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PROCEEDINGS OF THE
COMPTE RENDU DU

Forest Pest Management

FORUM

sur la répression des ravageurs forestiers

2012

DECEMBER 4-6
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The Forest Pest Management Forum would like to acknowledge

Nelson Carter

from the New Brunswick Department of Natural Resources (retired), for the 36 years he has contributed to the Forest Pest Management Forum and the advancement of forest pest management research in Canada

Le Forum sur la répression des ravageurs forestiers aimerait souligner l'ensemble du travail de

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du ministère des Ressources naturelles du Nouveau-Brunswick (retraité), pour les 36 années qu'il a consacré au Forum sur la répression des ravageurs forestiers et à l'avancement de la recherche sur la lutte contre les ravageurs forestiers au Canada

FOREST PEST MANAGEMENT FORUM 2012 PROCEEDINGS / COMPTE RENDU DU FORUM 2012 SUR LA RÉPRESSION DES RAVAGEURS FORESTIERS

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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 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 2012 FORUM ORGANIZING COMMITTEE

Le Forum 2012 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 au soutien technique. Nos remerciements vont également aux participants qui provenaient de différentes régions du Canada et des États-Unis.

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FOREST PEST MANAGEMENT FORUM 2012

DECEMBER 4-6, 2012
Ottawa Convention Centre
Ottawa, Ontario

TUESDAY, DECEMBER 4

08:00 **Registration**

08:20 **Welcome to the Forest Pest Management Forum**
Kami Ramcharan, Natural Resources Canada, Canadian Forest Service

Chair: *To be announced*

Session I: National Forest Pest Strategy Update

08:30 An update on the National Forest Pest Strategy projects
Vince Nealis or Kevin Porter, Natural Resources Canada, Canadian Forest Service

Session II: Eastern Pest Management Issues

08:50 Newfoundland and Labrador Report
Pierre Therrien, Ministère des Ressources naturelles et de la Faune du Québec for Newfoundland and Labrador Department of Natural Resources

09:10 Nova Scotia Report
Tanya Borgal, Nova Scotia Department of Natural Resources

09:30 New Brunswick Report
Jeremy Gullison, New Brunswick Department of Natural Resources

09:50 **Break and Poster Session**

Chair: *Lise Caron, Natural Resources Canada, Canadian Forest Service*

Session III: Spruce Budworm

10:15 Genomics tools for spruce budworm management in the genomics era
Michel Cusson, Natural Resources Canada, Canadian Forest Service

10:40 Ecology and management of rising spruce budworm outbreaks
Jacques Régnière, Natural Resources Canada, Canadian Forest Service

11:05 Decision support for eastern spruce budworm
Kevin Porter, Natural Resources Canada, Canadian Forest Service

11:30 Historical analysis – motivations, limitations, results and potential
Rich Fleming, Natural Resources Canada, Canadian Forest Service

11:55 Budworm nation
Vince Nealis, Natural Resources Canada, Canadian Forest Service

12:20 Session summary
Lise Caron, Natural Resources Canada, Canadian Forest Service

12:30 **Lunch (not provided)**

Session IV: Eastern Pest Management Issues

13:50 Quebec Report
Louis Morneau, Ministère des Ressources naturelles et de la Faune du Québec

14:10 Ontario Report
Taylor Scarr, Ontario Ministry of Natural Resources

Session V: North of 60 Reports

14:30 Northwest Territories Report
Mike Gravel, Government of the Northwest Territories, Environment and Natural Resources

14:50 Yukon Report
Rory McIntosh, Saskatchewan Ministry of Environment, Forest Service Branch, for Government of Yukon, Energy, Mines & Resources

15:10 **Break – Extended Poster Session**

Chair: *Michael Irvine, Ontario Ministry of Natural Resources*

Session VI: Pesticide Regulations, Alternatives, Minor Use

15:50 Introduction
Michael Irvine, Ontario Ministry of Natural Resources

16:00 PMRA Update
Terry Caunter, Health Canada, Pest Management Regulatory Agency

16:20 Risks of pesticide use on pollinators
Wayne Hou, Health Canada, Pest Management Regulatory Agency

