8	-	244.0	+++	99.0	-	124.8	+	101.2	60.6	~
1993	21.2	--	102.6	+	106.0	-	104.8	-	118.6	+	134.4	+	98.1	38.4	~
1994	61.7	~	114.2	+	191.0	++	159.2	+	204.0	++	74.3	-	134.1	58.9	++
1995	63.2	~	120.6	+	56.5	-	83.5	-	63.4	-	51.0	--	76.4	25.6	--
1996	96.5	+	88.4	-	96.0	-	300.4	+++	60.4	-	145.3	+	126.5	90.9	++
1997	38.5	-	103.6	+	80.4	-	197.2	++	82.2	-	108.4	~	101.7	52.9	~
1998	55.6	-	75.6	-	256.2	+++	115.2	~	101.6	-	110.6	~	119.6	72.0	+
1999	31.8	-	88.5	-	126.4	+	133.2	+	59.0	-	185.6	++	101.3	57.6	~
2000	106.8	++	145.5	++	202.5	++	129.8	+	153.8	+	131.4	+	144.8	32.7	+++
2001	25.5	--	56.9	-	131.8	+	59.3	-	67.6	-	94.2	-	72.6	36.5	--
2002	96.5	+	74.2	-	104.6	-	38.3	--	35.4	--	46.4	--	66.2	36.7	--
2003	63.8	~	68.9	~	56.1	--	92.9	-	102.0	-	145.6	+	91.6	31.8	-
2004	5.9	--	104.6	+	76.0	-	83.0	-	92.8	-	131.5	+	82.3	42.2	--
2005	147.4	+++	33.2	--	106.9	-	61.0	-	93.9	-	157.7	++	100.0	48.3	~
2006	94.8	+	103.9	+	136.8	+	140.5	+	138.2	+	121.1	+	121.2	18.4	+
Ave	68.8		88.4		115.2		113.0		109.4		109.9		102.1		
St. Dev.	35.0		39.1		48.1		65.9		60.7		40.6			19.6	

+++	between 2 and three standard deviations over the average precipitation
++	between 1 and 2 standard deviations over the average precipitation
+	within 1 standard deviation over the average precipitation
~	within 5mm of the average precipitation
-	within 1 standard deviation less than the average precipitation
--	between 1 and 2 standard deviations less than the average precipitation
---	between 2 and three standard deviations less than the average precipitation


Canadian Wood Fibre Centre
Centre canadien sur la fibre de bois
- Nashwaak Lake, N.B. bF stand 40 yr age, 20 yr since PCT
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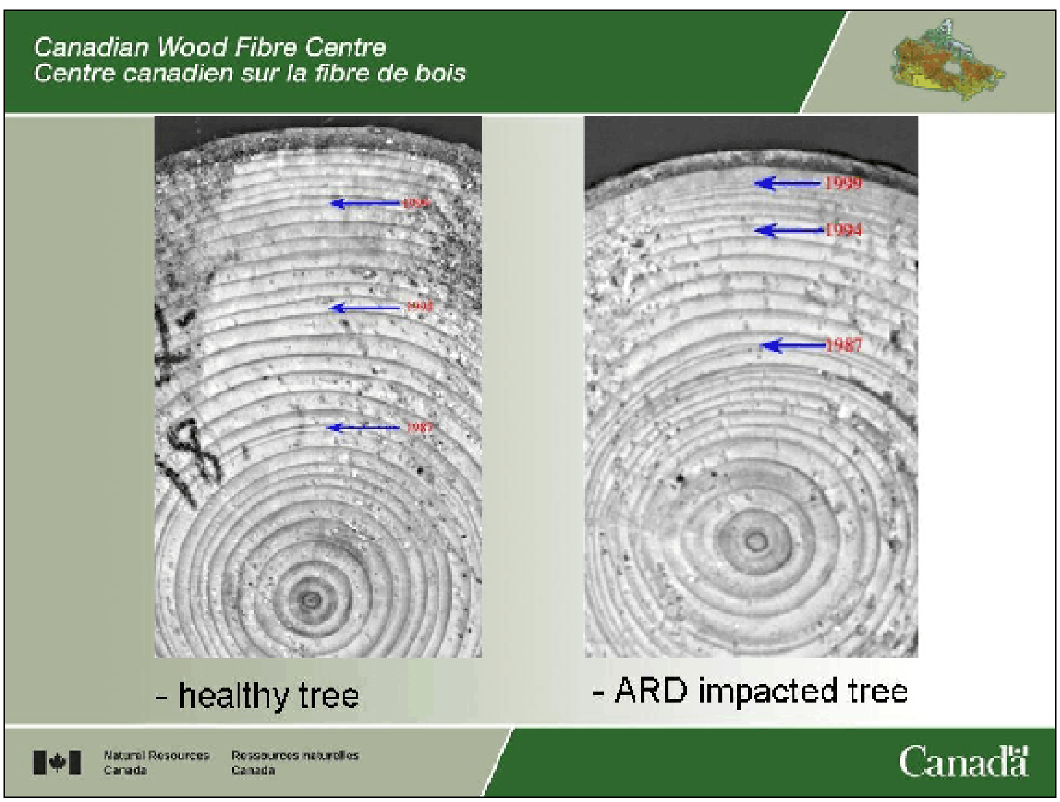
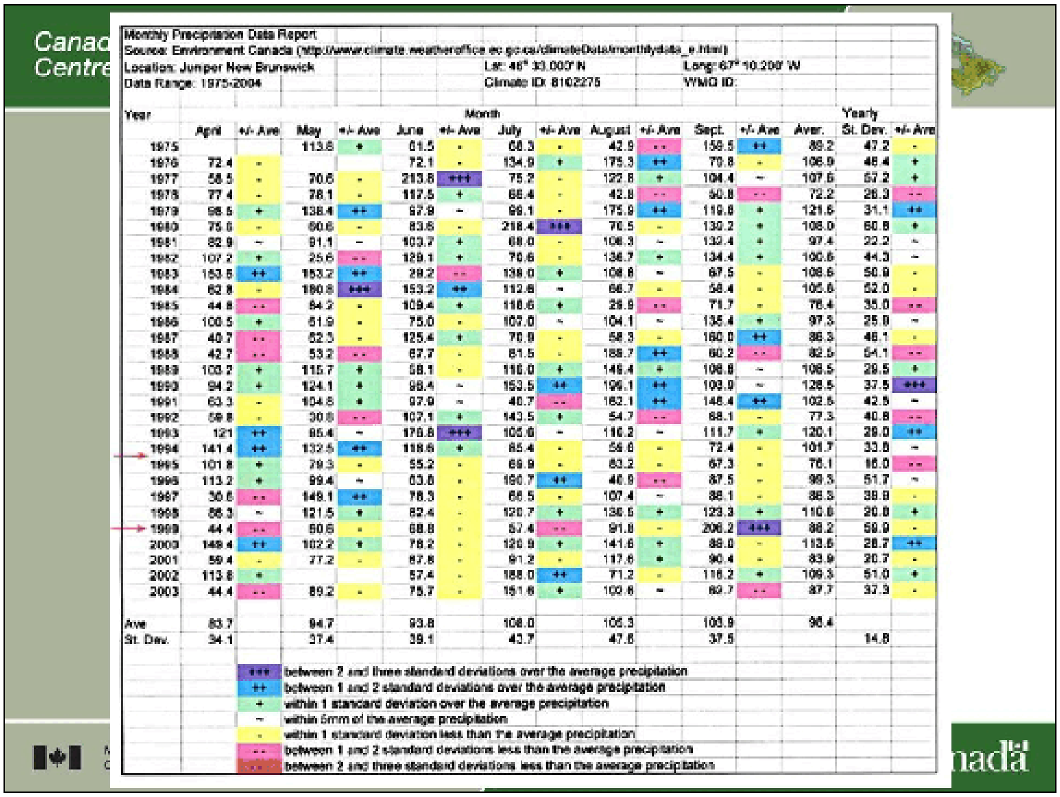

Canadian Wood Fibre Centre
Centre canadien sur la fibre de bois
1999
1994
1987
- healthy tree
- ARD impacted tree
Natural Resources Canada
Ressources naturelles Canada
Canada



Monthly Precipitation Data Report
Source: Environment Canada (http://www.climate.weatheroffice.ec.gc.ca/climateData/monthlydata_e.html)
Location: Juniper New Brunswick — Lat: 46° 33.000' N — Long: 67° 10.200' W
Data Range: 1975-2004 — Climate ID: 8102275 — WMO ID:

Year	April	+/- Ave	May	+/- Ave	June	+/- Ave	July	+/- Ave	August	+/- Ave	Sept.	+/- Ave	Aver.	Yearly St. Dev.	+/- Ave
1975			113.6	+	61.5	-	68.3	-	42.9	- -	158.5	++	89.2	47.2	-
1976	72.4	-			72.1	-	134.9	+	175.3	++	70.8	-	106.9	48.4	+
1977	58.5	-	70.6	-	213.8	+++	75.2	-	122.8	+	104.4	~	107.6	57.2	+
1978	77.4	-	78.1	-	117.5	+	66.4	-	42.8	- -	50.8	- -	72.2	26.3	- -
1979	98.5	+	138.4	++	97.9	~	99.1	-	175.9	++	119.8	+	121.6	31.1	++
1980	75.6	-	80.6	-	83.6	-	218.4	+++	70.5	-	130.2	+	108.0	60.8	+
1981	82.9	~	91.1	~	103.7	+	68.0	-	106.3	~	132.4	+	97.4	22.2	~
1982	107.2	+	25.6	- -	129.1	+	70.6	-	136.7	+	134.4	+	100.6	44.3	~
1983	153.6	++	153.2	++	29.2	- -	138.0	+	108.8	~	67.5	-	108.6	50.9	-
1984	62.8	-	180.8	+++	153.2	++	112.8	~	66.7	-	58.4	-	105.6	52.0	-
1985	44.8	- -	84.2	-	109.4	+	118.6	+	26.9	- -	71.7	-	76.4	35.0	- -
1986	100.5	+	61.9	-	75.0	-	107.0	~	104.1	~	135.4	+	97.3	25.9	~
1987	40.7	- -	62.3	-	125.4	+	70.9	-	58.3	-	160.0	++	86.3	46.1	-
1988	42.7	- -	53.2	- -	67.7	-	81.5	-	188.7	++	60.2	- -	82.5	54.1	- -
1989	103.2	+	115.7	+	58.1	-	116.0	+	146.4	+	106.8	~	108.5	29.5	+
1990	94.2	+	124.1	+	98.4	~	153.5	++	196.1	++	103.9	~	128.5	37.5	+++
1991	63.3	-	104.8	+	97.9	~	40.7	- -	162.1	++	146.4	++	102.5	42.5	~
1992	59.8	-	30.8	- -	107.1	+	143.5	+	54.7	- -	68.1	-	77.3	40.8	- -
1993	121	++	85.4	~	176.8	+++	105.6	~	116.2	~	111.7	+	120.1	29.0	++
1994	141.4	++	132.5	++	118.6	+	85.4	-	56.6	-	72.4	-	101.7	33.8	~
1995	101.8	+	79.3	-	55.2	-	69.9	-	83.2	-	67.3	-	76.1	16.0	- -
1996	113.2	+	99.4	~	63.8	-	160.7	++	46.9	- -	87.5	-	95.3	51.7	~
1997	30.6	- -	149.1	++	78.3	-	66.5	-	107.4	~	88.1	-	86.3	38.9	-
1998	86.3	~	121.5	+	82.4	-	120.7	+	130.5	+	123.3	+	110.8	20.8	+
1999	44.4	- -	80.6	-	68.8	-	57.4	- -	91.8	-	206.2	+++	88.2	59.9	-
2000	149.4	++	102.2	+	78.2	-	120.9	+	141.6	+	88.0	-	113.6	28.7	++
2001	59.4	-	77.2	-	87.8	-	91.2	-	117.6	+	90.4	-	83.9	20.7	-
2002	113.8	+			57.4	-	188.0	++	71.2	-	116.2	+	109.3	51.0	+
2003	44.4	- -	89.2	-	75.7	-	151.6	+	102.6	~	69.7	- -	87.7	37.3	-
Ave	83.7		94.7		93.8		108.0		105.3		103.9		96.4		
St. Dev.	34.1		37.4		39.1		43.7		47.6		37.5			14.8	