16:40 Tree Azin® - A natural botanical insecticide for management of EAB and other wood boring invasive alien insect pests
Dean Thompson, Natural Resources Canada, Canadian Forest Service

17:00 Adjourned

WEDNESDAY, DECEMBER 5

08:00 **Registration**

Chair: *To be announced*

Session VII: Western Pest Management Issues

08:20 Manitoba Report
Fiona Ross, Manitoba Conservation, Forestry Branch

08:40 Saskatchewan Report
Rory McIntosh, Saskatchewan Ministry of Environment, Forest Service Branch

09:00 Alberta Report
Dan Lux, Alberta Sustainable Resource Development, Forest Division

09:20 British Columbia Report
Jennifer Burleigh, British Columbia Ministry of Forests, Lands and Natural Resource Operations

Session VIII: United States Report

09:40 Overview of forest pest conditions in the U.S.A.
Robert Rabaglia, United States Department of Agriculture, Forest Health Protection

10:10 **Break and Poster Session**

Chair: *Tod Ramsfield, Natural Resources Canada, Canadian Forest Service*

Session IX: Pest Management Challenges in a Changing World

10:30 Development of an integrated approach to forecast migration by eastern spruce budworm
Marc Rhainds, Natural Resources Canada, Canadian Forest Service

10:50 Spruce budworm parasitism by *Tranosema rostrale*: what influences its efficiency?
Lukas Seehausen, University of Toronto, Faculty of Forestry

11:10 Some ecological implications of emerald ash borer-induced loss of ash in riparian forests
David Kreutzweiser, Natural Resources Canada, Canadian Forest Service

11:30 All are not equal: differential responses to environmental challenges by bark beetles
Mark Reid, University of Calgary, Department of Biological Sciences

11:50 Early detection of emerging diseases on urban trees using next generation DNA sequencing
Jean Bérubé, Natural Resources Canada, Canadian Forest Service

12:10 Longevity of *Heterobasidion occidentale* in untreated western hemlock lumber
Brenda Callan, Natural Resources Canada, Canadian Forest Service

12:30 **Lunch (not provided)**

Chair: *Bill Wilson, Natural Resources Canada, Canadian Forest Service*

Session X: Mountain Pine Beetle

Introduction

13:50 MPB invasive spread into the northern and boreal plains regions – are we doing enough?
Barry Cooke, Natural Resources Canada, Canadian Forest Service

Plenary session of invited speakers

14:00 Host defense and susceptibility in the expanding range of mountain pine beetle
Allan Carroll, University of British Columbia

14:20 Advances in modeling mountain pine beetle climatic suitability across its expanding range
Jacques Régnière, Natural Resources Canada, Canadian Forest Service

14:40 Managing invasive spread through Alberta and beyond using a collaborative approach
Dan Lux, Alberta Sustainable Resource Development

15:00 **Break – Extended Poster Session**

15:30 Mountain pine beetle invasive detection and control optimization modeling in sparse mixedwood landscapes
Barry Cooke, Natural Resources Canada, Canadian Forest Service

Open Discussion

16:00 MPB invasive spread – are we doing enough?
[***Questions and discussion from the audience at large***]

Session Summary

16:50 Gaps in knowledge, knowledge synthesis, and operations
Barry Cooke, Natural Resources Canada, Canadian Forest Service

17:00 Adjourned

THURSDAY, DECEMBER 6

CFIA's Asian Gypsy Moth Summit

08:00 **Registration**

Chair: *Mireille Marcotte, Canadian Food Inspection Agency*

08:20 Introduction
Mireille Marcotte, Canadian Food Inspection Agency

Session I: Information Session

08:30 Asian gypsy moth science/risk assessment
Lesley Cree, Canadian Food Inspection Agency

09:05 Update on current situation of Asian gypsy moth
Lee Humble, Natural Resources Canada, Canadian Forest Service
Jamie Richardson, Canadian Food Inspection Agency

09:30 Asian gypsy moth regulatory policy/program
Gregg Cunningham and Diana Mooij, Canadian Food Inspection Agency

10:00 **Break**

10:20 Shipping industry perspective
Bonnie Gee, The Chamber of Shipping of British Columbia

10:40 Asian gypsy moth: A forest industry what-if?
Brian Zak, The Canada Wood Group

11:00 Provincial perspective
Jennifer Burleigh, British Columbia Ministry of Forests, Lands and Natural Resource Operations

11:20 Environmental perspective
The Nature Conservancy of Canada / Sierra Club Canada (to be confirmed)

11:40 Importer/Exporter Associations perspective
(Presenter to be announced)

12:00 **Forest Pest Management Forum is adjourned**

CFIA Facilitated Session

Chair: *Cameron Duff, Canadian Food Inspection Agency*

Session II: Asian gypsy moth

13:00 Stakeholder Panel Discussion
(Panel participants to be announced)

Discussion on possible approaches

13:00 Facilitated discussion on possible approaches to the Asian Gypsy Moth problem
Does everyone understand the problem and possible approaches?
Partners' perspectives on each approach:
- What works?
- what are the barriers?
- How can we address the barriers and work together?
- Are there additional alternatives not captured?

14:20 **Break**

14:40 Facilitated discussions (continued)

16:20 Wrap up and next steps

16:40 Adjourn

FORUM 2012 SUR LA RÉPRESSION DES RAVAGEURS FORESTIERS

4-6 DÉCEMBRE 2012
Centre des congrès d'Ottawa
Ottawa, Ontario

MARDI 4 DÉCEMBRE

8 h 00 **Inscription**

8 h 20 Mot de bienvenue au Forum sur la répression des ravageurs forestiers
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 30 Le point sur les projets de la Stratégie nationale de lutte contre les ravageurs forestiers
Vince Nealis ou Kevin Porter, Ressources naturelles Canada, Service canadien des forêts

Séance II : La répression des ravageurs dans l'Est

8 h 50 Rapport de Terre-Neuve et du Labrador
Pierre Therrien, Ministère des Ressources naturelles et de la Faune du Québec pour Newfoundland and Labrador Department of Natural Resources

9 h 10 Rapport de la Nouvelle-Écosse
Tanya Borgal, Nova Scotia Department of Natural Resources

9 h 30 Rapport du Nouveau-Brunswick
Jeremy Gullison, Ministère des Ressources naturelles du Nouveau-Brunswick

9 h 50 **Pause et séance d'affiches**

Présidente : *Lise Caron, Ressources naturelles Canada, Service canadien des forêts*

Séance III : La tordeuse des bourgeons de l'épinette

10 h 15 Gestion des populations de TBE à l'ère de la génomique
Michel Cusson, Ressources naturelles Canada, Service canadien des forêts

10 h 40 Écologie et gestion des infestations de tordeuses des bourgeons de l'épinette
Jacques Régnière, Ressources naturelles Canada, Service canadien des forêts

11 h 05 Outil d'aide à la décision concernant la tordeuse des bourgeons de l'épinette
Kevin Porter, Ressources naturelles Canada, Service canadien des forêts

11 h 30 Analyse historique – motivations, restrictions, résultats et possibilités
Rich Fleming, Ressources naturelles Canada, Service canadien des forêts

11 h 55 Au pays de la tordeuse
Vince Nealis, Ressources naturelles Canada, Service canadien des forêts

12 h 20 Résumé de la séance
Lise Caron, Ressources naturelles Canada, Service canadien des forêts

12 h 30 **Dîner (le repas n'est pas fourni)**

Séance IV : La répression des ravageurs dans l'Est

13 h 50 Rapport du Québec
Louis Morneau, Ministère des Ressources naturelles et de la Faune du Québec

14 h 10 Rapport de l'Ontario
Taylor Scarr, Ministère des Richesses naturelles de l'Ontario

Séance V : Au nord du 60e parallèle

14 h 30 Rapport des Territoires du Nord-Ouest
Mike Gravel, Government of the Northwest Territories, Environment and Natural Resources

14 h 50 Rapport du Yukon
Rory McIntosh, Saskatchewan Ministry of Environment, Forest Service Branch, pour Government of Yukon, Energy, Mines & Resources