+++	between 2 and three standard deviations over the average precipitation
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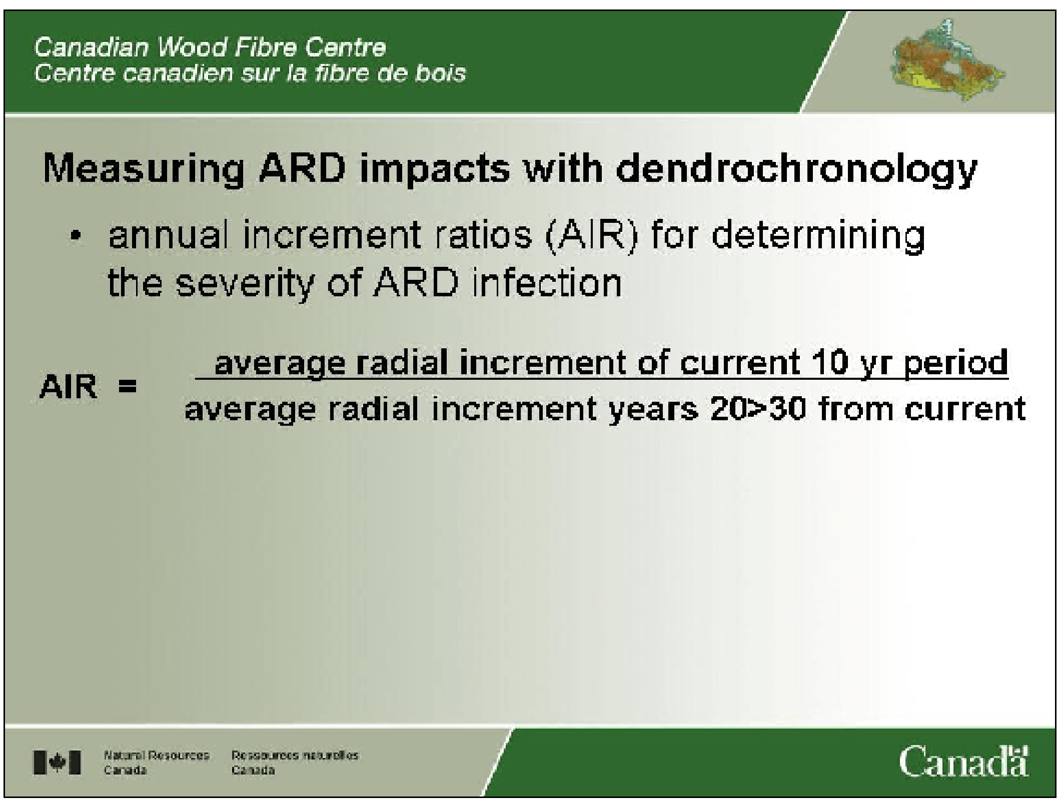
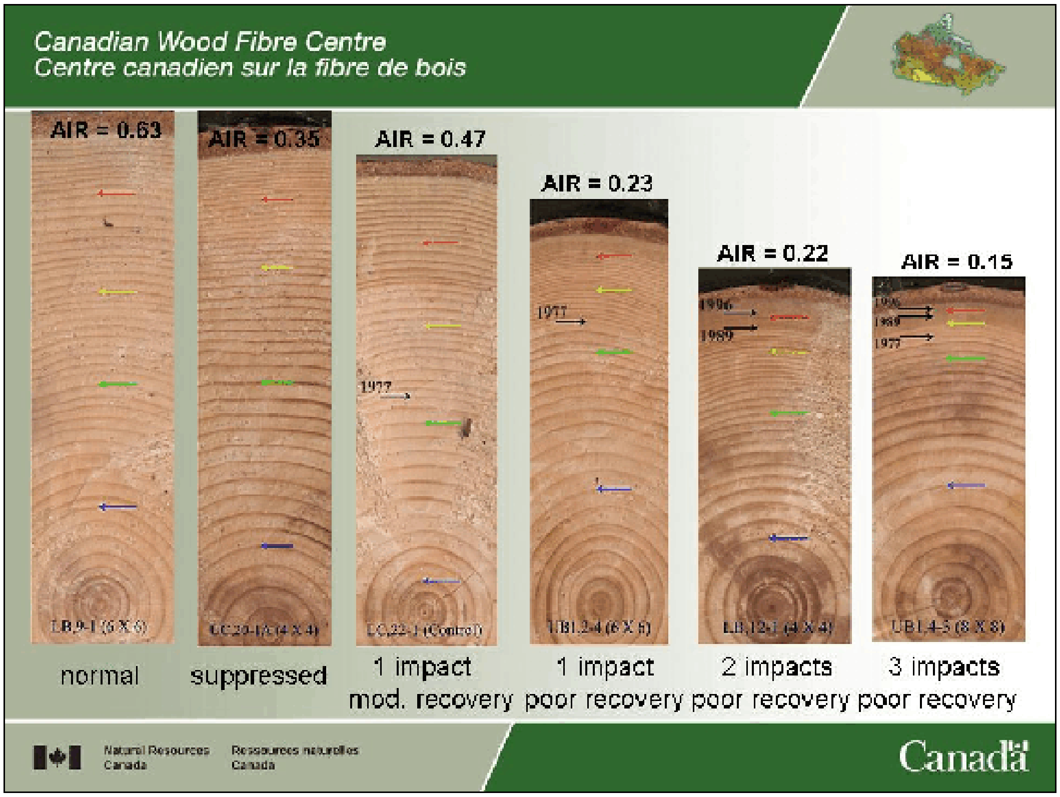
~	within 5mm of the average precipitation
-	within 1 standard deviation less than the average precipitation
- -	between 1 and 2 standard deviations less than the average precipitation
- - -	between 2 and three standard deviations less than the average precipitation





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Green River Spacing Trial BH Disk Review
Tree Growth & Impact Category Summary

Tree Growth/Impact Category	# trees	DBH (cm)	Std. Dev.	AIRatio	Std. Dev.
Normal	37	23.4	4.1	0.57	0.12
Suppression & cont'd decline	10	17.5	5.5	0.29	0.07
Impact '77 mod. recovery	17	19.3	5.8	0.40	0.08
Impact '77 poor recovery	12	13.6	3.2	0.27	0.05
Impact '96 poor recovery	8	17.8	3.5	0.31	0.05
2X Impact '96, '89,	10	12.9	2.9	0.19	0.04
3X Impact '96, '89, '77	8	13.8	2.8	0.12	0.02
Total # trees sampled	120				

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- specific volume increments (SVI) for comparing growth rates and tree volume losses from ARD

$$SVI = \frac{\text{surface area of cambial sheath year X}}{\text{volume of sheath year X}}$$

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- Patricia Baines - CFS, CWFC
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- Gaston Laflamme - CFS, LFC

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Multi-Scale Testing an Operational *Armillaria* Root Disease Mapping Procedure for British Columbia

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Abstract

The distribution of Armillaria root disease, caused by *Armillaria ostoyae*, is widespread in southern British Columbia. Although it is known to occur south of 53 degrees latitude its distribution has never been accurately mapped, nor do we know how rapidly its distribution is expanding northward. The purpose of this project is to assess the accuracy of a landscape level detailed aerial sketch map of the distribution of Armillaria at the northern portion of the Headwaters Forest District (former Robson Valley Forest District) using multiple scales of "ground" truth.

This Armillaria map was developed between 1991 and 2006, using primarily low-level aerial sketch mapping using rotary wing aircraft, and limited ground surveys. The detailed aerial sketch mapping was conducted extensively across the district and worked well for mapping above-ground symptoms of Armillaria root disease centers in older plantations and unmanaged stands, especially for moderately to highly susceptible species, such as Douglas-fir, white spruce, and subalpine fir.

In 2006 a validation ground survey project was initiated, in collaboration with Michelle Cleary of the Southern Interior Forest Region, to determine the reliability of this Armillaria map by ground surveying a number of young stands representative of the landscape level species composition and geographic factors. The survey recorded: species composition, an estimate of the tree based incidence of Armillaria, and the GPS location of each transect segment on a 50 meter interval. The final stage was spatially guided by the results of the transect survey, involved a detailed ground based GPS delineation of the observed Armillaria centers. All shape files are now collected in the field using a custom designed ArcPad survey and delineation program.

For the second scale of detection, four areas were selected for aerial photography using 1:4,000 scale colour photography. The photos were flown in the fall of 2006, digitally scanned, orthorectified, and then evaluated in stereo using SoftCopy photo-grammetry. Dead and dying trees and associated canopy gaps were mapped were mapped in silviculture openings in these four areas. The photo interpreted results provide a detailed comparison to the ground surveys.

For the third scale, one of the photo-interpreted silviculture opening was selected for detailed ground truth in the field using large scale photos reproduced at 1:200 scale. In the spring of 2007 over 14 hectares were ground truthed for comparison of the accuracy of photo-interpretation. Each tree, on the ground, was located on the photo for a 1 to 1 comparison. The location of trees that were too small to see on the photos were mapped onto the photos. The precision of detecting dead trees and trees expressing above ground symptoms was 40%, which was more than adequate for mapping the boundary of disease centres.

A fourth component of this project involves sampling the GPS delineated Armillaria centers to determine the DNA population structure of Armillaria at the stand and landscape level. This component is being used to interpret the results of operational surveys resulting in complex spatial patterns of disease centers, and to validate the detailed GPS centre delineation procedure.

Résumé

Essai multi-échelles d'une méthode de cartographie opérationnelle du pourridié-agaric en Colombie-Britannique

Le pourridié-agaric dû à l’*Armillaria ostoyae* est une maladie largement répandue dans le sud de la Colombie-Britannique. Même si sa présence est connue au sud du 53e parallèle, nous ne disposons pas d’une carte exacte de sa répartition et nous ne savons pas non plus à quelle vitesse elle progresse vers le nord. Ce projet a pour objectif d’évaluer le degré d’exactitude d’un croquis cartographique aérien, établi à l’échelle du paysage, de la répartition du pourridié-agaric dans la portion septentrionale du district forestier Headwaters (l’ancien district forestier Robson Valley) à l’aide de vérifications au sol à de multiples échelles.

Cette carte de la répartition du pourridié-agaric a été dressée entre 1991 et 2006, principalement à l'aide de croquis aériens réalisés à faible altitude par aéronef à voilure tournante et d'un nombre limité de relevés au sol. Les croquis cartographiques aériens détaillés ont été réalisés sur un vaste territoire dans le district et ont permis d'obtenir une bonne représentation cartographique des symptômes des portions aériennes des arbres des foyers d'infection du pourridié-agaric dans les plantations plus âgées et dans les peuplements non aménagés, notamment d'essences modérément à fortement sensibles, telles le douglas, l'épinette blanche et le sapin subalpin.

Un projet a été entrepris en 2006 à des fins de validation en collaboration avec Michelle Cleary de la région forestière intérieure du Nord. Il visait à établir le degré de fiabilité de cette carte du pourridié-agaric et consistait à effectuer des relevés au sol dans un certain nombre de jeunes peuplements représentatifs des facteurs géographiques et de la composition taxinomique à l'échelle du paysage. Les données suivantes ont été consignées lors des relevés : composition taxinomique, estimation (en fonction du nombre d'arbres) de l'incidence du pourridié-agaric et coordonnées GPS de chaque segment de transect, à intervalle de 50 mètres. Lors de la dernière étape, on a utilisé les références spatiales obtenues lors des relevés des transects pour effectuer une délimitation GPS au sol détaillée des foyers d'infection observés. Les fichiers de formes sont maintenant compilés sur le terrain à l'aide d'un programme personnalisé de délimitation et de relevé ArcPad.

Pour la deuxième étape du dépistage, on a sélectionné quatre secteurs pour y prendre des photographies aériennes en couleurs à une échelle de 1/4 000. Les photos ont été prises durant l'automne 2006, numérisées à l'aide d'un balayeur optique et orthorectifiées, puis ont fait l'objet d'une évaluation stéréoscopique à l'aide du logiciel de photogrammétrie SoftCopy. Les arbres morts et moribonds et les vides connexes dans le couvert ont été cartographiés dans les trouées sylvicoles de ces quatre secteurs. Les résultats de photo-interprétation fournissent des points de comparaison détaillés avec les relevés au sol.

Pour la troisième étape, on a sélectionné une des trouées sylvicoles photo-interprétées à des fins de vérification au sol à l'aide de photos à grande échelle reproduites à une échelle de 1/2 000. Au printemps 2007, plus de 14 hectares ont fait l'objet de vérifications au sol à des fins de comparaison de l’exactitude des résultats de photo-interprétation. Chaque arbre présent sur le terrain a été localisé individuellement sur la photo à des fins de comparaison biunivoque. L’emplacement des arbres trop petits pour être visibles sur les photos a été cartographié sur ces dernières. Le degré de précision auquel les arbres morts et les arbres dont les parties aériennes présentaient des symptômes ont été dépistés était de 40 %, un pourcentage plus qu’adéquat pour cartographier la périphérie des foyers d’infection.

Un quatrième volet du projet consiste à échantillonner les foyers d’infection délimités par GPS afin de déterminer, à partir de l’ADN, la structure de la population du champignon pathogène au niveau du peuplement et du paysage. Ce volet sert à interpréter les résultats des relevés opérationnels produisant des configurations spatiales complexes des foyers d’infection et à valider la procédure détaillée de délimitation des foyers par GPS.

Armillaria: Risk Assessment and Management

M. G. Cruickshank

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Abstract

Risk analysis is a technique used to determine the likelihood or chance of hazardous events occurring and the likely consequences. The process may also include risk management and risk communication. The context of risk analysis affects the way the analysis is performed. For example, risk of an introduced pest differs from that of an endemic pest because the former has to be inferred from what is known in another area, but the latter can be quantitatively sampled directly where it occurs. Quantitative sampling also gives a measure of uncertainty to the process. The context of risk can also change depending on the type of risk, biological, economic, or social and may include one or all of these factors. Risk can also change over time, an important consideration for forest pests. Confusion between different risk analyses often stems from the differences in risk context. A comparison of the risk analysis process for potentially introduced agricultural pests using an international standard and that of an endemic disease, *Armillaria* root rot, will be discussed.

Résumé

Le pourridié-agaric : Analyse et gestion du risque

L'analyse du risque est une technique utilisée pour déterminer la probabilité ou l'éventualité que se produisent des événements dangereux et leurs conséquences probables. Ce processus peut également inclure la gestion et la communication du risque. Le contexte de l'analyse du risque influe sur la façon dont l'analyse est réalisée. Ainsi, le risque lié à une espèce introduite diffère de celui lié à un organisme nuisible endémique. Dans le premier cas, il faudra procéder par déduction en partant des connaissances existant dans une autre région tandis que dans le second cas, on peut procéder par échantillonnage quantitatif directement dans la région où l'organisme nuisible endémique est présent. L'échantillonnage quantitatif confère également au processus un

certain degré d'incertitude. Le contexte du risque peut également changer en fonction du type de risque (biologique, économique ou social) et peut également inclure un ou l'ensemble de ces facteurs. Le risque peut également évoluer avec le temps, un aspect important dont il faut tenir compte dans le cas des organismes nuisibles des forêts. La confusion entre différentes analyses du risque provient souvent de différences au niveau du contexte du risque. On comparera une analyse du risque, fondée sur une norme internationale, pour des ennemis des cultures susceptibles d'avoir été introduits et pour une maladie endémique des arbres (le pourridié-agaric).

Risk analysis is a technique used to determine the likelihood or chance of hazardous events occurring and the likely consequences. The process may also include risk management and risk communication. The context of risk analysis affects the way the analysis is performed. For example, risk of an introduced pest differs from that of an endemic pest because the former has to be inferred from what is known in another area, but the latter can be quantitatively sampled directly where it occurs. A categorical system using low to high incidence and consequences is often used for introduced pests. The context of risk can also change depending on the type of risk, biological, economic, or social and may include one or all of these factors. Risk can also change over time, an important consideration for forest pests. Confusion between different risk analyses often stems from the differences in risk context.

The determination of pest incidence and especially consequences or impacts of an introduced pest is difficult because of the impossibility of direct sampling and generation of trends and confidence intervals. However for an endemic pest, direct sampling in the environment is possible. Incidence is straightforward to measure but the consequences or impacts are not. If incidence of attack is measured at the level of the individual plant (attacked or not) over time, then the damage or consequences of that attack can also be tracked over time. The incidence gives us the number of plants attacked at any one time. A damage function relates the level of damage after attack for an individual to time. For a given time, a certain number of individuals are newly attacked and others have been attacked for varying length of time. If the length of time of attack for each individual is known, then the incidence multiplied by the damage function gives the damage. The sum of individual damages will yield risk for that particular time (assuming that individuals behave as groups). Risk can take many different forms depending on the damage of interest, and the process can be simplified through computer modeling. A comparison of the risk analysis process for potentially introduced agricultural pests using an international standard and categorical measures with that of an endemic disease Armillaria root rot using direct ecological sampling and modeling will be contrasted.

Screening Half-sib Interior Douglas-fir Families for Resistance to *Armillaria ostoyae*

B. C. Jaquish[1], M. G. Cruickshank[2] and A.F.L.Nemec[3]

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[2]Natural Resources Canada, Canadian Forest Service – Pacific Forestry Centre, 506 West Burnside Road, Victoria, BC V8Z 1M5

[3]International Statistics and Research Corp, P.O. Box 39, Brentwood Bay, BC V8M 1R3

Abstract

Potted Interior Douglas-fir seedlings from 87 half-sib families were challenged for three years with *Armillaria ostoyae* in a greenhouse trial by inserting an inoculum source into the seedling root zone. The test seedlings were grown from seed originating from four geographically and ecologically distinct Douglas-fir tree breeding zones in the B.C. Interior. Mortality over three years and the final percent survival of inoculated trees showed clear differences among families (survival range 0-61.1%) and breeding zones (survival range 7.6-25.3%). However, survival analysis revealed that most of the differences among families could be explained by the zone from which the family originated. The least susceptible families originated from the drier and warmer zones, while the more susceptible families originated from wetter and cooler zones. Maximum heritability (h^2 =0.23) occurred at 27 months from the time of inoculation when seedling mortality was about 50 percent. The less susceptible families appeared to limit the spread of the fungus especially in the first year after infection, which reduced the overall mortality at the end of the experiment. Longer-term reactions, such as the formation of callus tissue, occurred more frequently at lesions on tree roots from the less susceptible seed zones. Parents of more susceptible families will likely be removed from seed orchards, while complements of the less susceptible families will likely be increased.

Résumé

Criblage de descendances uniparentales du douglas en fonction de la résistance à l'*Armillaria ostoyae*

Dans le cadre d'un essai en serre, des semis en récipient de douglas bleu provenant de 87 descendances uniparentales ont été exposés durant trois ans à l'*Armillaria ostoyae* par introduction d'une source d'inoculum dans leur zone racinaire. Ces semis étaient issus de graines provenant de quatre zones géographiques et écologiques distinctes de production de graines du douglas bleu de l'intérieur de la Colombie-Britannique. Le taux de mortalité triennal et le pourcentage final de survie des semis inoculés a mis en évidence des différences marquées entre les familles (survie variant de 0 à 61,1 %) et les zones de reproduction (survie variant de 7,6 à 25,3 %). Toutefois, l'analyse de la survie a révélé que la zone d'origine de la famille expliquait en grande partie les différences entre les familles. Les familles les moins sensibles provenaient des zones plus sèches et plus chaudes, tandis que celles plus sensibles venaient de zones plus pluvieuses et plus fraîches. L'héritabilité était maximale (h^2 =0,23) 27 mois après l'inoculation, au moment où la mortalité des semis était d'environ 50 %. Les familles moins sensibles ont semblé limiter la propagation du champignon, notamment au cours de la première année suivant l'infection, ce qui a eu pour effet de réduire la mortalité globale à la fin de l'essai. Des réactions à plus long terme, comme la formation de tissu de cicatrisation, ont été observées plus souvent sur les lésions des racines des semis provenant de zones de production de graines moins sensibles. Les parents issus de familles plus sensibles risquent d'être retirés des vergers à graines, tandis que l'effectif provenant de familles moins sensibles risque d'augmenter.