15 h 10 **Pause et séance d'affiches**

Président : *Michael Irvine, Ministère des Richesses naturelles de l'Ontario*

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

15 h 50 Introduction
Michael Irvine, Ministère des Richesses naturelles de l'Ontario

16 h 00 Mise à jour de l'ARLA
Terry Caunter, Santé Canada, Agence de réglementation de la lutte antiparasitaire

16 h 20 Risques associés à l'utilisation des pesticides sur les pollinisateurs
Wayne Hou, Santé Canada, Agence de réglementation de la lutte antiparasitaire

16 h 40 TreeAzin® - Un insecticide botanique naturel pour la gestion de l'agrile du frêne et d'autres insectes nuisibles exotiques envahissants perceurs du bois
Dean Thompson, Ressources naturelles Canada, Service canadien des forêts

17 h 00 Ajournement des travaux

MERCREDI 5 DÉCEMBRE

8 h 00 **Inscription**

Séance VII : La répression des ravageurs dans l'Ouest

8 h 20 Rapport du Manitoba
Fiona Ross, Manitoba Conservation, Forestry Branch

8 h 40 Rapport de la Saskatchewan
Rory McIntosh, Saskatchewan Ministry of Environment, Forest Service Branch

9 h 00 Rapport de l'Alberta
Dan Lux, Alberta Sustainable Resource Development, Forest Division

9 h 20 Rapport de la Colombie-Britannique
Jennifer Burleigh, Bristish Columbia Ministry of Forests, Lands and Natural Resource Operations

Séance VIII : Rapport des États-Unis

9 h 40 Survol des insectes et des maladies des arbres aux États-Unis
Robert Rabaglia, United States Department of Agriculture, Forest Health Protection

10 h 10 **Pause et séance d'affiches**

Président : *Tod Ramsfield, Ressources naturelles Canada, Service canadien des forêts*

Séance IX : Les défis de la lutte contre les ravageurs dans un monde en changement

10 h 30 Élaboration d'une approche intégrée pour prévoir la migration de la tordeuse des bourgeons de l'épinette
Marc Rhainds, Ressources naturelles Canada, Service canadien des forêts

10 h 50 Parasitisme de la tordeuse des bourgeons de l'épinette par la guêpe *Tranosema rostrale* : qu'est-ce qui influence son efficacité?
Lukas Seehausen, University of Toronto, Faculty of Forestry

11 h 10 Quelques conséquences écologiques de la perte de frênes dans les forêts riveraines provoquée par l'agrile du frêne
David Kreutzweiser, Ressources naturelles Canada, Service canadien des forêts

11 h 30 Ils ne sont pas tous égaux : différentes réactions des scolytes aux défis environnementaux
Mary Reid, University of Calgary, Department of Biological Sciences

11 h 50 Détection précoce des maladies émergentes sur les arbres urbains à l'aide du séquençage d'ADN de la prochaine génération
Jean Bérubé, Ressources naturelles Canada, Service canadien des forêts

12 h 10 Longévité de l'*Heterobasidion occidentale* dans le bois de pruche de l'Ouest non traité
Brenda Callan, Ressources naturelles Canada, Service canadien des forêts

12 h 30 **Dîner (le repas n'est pas fourni)**

Président : *Bill Wilson, Ressources naturelles Canada, Service canadien des forêts*

Séance X : Le dendroctone du pin ponderosa

Introduction

13 h 50 Envahissement des plaines nordiques et boréales par le dendroctone du pin ponderosa. En faisons-nous suffisamment?
Barry Cooke, Ressources naturelles Canada, Service canadien des forêts

Session plénière avec les conférenciers

14 h 00 Défense et réceptivité de l'hôte dans l'aire de distribution en expansion du dendroctone du pin ponderosa
Allan Carroll, University of British Columbia

14 h 20 Progrès dans la modélisation des conditions climatiques favorables au dendroctone du pin ponderosa dans son aire de distribution en expansion
Jacques Régnière, Ressources naturelles Canada, Service canadien des forêts

14 h 40 Gestion de l'expansion de l'infestation à travers l'Alberta et au-delà par l'utilisation d'une approche coopérative
Dan Lux, Alberta Sustainable Resource Development