SESSION 11: CANADIAN FOOD INSPECTION AGENCY UPDATES

Chair: Marcel Dawson
Canadian Food Inspection Agency

SÉANCE 11 : MISES À JOUR DE L'AGENCE CANADIENNE D'INSPECTION DES ALIMENTS

Président : Marcel Dawson
Agence canadienne d'inspection des aliments

Plant Health & Biosecurity Directorate

Marcel Dawson

Canadian Food Inspection Agency

NOT AVAILABLE

Invasive Alien Species Update

Lesley Cree

Canadian Food Inspection Agency

NOT AVAILABLE

Update on Wood Packaging Material Inspected at Marine Ports

Melanie Mecteau

Canadian Food Inspection Agency, Forestry Division,
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Abstract

The Government of Canada adopted the International Standards on Phytosanitary Measures (ISPM) No. 15 relative to wood packaging requirements in March 2002. Since this time, consultations with industry and notifications of non-compliance to importers were instrumental in informing them of the future full enforcement of ISPM No. 15. Since July 5, 2006 the Government of Canada is refusing entry of all non-compliant wood packaging material from off continent origin. The Canada Border Services Agency (CBSA) is applying the import requirements at the ports of Vancouver, Prince Rupert, Montreal and Halifax. CBSA collects wood packaging inspection data which is then analyzed by the Canadian Food Inspection Agency on a quarterly basis. All major non-compliances highlighted through the analysis are communicated to the National Plant Protection Organizations of the exporting countries to ensure corrective actions are taken. The compliance rate for wood packaging material has increased significantly since the implementation of the wood packaging inspection program. Timely notifications of non-compliances to exporting countries and the targeting of exporters with previously known non-compliances have contributed largely to this increase in compliance.

Résumé

Mise à jour sur les matériaux d’emballage en bois inspectés dans les ports maritimes

Le gouvernement du Canada a adopté les exigences de la Norme internationale pour les mesures phytosanitaires (NIMP) no. 15 relatives aux matériaux d'emballage en bois au mois de mars 2002. Depuis, des consultations avec l'industrie et des avis de non-conformité aux importateurs ont permis de les aviser d’une future mise en application intégrale de la NIMP no. 15. Depuis le 5 juillet 2006, le gouvernement du Canada refuse de laisser entrer au pays les matériaux d'emballage en bois non conformes provenant de l'étranger. L’Agence des services frontaliers du

Canada (ASFC) est responsable de l’application des exigences à l’importation aux ports de Vancouver, Prince Rupert, Montréal et Halifax. L’ASFC recueille les données d’inspection qui sont ensuite analysées par l’Agence canadienne d’inspection des aliments sur une base semestrielle. Toutes les non-conformités majeures relevées lors de l’analyse sont communiquées aux Organisations nationales de la protection des végétaux des pays exportateurs de façon à ce que des mesures correctives soient mises en place. Le taux de conformité des matériaux d’emballage en bois a augmenté significativement depuis la mise en place du programme d’inspection des matériaux d’emballage en bois. Le signalement rapide des non-conformités aux pays exportateurs et le ciblage des exportateurs ayant eu précédemment des non-conformités contribuent grandement à cette augmentation de la conformité.

Asian Gypsy Moth – NAPPO Standards

Shane Sela

Canadian Food Inspection Agency

NOT AVAILABLE

Regulatory Update for the European Woodwasp (*Sirex noctilio*) in Canada

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Abstract

The European Woodwasp, *Sirex noctilio* is a wood borer of pine trees, widely distributed in Europe, North Africa and Asia, where it is considered a secondary pest. However in countries where *S. noctilio* has been introduced unintentionally (South Africa, Australasia and South America) it has proven to cause extensive mortality of pine trees. *S. noctilio* was first confirmed in Ontario in the fall of 2005. Surveys conducted over the past few years have confirmed the range of this insect to exist throughout south-central Ontario. During the 2008 survey season, *S. noctilio* was confirmed in La Chute, Quebec, an area located near the Ontario Quebec border.

The decision to regulate and impose movement restrictions for a particular pest/commodity pathway is not an easy one. It is still unclear whether the European woodwasp is a significant threat to Canada. Scientists are studying the ecological relationship of *S. noctilio* with our native pine pests to determine how competitive it is in our pine ecosystems. *Beddingia siricidicola,* the nematode bio control agent which has been successful in reducing and managing *S. noctilio* populations in Australia and New Zealand was confirmed in association with *S. noctilio* adults in Canada, and the efficacy of these strains is currently being studied.

In addition to the scientific ecological research that is underway, the CFIA has undertaken several studies and outreach initiatives to gain knowledge of the potential impact of *S. noctilio*. A pest risk assessment was conducted on *S. noctilio*, and high risk pathways for the potential introduction of this insect have been determined. Pine inventories and pathways have been analyzed to determine the current movement of pine products and best strategies to regulate the movement of high risk pine materials. An Economic Impact Study that predicts the impact of *S. noctilio* if no controls are implemented was completed in October, 2007. Sirex stakeholder

consultations were held in January in both Quebec City and Toronto, designed to educate the industry on the importance of controlling movement of high risk pine materials, to discuss options for reducing the risk of artificial spread of this pest and to provide a forum for discussion on proposed regulations. Consultations with the Animal and Plant Health Inspection Service of the United States Department of Agriculture have been conducted to discuss a harmonized approach in the regulation of high risk pine commodities. A draft policy has been developed for external consultation during the fall, 2008.

Résumé

Le point sur les mesures réglementaires à l'égard du sirex européen du pin (*Sirex noctilio*) au Canada

Le sirex européen du pin *(Sirex noctilio*) est un coléoptère xylophage ravageur des pins qui est largement répandu en Europe, en Afrique du Nord et en Asie, où il est considéré comme un ravageur secondaire. Or, dans les pays où il a été introduit accidentellement (Afrique du Sud, Australasie et Amérique du Sud), il a provoqué une mortalité considérable des pins. La présence du *S. noctilio* a été confirmée pour la première fois en Ontario durant l'automne 2005. Les enquêtes effectuées au cours des dernières années ont confirmé que l'aire de répartition de cet insecte s'étendait à tout le centre-sud de l'Ontario. L'enquête de 2008 a confirmé sa présence à La Chute, au Québec, un secteur situé non loin du territoire de l'Ontario.

La décision de réglementer un organisme nuisible/une filière en particulier et d'imposer des mesures restreignant les déplacements n'est pas facile à prendre. Il n'est pas encore certain si le sirex européen du pin constitue une grave menace pour le Canada. Les scientifiques mènent actuellement des études sur les relations écologiques entre le *S. noctilio* et les ennemis naturels indigènes de nos pins afin de déterminer le degré de compétition qu'il peut exercer dans nos écosystèmes de pins. Il a été confirmé que le *Beddingia siricidicola*, le nématode utilisé comme agent de lutte biologique qui a permis de réduire et de contrôler les populations du *S. noctilio* en Australie et en Nouvelle-Zélande, était associé aux *S. noctilio* adultes au Canada, et l'efficacité de ces souches est actuellement à l'étude.

En plus des activités de recherche scientifique sur l’écologie en cours, l’ACIA a entrepris plusieurs études et initiatives de sensibilisation afin d’acquérir des connaissances sur l’impact potentiel du *S noctilio*. Elle a effectué une évaluation du risque phytosanitaire pour le *S. noctilio* et a déterminé les filières à haut risque d’introduction potentielle de cet insecte. Elle a analysé les stocks de pin et les filières afin de déterminer les meilleures stratégies pour réglementer le déplacement de produits du pin à haut risque. En octobre 2007, elle a terminé une étude d'impact économique qui visait à prévoir l'impact du *S. noctilio* en l'absence de mesures de contrôle. Elle a tenu en janvier des séances de consultation des intervenants à Québec et à Toronto afin de sensibiliser l'industrie à l'importance de contrôler le déplacement de produits de pin à haut risque, de discuter des options permettant de réduire le risque de dissémination artificielle de cet organisme nuisible et de permettre des échanges sur la réglementation proposée. Elle a consulté l’Animal and Plant Health Inspection Service du département de l’Agriculture des États-Unis pour discuter de l’harmonisation de la réglementation des produits de pin à haut risque. Durant l’automne 2008, elle a élaboré un avant-projet de politique à des fins de consultations externes.

Emerald Ash Borer Update

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NOT AVAILABLE

Phytophthora ramorum Update

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Abstract

Phytophthora ramorum is a quarantine pest that was first regulated by Canada in 2001 when it was reported to be causing a disease named sudden oak death (SOD) in coastal areas of central California. At that time, little was known of the biology and potential risks from this pathogen, so strict regulatory and eradication measures were put in place to control the nursery pathway that contributes to spread. Since then, a great deal has been learned, and this has been incorporated into updates of the CFIA's pest risk assessment, the latest being drafted at the end of 2007. Estimates of risk to Canada have now been reduced in recognition that SOD and its environmental impacts have remained restricted to the unique ecozone of the West Coast Fogbelt, despite obvious introductions elsewhere and that the two species that have driven the SOD epidemic, bay laurel and tanoak, do not occur in Canada. The disease on nursery plants is less severe and is typically a foliar blight or leaf spot. Canada's regulatory program, which is now focused on harmonizing regulatory measures with trading partners, principally the United States, will be discussed and survey data for 2008 will be presented.

Résumé

Le point sur la situation du *Phytophthora ramorum*

Le *Phytophthora ramorum* est un organisme nuisible justiciable de quarantaine qui a été réglementé pour la première fois par le Canada en 2001, lorsqu'il a été signalé comme l'agent d'une maladie appelée encre des chênes rouges dans des régions côtières du centre de la Californie. À cette époque, les connaissances sur la biologie et les risques potentiels de ce pathogène étaient très sommaires, et des mesures de réglementation et d'éradication strictes ont été prises pour réglementer les pépinières, des filières contribuant à la dissémination du pathogène. Depuis, les connaissances sur ce pathogène se sont beaucoup enrichies et ont été

intégrées aux mises à jour de l'évaluation des risques phytosanitaires faites par l'ACIA, la plus récente datant de la fin de 2007. Le risque posé par cet organisme nuisible au Canada est maintenant jugé moins important étant donné que cette maladie et ses effets sur l'environnement sont restés confinés à l'écozone unique de la zone de brouillard de la côte Ouest, malgré les introductions manifestes dans d'autres régions, et que les deux espèces ayant contribué à la dissémination de l'infection, le laurier et le lithocarpe, ne sont pas présentes au Canada. En pépinière, la maladie est moins grave et provoque généralement une brûlure ou une tache des feuilles. Cette présentation fera état du programme de réglementation du Canada, qui est maintenant axé sur l'harmonisation de ses mesures réglementaires avec celles de ses partenaires commerciaux, notamment les États-Unis, et des données de l'enquête de 2008.

Brown Spruce Longhorn Beetle (*Tetropium fuscum*) Update

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Abstract

In May, 2007, under the 2nd revision of the BSLB Infested Places Order, the Containment Area (CA) was expanded within central Nova Scotia to include 24 of the 25 previously external positive sites. In keeping with the BSLB "slow the spread" initiative, the Order named 3 regulated articles; spruce logs, bark and large wood chips (>4cm in at least 2 dimensions), each requiring CFIA Movement Certification for movement from regulated areas, based upon risk mitigation measures taken. Spruce firewood is prohibited from movement from regulated areas. The BSLB Risk Mitigation Program was implemented in accordance with the "slow the spread" regulatory focus. The 2007 BSLB survey led to the detection of 17 new positive sites outside of the CA. All outside positive sites were regulated individually under CFIA notices. Following extensive consultations during the winter of 2007-08, the Minister of AAFC met with stakeholders and decided not to expand the CA for the 2008 season, to enable further survey and scientific data to be gathered in support of further regulatory decisions. In 2008, the CFIA collaborated with CFS scientists to design a survey which would contribute to the scientific information, utilizing risk mapping to assist in the placement of traps. The 2008 findings included 8 new positive sites outside of the CA, each regulated independently. During the winter of 2008-2009, the survey information and the results of the 2008 BSLB research will be scientifically analysed to provide support to the CFIA decisions pertaining to official control of this species here in Canada.

Résumé

Le point sur le longicorne brun de l'épinette (*Tetropium fuscum*)

La deuxième révision de l'*Arrêté sur les lieux infestés par le longicorne brun de l'épinette* (LBE), entrée en vigueur en mai 2007, a élargi la zone de confinement dans le centre de la Nouvelle-

Écosse pour y inclure 24 des 25 autres localités qui s'étaient avérées infestées. Dans le cadre de la stratégie de ralentissement de la propagation du LBE, l'arrêté désigne trois produits réglementés, soit les billes d'épinette ainsi que les copeaux d'écorce et de bois (> 4 cm sur au moins deux côtés) et exige qu'ils soient accompagnés d'un certificat de circulation pour être transportés hors de la zone de confinement, conformément aux mesures d'atténuation du risque qui ont été adoptées. Il est interdit de transporter du bois de chauffage d'épinette hors des zones réglementées. Le ralentissement de la propagation du LBE est au cœur du programme d'atténuation du risque lié au LBE, qui a été mis en œuvre. L'enquête de 2007 sur le LBE a permis de détecter la présence du ravageur dans 17 nouvelles localités à l'extérieur de la zone de confinement. Tous ces endroits ont été réglementés individuellement par des avis délivrés par l'ACIA. À la suite de vastes consultations menées durant l'hiver 2007-2008, le ministre d'AAC a rencontré les intervenants et a décidé de ne pas agrandir la zone de confinement pour la saison 2008 afin de permettre la collecte d'autres données d'enquêtes et données scientifiques à l'appui d'autres décisions réglementaires. En 2008, l'ACIA, en collaboration avec des scientifiques du SCF, a élaboré un protocole d'enquête qui avait pour but d'enrichir l'information scientifique et utilisait des cartes du risque pour appuyer le déploiement des pièges. Grâce à l'enquête de 2008, huit nouvelles localités infestées ont notamment été découvertes à l'extérieur de la zone de confinement et ont été réglementées individuellement. Durant l'hiver 2008-2009, les résultats de l'enquête et des activités de dépistage du LBE menées en 2008 feront l'objet d'analyses scientifiques à l'appui de la prise de décisions par l'ACIA concernant les mesures officielles de contrôle de cette espèce nuisible au Canada.

Update on the Asian Long-Horned Beetle Eradication Program – 2008

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Abstract

An Asian Long-Horned Beetle infestation was first detected in September 2003 in Vaughan, north of Toronto and partnerships with local municipalities, federal and provincial departments and international government agencies were established quickly to develop and implement an eradication program. A delimitation survey revealed that the infestation extended south to part of Toronto. Since February 2004, a Regulated Area under Ministerial Order has been in effect to prevent the spread of potentially infested material to other areas of the Greater Toronto Area. Information gathered during the removal of approximately 28,000 trees (i.e., all infested trees and all trees within 200-400 m of infested trees and considered at high risk of being infested) has been used to fine tune many aspects of the eradication program. Visual inspections of the trees located within the Regulated Area, either from the ground or from the canopy by tree climbers, will continue until no signs of attack have been detected for a period of 5 consecutive years.

In order to support the eradication effort and Canada's international claims of pest freedom in other parts of Ontario, the CFIA is also conducting systematic grid surveys outside of the Regulated Area. In 2008 a pilot program for the grid surveys is taking place in the cities of London, Kitchener-Waterloo and Ottawa as well as parts of Toronto outside of the Regulated Area. In 2009, the survey will extend to other major centres in Ontario and other provinces across Canada. The grid survey methodology was designed by scientists at the Canadian Forest Service and provides a high degree of confidence in our ability to detect new and relatively small infestations.

Résumé

Le point sur le Programme d'éradication du longicorne étoilé – 2008

Une infestation du longicorne étoilé a été détectée pour la première fois en septembre 2003 à Vaughan, au nord de Toronto, et des partenariats entre les administrations locales, des ministères provinciaux et fédéraux et des organismes gouvernementaux internationaux ont rapidement été mis sur pied pour élaborer et mettre en œuvre un programme d'éradication. Une enquête de délimitation a révélé que l'infestation s'étendait plus au sud jusqu'à une partie de la ville de Toronto. En vertu d'une ordonnance ministérielle prise en février 2004, une zone réglementée a été établie pour empêcher la dissémination de matériel potentiellement infesté dans d'autres secteurs de la région du Grand Toronto. Les données recueillies lors de l'abattage de quelque 28 000 arbres (à savoir, tous les arbres infestés et tous les arbres croissant dans un périmètre de 200 à 400 m des arbres infestés et jugés très susceptibles d'être infestés) ont servi à peaufiner de nombreux aspects du programme d'éradication. Les inspections visuelles des arbres situés dans la zone réglementée, effectuées depuis le sol ou à même le houppier par des grimpeurs, se poursuivront jusqu'à ce qu'aucun signe d'attaque ne soit détecté pendant une période de cinq années consécutives.

Afin d'appuyer les efforts d'éradication et les allégations du Canada que les autres régions de l'Ontario sont exemptes du ravageur, l'ACIA effectue également des enquêtes systématiques (par quadrillage) à l'extérieur de la zone réglementée. En 2008, un programme pilote d'enquêtes par quadrillage s'est déroulé dans les villes de London, de Kitchener-Waterloo et d'Ottawa ainsi que dans certains secteurs de la ville de Toronto situés à l'extérieur de la zone réglementée. En 2009, l'enquête sera étendue à d'autres grands centres de l'Ontario et d'autres provinces canadiennes. La méthode d'enquête par quadrillage a été élaborée par des scientifiques du Service canadien des forêts et nous fournit un outil très fiable pour détecter des foyers d'infestation nouveaux et relativement petits.

CFIA – Invasive Alien Species Pest Interception Report 2008

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Abstract

Insect forest pests continue to enter Canada as pests in nursery stock and as hitch-hikers on vessels, containers and in a wide variety of wood products, including pallets, crates and dunnage. We compare some currently intercepted species to the legacy of past interceptions and to the detection of pests such as *Agrilus planipennis* (EAB) and *Anoplophora glabripennis* (ALHB). The lack of exhaustive national insect surveys means that the delay between introduction and first detection of a pest can often be 10 years or more. Historical interception records are used to predict the likelihood of finding undetected alien forest pests in Canada. This point is illustrated by the case of *Trichoferus campestris*, an Asian-Pacific long-horned beetle (Cerambycidae) recently detected in Montreal.

Résumé

ACIA - Rapport sur les interceptions d'espèces exotiques envahissantes d'organismes nuisibles en 2008

Les insectes forestiers nuisibles continuent de s'introduire au Canada par l'intermédiaire de matériel de pépinière ou dissimulés dans des navires, des conteneurs et un large éventail de produits du bois, y compris les palettes, les caisses et le bois de calage. Nous comparons certaines des espèces actuellement interceptées avec celles que nous ont laissées les interceptions passées et avec celles qui ont été détectées, comme l'agrile du frêne (*Agrilus planipennis*) et le longicorne étoilé (*Anoplophora glabripennis*). Faute d'enquêtes nationales exhaustives sur les insectes, il s'écoule souvent 10 ans et même plus entre le moment où un organisme nuisible est introduit et celui où il est détecté pour la première fois. Les registres des interceptions passées servent à prévoir la probabilité de découvrir des ravageurs forestiers exotiques non détectés au Canada. Cet

aspect est illustré par le cas du *Trichoferus campestris*, un longicorne de l'Asie et du Pacifique (Cérambycidés) détecté récemment à Montréal.

SESSION 12: RISK MANAGEMENT PROCESS

SÉANCE 12 : PROCESSUS DE GESTION DU RISQUE

A Decision Support System for the Eradication and Containment of Pest Outbreaks in Europe: The PRATIQUE Project

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Abstract

The purpose of PRATIQUE is to address the major challenges for pest risk analysis (PRA) in (a) predicting the entry and establishment of new plant pests, diseases and invasive alien species in the EU, (b) estimating potential economic, environmental and social impacts and (c) preventing eradicating, containing and controlling invasions. This will be achieved through improvements to the functionality and user-friendliness of the current EPPO-PRA decision support scheme and a new decision support scheme to combat pest outbreaks. In the EU, some directives describe measures to be taken following outbreaks of a few well known quarantine pests, but there is no generic decision support scheme to help guide eradication or containment actions for all quarantine pests. To develop the first EU decision support scheme to guide actions at outbreaks, PRATIQUE will identify best practice by reviewing plant health contingency plans and conduct a meta-analysis of the successes and failures of eradication and containment campaigns worldwide. Particular emphasis will be given to the provision of guidance for assessing the costs and benefits of measures that can be taken to eradicate or contain pests at three key stages: when developing contingency plans, when a new outbreak has been discovered and when deciding whether to continue an official control campaign. Pest surveying techniques and detection methods play a key role in identifying potential pests, new arrivals, first outbreaks and, once an outbreak has been detected, in defining its limits. This project will review pest surveying techniques worldwide and prepare a guidance document describing best practice for detecting new incursions and surveying pest outbreaks.