15 h 00 **Séance prolongée de présentation d'affiches**

15 h 30 Modélisation de l'optimisation du contrôle et de la détection de l'envahissement des paysages mixtes clairsemés par le dendroctone du pin ponderosa
Barry Cooke, Ressources naturelles Canada, Service canadien des forêts

Discussion libre

16 h 00 Envahissement par le dendroctone du pin ponderosa. En faisons-nous suffisamment?
[*questions et discussion de l'auditoire*]

Résumé de la séance

16 h 50 Lacunes dans les connaissances, synthèse des connaissances et opérations
Barry Cooke, Ressources naturelles Canada, Service canadien des forêts

17 h 00 Ajournement des travaux

JEUDI 6 DÉCEMBRE

Sommet sur la spongieuse asiatique de l'ACIA

8 h 00 **Inscription**

Présidente : *Mireille Marcotte, Agence canadienne d'inspection des aliments*

8 h 20 Introduction
Mireille Marcotte, Agence canadienne d'inspection des aliments

Séance I : Séance d'information

8 h 30 Évaluation scientifique des risques causés par la spongieuse asiatique
Lesley Cree, Agence canadienne d'inspection des aliments

9 h 05 Le point sur la situation actuelle concernant la spongieuse asiatique
Lee Humble, Ressources naturelles Canada, Service canadien des forêts
Jamie Richardson, Agence canadienne d'inspection des aliments

9 h 30 Politique et programme de réglementation concernant la spongieuse asiatique
Gregg Cunningham et Diana Mooij, Agence canadienne d'inspection des aliments

10 h 00 **Pause**

10 h 20 Point de vue de l'industrie du transport
Bonnie Gee, The Chamber of Shipping of British Columbia

10 h 40 La spongieuse asiatique : un questionnement pour l'industrie forestière!
Brian Zak, The Canada Wood Group

11 h 00 Point de vue provincial
Jennifer Burleigh, British Columbia Ministry of Forests, Lands and Natural Resource Operations

11 h 20 Point de vue environnemental
The Nature Conservancy of Canada / Sierra Club Canada (à confirmer)

11 h 40 Point de vue des associations d'importateurs et d'exportateurs
(Conférencier à confirmer)

12 h00 **Le Forum sur la répression des ravageurs forestiers est ajourné**

Session facilitée de l'ACIA

Présidente : *Cameron Duff, Agence canadienne d'inspection des aliments*

Séance II : La spongieuse asiatique

13 h 00 Débat d'experts
(Les participants seront bientôt annoncés)

Discussion sur des approches possibles

13 h 30 Discussions facilitées sur des approches possibles relativement aux problèmes causés par la spongieuse asiatique :
Est-ce que tout le monde comprend la problématique et les approches possibles?
Points de vue des partenaires au sujet de chaque approche :

- Qu'est-ce qui fonctionne?
- Qu'est-ce qui fait obstacle?
- Comment pouvons-nous surmonter les obstacles et travailler ensemble?
- Y a-t-il d'autres solutions que nous n'avons pas examinées?

14 h 20 **Pause**

14 h 40 Discussions facilitées (suite)

16 h 20 Récapitulation et prochaines étapes

16 h 40 Ajournement des travaux

SESSION I: NATIONAL FOREST PEST STRATEGY UPDATE

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

AN UPDATE ON THE NATIONAL FOREST PEST STRATEGY PROJECTS

Kim Ramcharan

Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre

ABSTRACT

The Working Group's objectives are to 1) Support effective, timely and integrated decision-making, resource prioritization and collaboration in the resolution of current and future forest pest problems and 2) Disseminate best practices to facilitate forecasting, preparedness and coordination of pest management activities in Canada. This year the group published three synthesis reports, on Forest pest monitoring in Canada, Diagnostic and taxonomic resources in Canada, and a NFPS Information System. Reports in preparation include S&T priorities of CCFM member agencies, and risk analyses for Brown Spruce Longhorn Beetle (Nova Scotia focus area) and Emerald Ash Borer (Manitoba focus area). Also in preparation is a Decision Support Framework for invasive alien species, to facilitate communication and coordination between agencies.