Résumé

Le projet PRATIQUE, un système d'aide à la décision pour l'éradication et la contention des pullulations des nouveaux ravageurs arrivant en Europe

L'objectif de PRATIQUE est d'aborder les principaux défis rencontrés dans de domaine de l'analyse de risques phytosanitaires (PRA), c à d. (a) prédire l'arrivée et l'établissement de nouveaux ravageurs, maladies des plantes et autres espèces exotiques envahissantes dans l'Union Européenne, (b) estimer leurs impacts potentiels aux niveaux économiques, environnementaux et sociaux et (c) prévenir, éradiquer, contenir et contrôler ces invasions selon les cas. Pour cela, nous visons à améliorer la fonctionnalité comme la facilité d'utilisation du schéma d'aide à la décision actuellement utilisé dans le PRA de l'OEPP ainsi qu'à développer un nouveau schéma d'aide à la décision pour lutter contre les irruptions de nouveaux ravageurs. Dans l'UE, certaines directives décrivent les mesures à prendre lors d'irruptions de quelques organismes de quarantaine bien connus, mais il n'y a pas de schéma d'aide à la décision générique valable pour n'importe quel organisme de quarantaine. Pour développer le premier schéma d'aide à la décision européen pour lutter contre les irruptions de ravageurs, PRATIQUE va passer en revue et évaluer les plans d'urgence utilisés dans le domaine de la santé des végétaux et effectuer une méta-analyse des succès et échecs des actions d'éradication et de contention menées dans le monde. Une attention particulière sera portée à la définition de critères d'évaluation des coûts et bénéfices des mesures pouvant être prises pour éradiquer ou contenir un ravageur, ceci à trois stades bien précis : quand un plan d'urgence est développé, quand une nouvelle irruption est identifiée et lors de la décision de poursuivre ou non une campagne officielle de lutte. Les méthodes de prospection et de détection jouent un rôle clef dans l'identification de ravageurs potentiels, de nouvelles introductions, de premières irruptions et, une fois une irruption détectée, dans la définition de ses limites. Ce projet va passer en revue les techniques de surveillance de ravageurs dans le monde et préparer un document- guide décrivant les meilleures méthodes pour détecter les nouvelles introductions et irruptions.

Safeguarding American Agriculture and the Environment: Pest Risk Identification, Assessment and Management

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Abstract

Plant Protection and Quarantine (PPQ) is responsible for pest risk identification, assessment, and management functions that support safeguarding activities authorized by the Plant Protection Act that are carried out by several PPQ programs. The Center for Plant Health Science and Technology (CPHST) is responsible for developing pest risk analyses that support regulatory decision-making and operational activities. The New Pest Advisory Group (NPAG), CPHST, organizes panels of federal, state, and university experts to assess the risk associated with exotic plant pests that are new or imminent threats to plant health. Detection of a new exotic plant pest in the United States, or identification of a pathway for a new pest's introduction initiates the NPAG process to develop response recommendations. The Response and Recovery Systems Technology (RRST) Program, CPHST, provides scientific support to PPQ managers and decision-makers by developing management plans for the application of specific technologies in operational programs. Emergency and Domestic Programs (EDP) establish programs to eradicate, suppress, or contain new plant pest introductions in cooperation with state departments of agriculture and other government agencies. Pest surveillance is an ongoing activity. The Cooperative Agricultural Pest Survey is conducted in cooperation with state departments of agriculture and universities. Plant Health Programs (PHP) are responsible for developing import regulatory policy to exclude quarantine pests that are not present in the United States, or if present, not widely distributed. CPHST develops pathway risk analyses in accordance with “Guidelines for Pathway-initiated Pest Risk Assessments, Version 5.02, October 17, 2000”, to provide scientific justification for the establishment of import requirements. PHP develops risk management strategies and import operational policy in consultation with other PPQ programs and government officials in exporting countries in order to facilitate safe trade.

Résumé

Protéger l'agriculture et l'environnement des États-Unis : la détermination, l'évaluation et la gestion des risques phytosanitaires

Plant Protection and Quarantine (PPQ) est responsable des fonctions de détermination, d'évaluation et de gestion des risques phytosanitaires à l'appui des activités de protection autorisées par la *Plant Protection Act* qu'exercent plusieurs programmes du PPQ. Le Center for Plant Health Science and Technology (CPHST) est chargé d'élaborer des analyses des risques phytosanitaires qui soutiennent la prise de décisions réglementaires et les activités opérationnelles. Le New Pest Advisory Group (NPAG) du CPHST met sur pied des comités d'experts du gouvernement fédéral, de l'État et des universités pour évaluer le risque associé aux phytoravageurs exotiques constituant de nouvelles menaces pour la protection des végétaux. À la suite de la découverte d'un nouveau phytoravageur exotique aux États-Unis ou de l'identification d'une voie permettant l'introduction de nouveaux ravageurs, le NPAG amorce l'élaboration de recommandations au chapitre de l'intervention. Le Response and Recovery Systems Technology (RRST) Program du CPHST fournit un soutien scientifique aux gestionnaires et aux décideurs du PPQ en élaborant des plans de gestion en vue de l'application de technologies précises dans les programmes opérationnels. Les Emergency and Domestic Programs (EDP) sont chargés d'établir des programmes pour éradiquer ou contenir les nouvelles introductions de phytoravageurs en collaboration avec les départements d'État de l'agriculture et d'autres organismes gouvernementaux. La surveillance des ravageurs s'avère une activité permanente. Le Cooperative Agricultural Pest Survey est réalisé en collaboration avec les départements d'État de l'agriculture et certaines universités. Les Plant Health Programs (PHP) sont responsables de l'élaboration de la politique de réglementation de l'importation afin de tenir à l'écart les ravageurs justiciables de quarantaine absents aux États-Unis ou dont la présence n'est pas largement répandue. Le CPHST élabore des analyses des risques associés aux voies conformément au document intitulé « Guidelines for Pathway-initiated Pest Risk Assessments, Version 5.02, October 17, 2000 », en vue de justifier, sur le plan scientifique, l'établissement d'exigences à l'importation. Les PHP élaborent des stratégies de gestion des risques ainsi qu'une politique opérationnelle en matière d'importation en consultation avec d'autres programmes du PPQ ainsi que les responsables du gouvernement des pays exportateurs, afin d'assurer un commerce sécuritaire.

Response Cases of Failed Eradication of Invasive Plants and Plant Pests

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Abstract

Eradication is one of the many strategies the Canadian Food Inspection Agency (CFIA) uses in order to control invasive plants and plant pests. However, this method is not always successful, nor cost/benefit efficient. In such cases, the CFIA must re-evaluate the case and adopt a new strategy or abandon the control effort. In order to make better use of the CFIA's budget and ensure the protection of natural resources, a consistent and transparent re-evaluation policy is necessary. This presentation evaluates the response of three different industrialized countries' governments when faced with cases of unsuccessful eradication. These cases are: Citrus Canker in the United-States, Dutch Elm Disease in New Zealand and Skeleton Weed in Australia. By drawing parallels and differences between each case, general themes to be considered in an eventual standard Canadian re-evaluation policy are outlined.

Résumé

Études de cas de politiques d'éradications d'espèces envahissantes ratées

L'éradication est une des stratégies qu'emploie l'Agence canadienne d'inspection des aliments (ACIA) afin de contrôler les espèces envahissantes, notamment les plantes et les parasites de plantes. Par contre, cette méthode n'est pas toujours réussie et peut représenter des coûts économiques importants. Dans de tels cas, l'ACIA doit réévaluer la situation et utiliser une nouvelle stratégie de gestion ou simplement abandonner l'effort de gestion. Afin d'assurer une protection optimale des ressources naturelles, il est nécessaire d'établir une politique de réévaluation d'éradications ratées. Cette présentation porte sur la stratégie de réévaluation de l'éradication ratée d'espèces envahissantes de trois pays industrialisés. Les études de cas sont : le chancre citrique aux États-Unis, la maladie hollandaise de l'orme en Nouvelle-Zélande et la

chondrille à tige de jonc en Australie. En comparant les points communs et distincts des divers cas, des points importants à considérer dans l'établissement d'une politique canadienne éventuelle sont soulignés.

The Risk Management Process for Invasive Alien Forest Pests at the CFIA

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Abstract

The Canadian Food Inspection Agency (CFIA) is committed to prevent the introduction and spread within Canada of plant pests of quarantine significance and to detect and control or eradicate designated plant pests in Canada. Risk management decisions at the CFIA are guided by the international obligations that Canada must adhere to as a signatory to the International Plant Protection Convention (IPPC) and as a member country of the World Trade Organization.

This presentation will describe CFIA's risk management process for dealing with incursions of invasive alien forest pests. It will demonstrate how the CFIA applies the basic and operational principles of the International Standards for Phytosanitary Measures of the IPPC related to plant protection and pest risk analysis. The presenters will explain the type of information and the considerations that are taken into account when making a risk management decision. They will also elaborate on the factors that could potentially trigger a re-evaluation of one or more selected risk management option(s) or phytosanitary measures. Examples of quarantine forest pests that have become established in Canada will be used to illustrate various strategies used for managing risk.

Résumé

Processus de gestion du risque d’invasion de ravageurs forestiers exotiques de l’Agence canadienne d’inspection des aliments

L’Agence canadienne d’inspection des aliments (ACIA) s’engage à prévenir l’introduction et la propagation de ravageurs forestiers justiciables de quarantaine au Canada ainsi qu’à détecter ceux qui se trouvent au pays. Elle s’engage également à lutter contre ces ravageurs ou à les éradiquer lorsque leur présence est détectée au Canada. Les décisions en matière de gestion du risque prises par l’ACIA sont déterminées par les obligations internationales auxquelles le Canada doit se conformer en tant que signataire de la Convention internationale pour la protection des végétaux (CIPV) et membre de l’Organisation mondiale du commerce (OMC).

Cette présentation vise à expliquer le processus de gestion du risque qu’adopte l’ACIA pour lutter contre les invasions de ravageurs forestiers. Il sera question de la façon dont l’ACIA applique les principes opérationnels de base liés aux Normes internationales pour les mesures phytosanitaires de la CIPV en ce qui a trait à la protection des végétaux et à l’analyse du risque d’invasion de ravageurs. Les présentateurs expliqueront le type de données et les facteurs dont il faut tenir compte lorsque l’on prend une décision concernant la gestion du risque. Ils donneront également de plus amples détails sur les facteurs qui pourraient rendre nécessaire la réévaluation d’au moins une des options de gestion du risque ou des mesures phytosanitaires sélectionnées. Les présentateurs se serviront de cas de lutte contre des ravageurs forestiers établis au Canada pour illustrer diverses stratégies de gestion du risque.

SESSION 13: CANADIAN FOOD INSPECTION AGENCY UPDATES

SÉANCE 13 : MISES À JOUR DE L’AGENCE CANADIENNE D’INSPECTION DES ALIMENTS

Hemlock Woolly Adelgid: A Pest of Quarantine Concern

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Abstract

In 2008, the Canadian Food Inspection Agency implemented the policy directive D-07-05, which describes the import and domestic movement requirements for all hemlock (*Tsuga* spp.), Yeddo spruce (*Picea jezoensis*), and Tiger-tail spruce (*Picea polita*) plants for planting, plant parts, and wood products with bark from areas of Canada and the United States (US) infested with the hemlock woolly adelgid (HWA), *Adelges tsugae* Annand, to prevent its introduction into non-infested areas of Canada. Some justifications for regulating and a brief overview of this new policy directive will be presented.

Résumé

Le puceron lanigère de la pruche : un organisme nuisible justiciable de quarantaine

En 2008, l'Agence canadienne d'inspection des aliments a mis en œuvre la directive D-07-05, qui énonce les exigences phytosanitaires régissant l'importation et le transport en territoire canadien de végétaux destinés à la plantation, de parties de végétaux et de produits de bois avec écorce de pruche (*Tsuga* spp.), d'épinette de Hondo (*Picea jezoensis*) et d'épinette du Japon (*Picea polita*) provenant de régions du Canada et des États-Unis infestées par le puceron lanigère de la pruche (*Adelges tsugae* Annand). Ces exigences visent à prévenir l'introduction du ravageur dans les régions non infestées du Canada. Des justifications liées à la réglementation et un aperçu général de cette nouvelle directive seront présentés.

SCIENCE AND TECHNOLOGY À LA CARTE

Chair: Matt Meade
Canadian Institute of Forestry

SCIENCES ET TECHNOLOGIE À LA CARTE

Président : Matt Meade
Institut forestier du Canada

Effect of Host Tree Condition on the Fitness of the Brown Spruce Longhorn Beetle, *Tetropium fuscum* (Fabr.), in Canada

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Abstract

The brown spruce longhorn beetle (BSLB), *Tetropium fuscum* (Fabr.), a European cerambycid, was discovered in Halifax, Nova Scotia in 1999. The BSLB primarily infests weakened *Picea abies* (L.) Karst. in Europe, but has been reported to infest seemingly healthy spruce, *Picea* spp. in Canada. Preliminary research suggests that red spruce of low vigour is more susceptible to colonization by BSLB than trees of high vigour. In this study, we evaluate the effect of host tree condition on BSLB fitness and analyze stage specific mortality, including that due to natural enemies. We caged mated BSLB pairs on red spruce trees that of varying condition (healthy, girdled and recently cut) and allowed females to oviposit. One bolt per study tree will be reared in the laboratory to determine adult emergence rate and potential fecundity of females emerging from hosts of varying condition. Stage-specific mortality rates and factors will be evaluated by bolt dissection. This research will significantly improve our understanding of BSLB population ecology in Canada, and will contribute to the development of BSLB population growth models.

Résumé

Effet de l'état de l'arbre hôte sur la valeur adaptative du longicorne brun de l'épinette (*Tetropium fuscum* (Fabr.)) au Canada

Le longicorne brun de l'épinette (LBE) (*Tetropium fuscum* (Fabr.)), un cérambycidé originaire d'Europe, a été découvert en 1999 à Halifax, en Nouvelle-Écosse. En Europe, le LBE infeste principalement des sujets affaiblis de *Picea abies* (L.) Karst. tandis qu'au Canada, il a été signalé sur diverses essences d'épinette apparemment en santé. D'après des résultats de recherche préliminaires, il semble que les épinettes rouges peu vigoureuses risquent davantage d'être colonisées par le LBE que les épinettes très vigoureuses. Dans le cadre de cette étude, nous

évaluons l’effet de l’état de l’arbre hôte sur la valeur adaptative du LBE et nous analysons la mortalité propre à chaque stade, y compris celle due aux ennemis naturels. Nous avons gardé en cage des couples de LBE avec des arbres de différentes conditions (en santé, annelés et récemment abattus) et permis aux femelles de déposer leurs œufs. Un billon par arbre sera placé dans des installations d’élevage, en laboratoire, afin de déterminer le taux d’émergence des adultes et la fécondité potentielle des femelles émergeant de ces différents hôtes. La dissection des billons permettra d’évaluer la mortalité à chaque stade de développement. Cette recherche permettra de beaucoup mieux comprendre l’écologie des populations du LBE au Canada et contribuera à élaborer des modèles de l’accroissement des populations du LBE.

Clonal and Treatment Variation in *Hypoxylon* Canker Occurrence for Trembling Aspen Exposed to Elevated CO_2 and O_3

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Abstract

Hypoxylon canker, caused by the fungus *Hypoxylon mammatum*, is a major pest of trembling aspen (*Populus tremuloides* Michx.) in the lake States (Ostry et al. 1988) and across much of the Boreal forest. It has been estimated to kill 1-2% of the region's aspen annually (Schipper and Anderson 1976). Little is known about how this disease will be impacted by climate change, but it is well known that drought stress can predispose trees to this pest (Manion and Griffin 1986). For the past five years, we have been examining the occurrence and severity of *Hypoxylon* canker on aspen growing under conditions of atmospheric CO_2 and O_3 projected for the year 2050. Averaged across the four aspen clones mean, disease occurrence ranged from 3.79% to 7.54%. Elevated CO_2 decreased the occurrence of *Hypoxylon* canker by more than nearly 40%, regardless of O_3 treatment. Most likely this was due to the decreased stomatal conductance under elevated CO_2 which reduced water stress under the dry conditions of the past five years. In contrast, *Hypoxylon* canker occurrence was highest for all five aspen clones in the elevated O_3 treatment.

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Acknowledgments

This research was principally supported by the U.S. Department of Energy's Office of Biological and Environmental Research, Grant No. DE-FG02-95ER62125. Other support has come from the USDA Forest Service Northern Global Change Program, the USDA Forest Service Northern Research Station, Michigan Technological University, the McIntire-Stennis Program, and Natural Resources Canada-Canadian Forest Service.

Résumé

Variation, selon le clone et le traitement, de la fréquence du chancre hypoxylonien observée chez le peuplier faux-tremble exposé à des concentrations élevées de CO_2 et/ou d'O_3

Le champignon *Hypoxylon mammatum*, qui cause le chancre hypoxylonien, est un organisme nuisible redoutable du peuplier faux-tremble (*Populus tremuloides* Michx.) dans les États des Grands Lacs (Ostry *et al*., 1988) et dans une bonne partie de la forêt boréale. On estime qu'il tue 1 à 2 % des peupliers faux-trembles de la région chaque année (Schipper and Anderson, 1976). Les connaissances sur l'impact du changement climatique sur cette maladie sont très sommaires, mais il est bien connu que le stress causé par la sécheresse peut prédisposer les arbres à cette maladie (Manion and Griffin, 1986). Au cours des cinq dernières années, nous avons examiné la fréquence et la gravité de cette maladie chez des peupliers faux-trembles exposés à des conditions de croissance correspondant aux concentrations atmosphériques de CO_2 et de O_3 prévues pour 2050. La fréquence moyenne de cette maladie (calculée à partir de la moyenne des quatre clones de peuplier faux-tremble) variait de 3,79 à 7,54 %. Des concentrations élevées de CO_2 ont fait diminuer la fréquence du chancre hypoxylonien de près de 40 %, peu importe la concentration d'O_3 à laquelle les clones étaient exposés. Ce phénomène est probablement attribuable à une diminution de la conductance stomatique en réaction à des concentrations élevées de CO_2, qui atténuait le stress hydrique dans les conditions sèches des cinq dernières années. Par ailleurs, la fréquence du chancre hypoxylonien était à son maximum chez les cinq clones de peuplier faux-tremble exposés à des concentrations élevées d'O_3.

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Early Warning System Against Invasive Alien Fungal Species Entering Canada

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Abstract

The ISPM 15 international phytosanitary standard was developed to control pests on woody packaging material. Unfortunately it does not target live plant material of any kind shipped between trading countries. Many forest invasive alien fungal species responsible for diseases such as chestnut blight, Scleroderris canker, white pine blister rust, butternut canker and sudden oak death came to North America on live plant material. Many more will certainly arrive in the future.

In order to target this pathway of introduction that is not subjected to the ISPM 15 measure, we developed a new early warning system based on cloned fungal ribosomal DNA extracted from live plant material (leaves, stems, twigs and seeds). Annually, the objective is to process 400 randomly selected samples from major Canadian ports of entry and have their DNA extracted, PCR amplified for the ribosomal ITS region, then cloned and sequenced. Homologies with reference sequences from GenBank will provide information about the potential of foreign fungi found inside the live plant material to be invasive forest pests. The data will provide a 'radar image' of new fungal threats presently coming from abroad.

Résumé

Système d'alerte précoce contre les ravageurs fongiques invasifs arrivant au Canada

La nouvelle norme phytosanitaire ISPM 15 a été mise au point pour permettre le contrôle des ravageurs issus des matériaux d'emballage. Cependant, les ravageurs présents dans le matériel

végétal vivant ne sont pas ciblés par cette norme. Plusieurs ravageurs exotiques invasifs responsables de maladies tels que la brûlure du châtaignier, le chancre scléroderrien, la rouille vésiculeuse du pin blanc, le chancre du noyer ou l'encre du chêne rouge ont été introduits via du matériel végétal vivant. À l'avenir, d'autres maladies pourraient être introduites par l'intermédiaire du transport du matériel végétal vivant.

Pour mieux cibler ce mode d'introduction, nous avons développé un nouveau système d'alerte précoce basé sur le clonage des ADN ribosomiques fongiques extraits de tissus végétaux (feuilles, tige, rameau et graines). Notre objectif annuel est de traiter 400 échantillons provenant des ports et autres points d'entrées majeurs au Canada afin de les amplifier par PCR, les cloner et les séquencer. Par comparaison des séquences avec celles présentes dans GenBank, nous obtiendrons de l'information sur l'identité des espèces fongiques présentes dans les tissus végétaux exotiques arrivant au Canada, de même qu'une évaluation de leur potentiel à être des ravageurs invasifs. L'ensemble fournira une image radar des menaces potentielles contre nos forêts.