RÉSUMÉ

Les objectifs du groupe de travail sont de 1) Appuyer une prise de décision efficace, opportune et intégrée, la priorisation des ressources et la collaboration dans la résolution des problèmes actuels et futurs liés au ravageurs forestiers; et 2) Propager les meilleures pratiques afin de faciliter la prévision, la préparation et la coordination des activités de gestion des ravageurs au Canada. Cette année trois rapports ont étés publiés : la surveillance des ravageurs forestiers au Canada, les ressources de diagnostic et de taxonomie au Canada, et un système d'information SNLRF. Le travail en cours comprend des rapports sur les priorités en matière de S et T des membres du CCMF, et des évaluations de risque pour le Longicorne brun de l'épinette (visant la Nouvelle-Écosse), et l'Agrile du frêne (visant le Manitoba). Un cadre d'appui aux décisions pour les espèces exotiques envahissantes forestières est également en voie de préparation. Le but de ce dernier est de faciliter la communication et la collaboration entre les agences.

SESSION II: EASTERN PEST MANAGEMENT ISSUES

SÉANCE II : LA RÉPRESSION DES RAVAGEURS DANS L'EST

NEWFOUNDLAND AND LABRADOR REPORT

Dan Lavigne

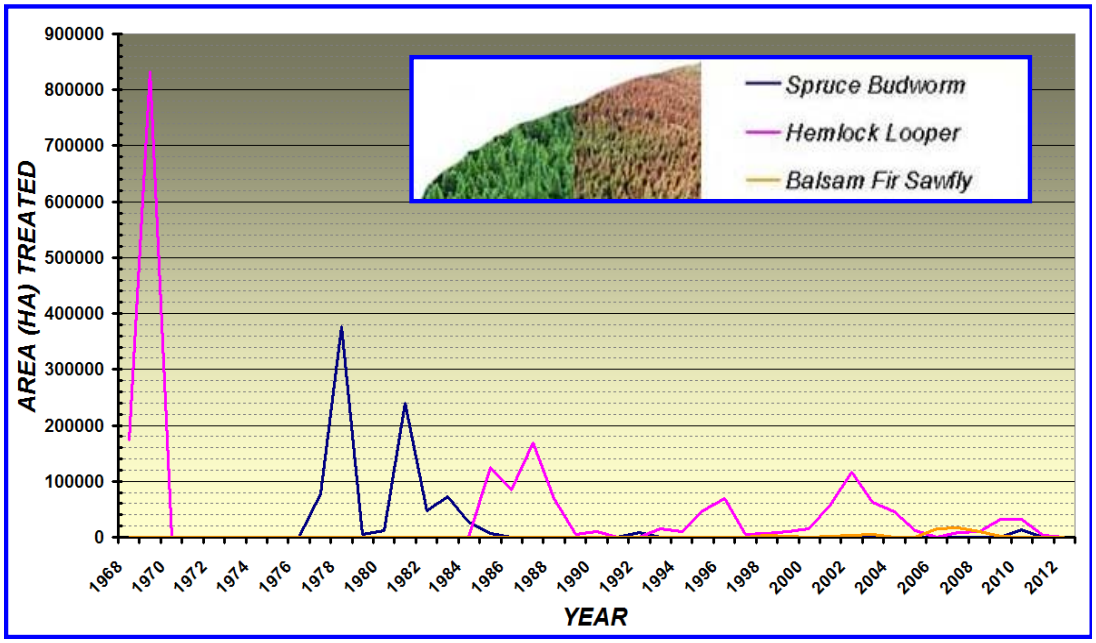
Province of Newfoundland and Labrador, Department of Natural Resource, Forestry Services Branch

A brief summary of the control and monitoring activities conducted by the Newfoundland and Labrador Department of Natural Resources for forest pests in 2012 is provided using the following outline.

1) Controls
2) Monitoring in 2012:
   a) Pheromone Trapping Results
   b) Aerial Defoliation Survey Results
   c) Fall Forecast Survey Results
   d) Special Surveys: - Scleroderris Canker (European Strain)
   - Survey in high-value stands
3) Next Steps

1) *Controls*

The following graph provides a summary of the areas treated (ha) for major forests pests in the Province.