Risk Assessment of the Threat of Mountain Pine Beetle to the Boreal Forest

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Abstract

A risk assessment of the threat of mountain pine beetle to the boreal forest found that recent expansion of mountain pine beetle populations in northern BC and AB represent an historical range extension by this insect. There are few biological impediments to persistence and further expansion of the insect's range as pine species east of the continental divide are susceptible to the beetle and its associated fungi. However, forest structure and the likelihood of adverse weather will continue to make the boreal zone a suboptimal environment for the insect. Nonetheless, the persistent populations of mountain pine beetle in the boreal zone increases the risk of damage significantly. The current economic situation in the area at immediate risk is less reliant on wood supply than areas further west. Nonetheless, other forest values are at risk and impacts could further reduce the region's capacity to include forest products as part of a diversified economic strategy.

Résumé

Évaluation du risque lié à la menace posée par le dendroctone du pin ponderosa en forêt boréale

D'après les résultats d'une évaluation du risque liée à la menace posée par le dendroctone du pin ponderosa en forêt boréale, l'expansion récente des populations du dendroctone du pin ponderosa dans le nord de la Colombie-Britannique et en Alberta représente une extension de l'aire historique de cet insecte. Les facteurs biologiques susceptibles de faire obstacle à la persistance et à l'expansion de l'aire de l'insecte sont peu nombreux, puisque les essences de pins présentes à l'est de la ligne continentale de partage des eaux sont sensibles à ce coléoptère et aux champignons qui lui sont associés. Or, la structure de la forêt et les probabilités de conditions

climatiques défavorables continueront de faire de la zone boréale un environnement sous-optimal pour cet insecte. Cependant, les populations persistantes du dendroctone du pin ponderosa dans la zone boréale accroissent considérablement le risque de dégâts. La situation économique actuelle de la région menacée dans un proche avenir dépend moins de l’approvisionnement en bois que celle des régions situées plus à l’ouest. Cependant, d’autres valeurs de la forêt sont menacées, et les répercussions du ravageur pourraient réduire davantage la capacité de la région d’inclure les produits forestiers dans une stratégie économique diversifiée.

Gene Organization of the *Choristoneura occidentalis* Granulovirus

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Abstract

Choristoneura occidentalis granulovirus (ChocGV), a baculovirus that infects the western spruce budworm, has been fully sequenced and analyzed. To date, ChocGV is the only GV identified containing a homologue to the apoptosis inhibitor protein P35/P49. It shared the highest aa identity with SpliMNPV P49 (27.0%), followed by SpltNPV P49 (25.7%), suggesting that it may be a P49 homologue rather than P35 homologue. A P10 homologue was also found in choc48 as it followed the general P10 model with a coiled coil region, a proline rich region, and a basic carboxyl terminal. The PEP protein in ChocGV (choc18) also contained a P10-like motif present in other GVs (AdorGV, XecnGV, CrleGV). Choc48 (P10) exhibited 30.5% aa identity with FALPE of AmEPV. Two large intergenic spaces were found between choc21 and choc22 (1.018kb) and between choc22 and choc23 (1.545kb). It was thought these regions should contain ORFs as homologues to CpGV ORFs and CrleGV ORFs expected in this area were missing. Intergenic spaces greater than 1kb are found in CrleGV and XecnGV, both corresponding to approximately the same region as the intergenic spaces in ChocGV. Phylogenetically, ChocGV was most closely related to CpGV and CrleGV.

Résumé

Organisation génique du granulovirus de *Choristoneura occidentalis*

La séquence du granulovirus de *Choristoneura occidentalis* (ChocGV), un baculovirus qui infecte la tordeuse occidentale de l'épinette, a été entièrement caractérisée. Jusqu'ici, le ChocGV est le seul granulovirus connu qui possède un homologue de la protéine inhibitrice de l'apoptose P35/P49. Il a le plus grand degré d'identité d'aa avec la P49 du SpliMNPV (27,0 %), puis vient

la P49 du SpltNPV (25,7 %), ce qui permet de penser qu'il pourrait s'agir d'un homologue de la P49 plutôt que de la P35. Il y a aussi un homologue de la protéine P10 chez le choc48 : son organisation générale est proche de celle de la protéine P10, avec une région d'enroulement coiled coil, une région riche en proline et une extrémité carboxylique de base. La protéine PEP du ChocGV (choc18) renfermait aussi un motif de type P10 qui se retrouve aussi chez d'autres granulovirus (AdorGV, XecnGV, CrleGV). Le Choc48 (P10) a un degré d'identité d'aa de 30,5 % avec la protéine FALPE du virus AmEPV. Deux grands espaces intergéniques ont été mis en évidence entre les choc21 et choc22 (1,018kb) et entre les choc22 et choc23 (1,545kb). On pense que ces régions renferment des cadres de lecture ouverts (ORF), car les homologues ORF du CpGV et du CrleGV, qu'on s'attendrait à y trouver, font défaut. Il y a des espaces intergéniques de plus de 1kb chez les virus CrleGV et XecnGV; dans les deux cas, ils correspondent approximativement à la même région que les espaces intergéniques du ChocGV. Au point de vue phylogénétique, le ChocGV est plus proche du CpGV et du CrleGV.

Forest Development Following Mountain Pine Beetle Outbreaks in British Columbia

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Abstract

As a natural agent of disturbance, beetle outbreaks play an important functional role in directing ecological processes and maintaining biological diversity of forest ecosystems. The mountain pine beetle (*Dendroctonus ponderosae* Hopkins) is the major natural disturbance agent affecting lodgepole pine (*Pinus contorta* Dougl.) forests in British Columbia, Canada. As the current outbreak has reached close to 10 million hectares in size, forest managers need post-outbreak strategies to manage the large areas left unsalvaged. For this they need information on stand dynamics processes associated with mountain pine beetle outbreaks, such as host mortality, post-outbreak stand growth, recruitment rates, and species composition following outbreaks. We examined the dynamics of lodgepole pine in even-aged and uneven-aged stands in the central interior of British Columbia, which are currently undergoing beetle outbreaks. Using historical ecology approaches, dendrochronology, and stand inventory data, we were able to determine the roles that fire and repeated MPB disturbances have played in maintaining the ecological complexity of lodgepole pine in these ecosystems. We found that stand replacing fires initiated seral even aged lodgepole pine stands, while multiple mixed severity fires initially created patchy uneven-aged stands. Selective tree killing by repeated MPB disturbances increased the complexity of these ecosystems.

Keywords: Dendroecology, stand dynamics, forest disturbances, mountain pine beetle

Résumé

Développement de la forêt après les infestations du dendroctone du pin ponderosa en Colombie-Britannique

À titre de facteurs de perturbation naturelle, les infestations de coléoptères jouent un important rôle dans la dynamique des processus écologiques et dans le maintien de la biodiversité biologique des écosystèmes forestiers. Le dendroctone du pin ponderosa (*Dendroctonus ponderosae* Hopkins) est un agent majeur de perturbation naturelle des forêts de pins tordus (*Pinus contorta* Dougl.) de la Colombie-Britannique, au Canada. Comme l'actuelle infestation s'est étendue sur près de 10 millions d'hectares, les aménagistes doivent se doter de stratégies post-infestation de gestion des vastes étendues où des coupes de récupération n'ont pas encore été effectuées. À cette fin, ils ont besoin d'information sur les processus animant la dynamique naturelle des peuplements et associés aux infestations du dendroctone du pin ponderosa, comme la mortalité des hôtes, la croissance des peuplements après infestation, les taux de recrutement et la composition taxinomique après les infestations. Nous avons examiné la dynamique du pin tordu dans des peuplements équiennes et inéquiennes de la région intérieure centrale de la Colombie-Britannique, où sévissent actuellement des infestations du dendroctone. Nous avons utilisé des méthodes de l'écologie historique, la dendrochronologie et des données d'inventaire des peuplements pour déterminer les rôles qu'ont joué le feu et les perturbations répétées dues au dendroctone du pin ponderosa dans le maintien de la complexité écologique du pin tordu dans ces écosystèmes. Nous avons constaté que les incendies entraînant le remplacement des peuplements engendraient des peuplements équiennes non climaciques de pins tordus, alors que des incendies multiples de gravité variable créaient au départ des peuplements inéquiennes morcelés. La mortalité sélective des arbres provoquée par des perturbations répétées dues au dendroctone du pin ponderosa augmentait la complexité de ces écosystèmes.

Mots-clefs : Dendroécologie, dynamique des peuplements, perturbations des forêts, dendroctone du pin ponderosa

Spruce Bark Beetles in the Southwest Yukon
Pilot Project to Test the National Forest Pest Strategy – Risk Analysis Framework

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Abstract

Since the early 1990s the largest spruce bark beetle outbreak ever recorded in Canada has infested over 360,000 ha of white spruce forests within the Traditional Territory of Champagne and Aishihik First Nations (CAFN) in the southwest Yukon. CAFN developed a pilot project to evaluate the National Forest Pest Strategy's Risk Analysis Framework. Building on existing CAFN and Government of Yukon programs, the project increases capacity for forest-related planning and management and provides a case study of the successes and challenges in implementing the framework.

The risk analysis framework is divided into three key areas:

- risk assessment;
- risk response; and
- risk communication.

A historical review of past meetings, plans and events, and a community workshop identified fire, the economy, ecology and traditional values as key risk areas. Risk responses include reduction of fire hazard, development of economic opportunities, reduction of negative impacts on hydrology, fish and wildlife, and maintaining traditional land use. Risk communication — particularly public consultation — was an important part of the framework.

Résumé

Le dendroctone de l’épinette dans le sud-ouest du Yukon
Projet pilote de mise à l’essai du cadre d’analyse de risque de la Stratégie nationale de lutte contre les ravageurs forestiers

Depuis le début des années 1990, la plus importante infestation du dendroctone de l’épinette jamais enregistrée au Canada a balayé plus de 360 000 hectares de forêt d’épinette blanche du territoire traditionnel des Premières nations de Champagne et de Aishihik dans le sud-ouest du Yukon. Ces Premières nations (PN) ont élaboré un projet pilote pour évaluer le cadre d’analyse de risque de la Stratégie nationale de lutte contre les ravageurs forestiers. Prenant appui sur des programmes des PN et du gouvernement du Yukon, le projet renforce les capacités de planification et d’aménagement des forêts et fournit une étude de cas des succès et des défis de la mise en œuvre du cadre.

L’analyse de risque comporte trois éléments principaux :

- l’évaluation du risque,
- la réaction au risque, et
- la communication du risque.

Un examen historique des réunions, des plans et des événements antérieurs et un atelier communautaire ont permis de déterminer que le feu, l’économie, l’écologie et les valeurs traditionnelles étaient les principaux éléments à risque. Les réactions au risque comprenaient la réduction du danger d’incendie, la création de possibilités économiques, la réduction des incidences négatives sur l’hydrologie, le poisson et la faune et le maintien de l’utilisation traditionnelle du territoire. La communication du risque — notamment les consultations publiques — était un volet important du cadre.