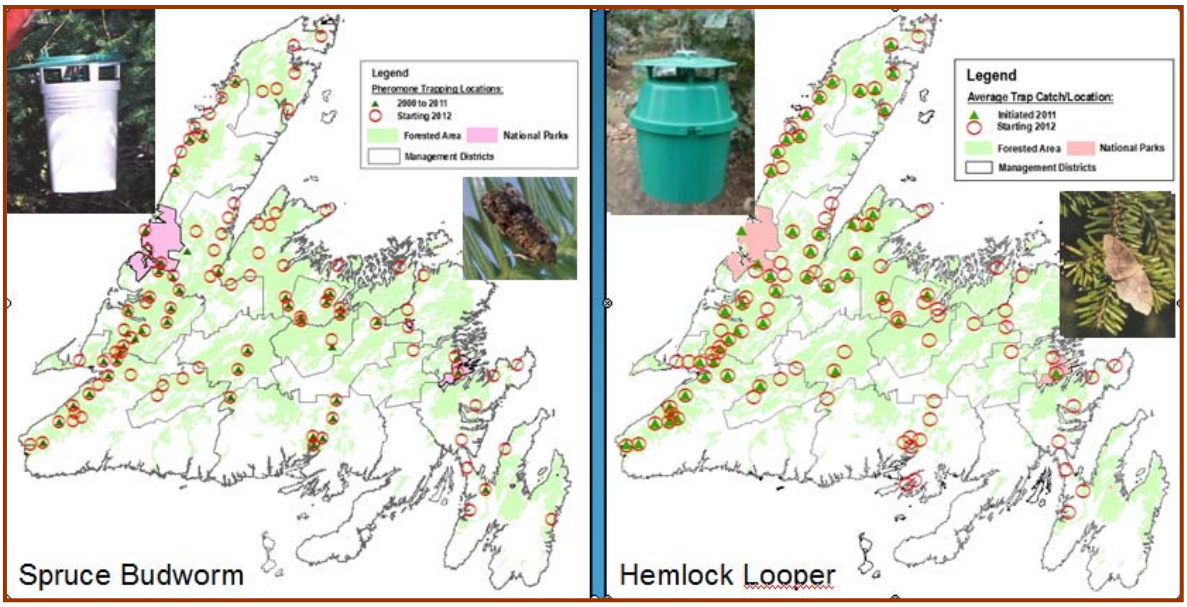


Hemlock looper has been the major forest pest with treatments conducted on the island in the late 60's and following the spruce budworm outbreak in the mid-1980s. Treatments for hemlock looper occurred for the first time in Labrador in 2007. Aerial spraying to control populations of the spruce budworm, another major pest, occurred from the late 1970s until 1986. Small areas were also treated on the island (Codroy Valley) in 1992 and in Labrador in 2010 (Mud Lake – Goose Bay area). Treatments for balsam fir sawfly were also conducted in the Province beginning in the late 1990s, with populations collapsing in 2009.

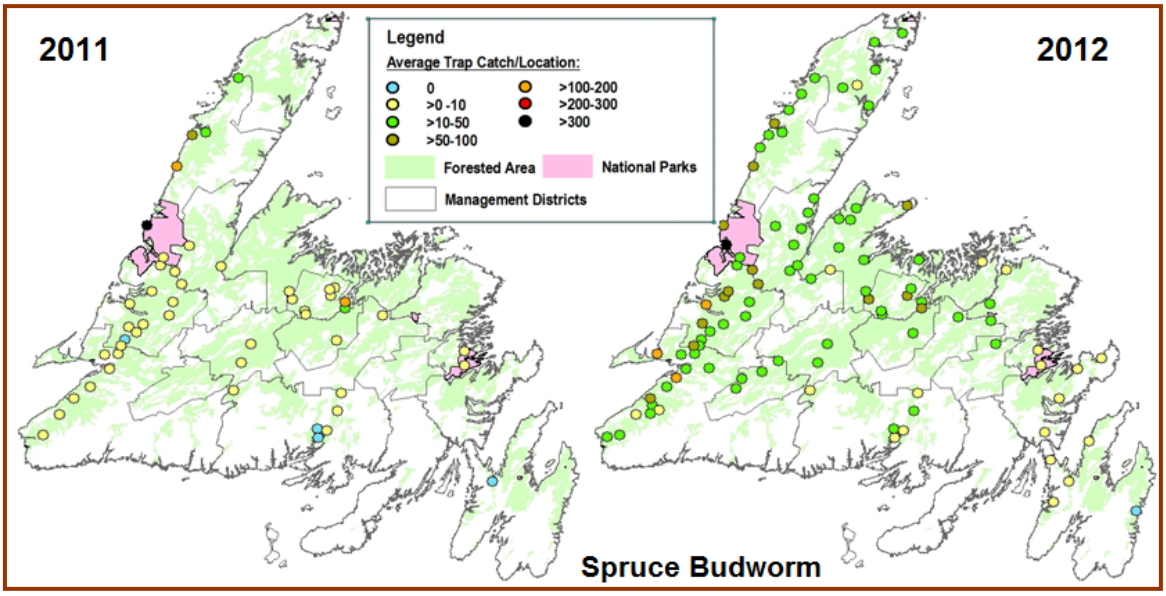
No control operations were conducted in 2012 – this is just the second time in the last 35 years that a control program has not been conducted in the province.

2. *Monitoring Surveys*

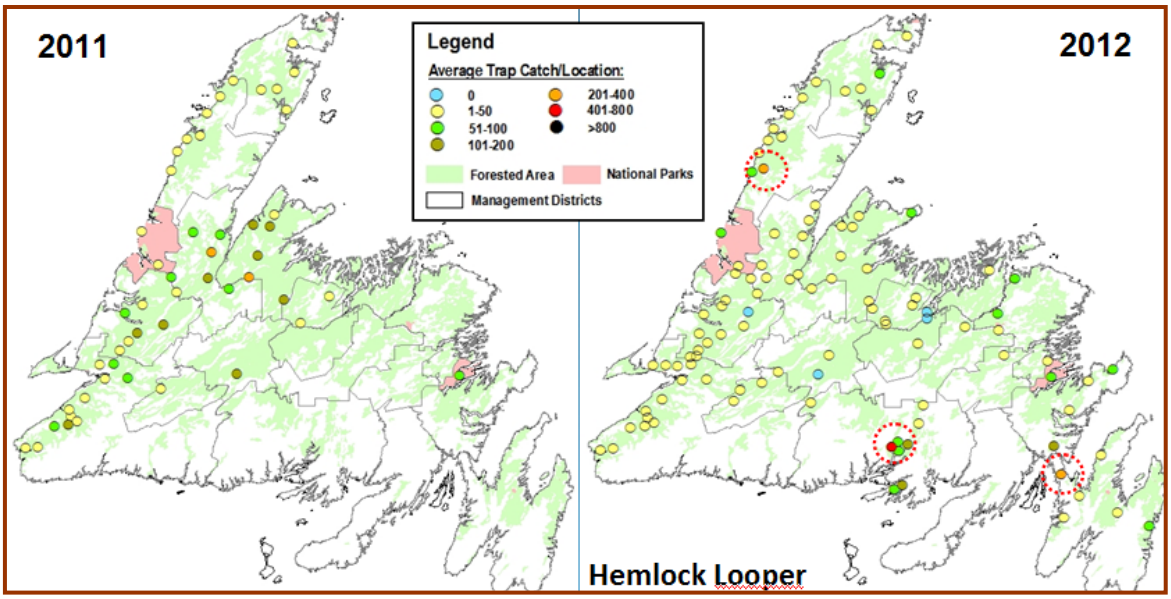
a) Pheromone Trapping Results – The network of traps used to monitor low density populations of spruce budworm and hemlock looper was increased from 50 to 100 locations on the island in 2012. At each location two non-saturating traps were placed. In Labrador, seven spruce budworm and seven hemlock looper trapping locations were established within areas where populations of these pests have been active.



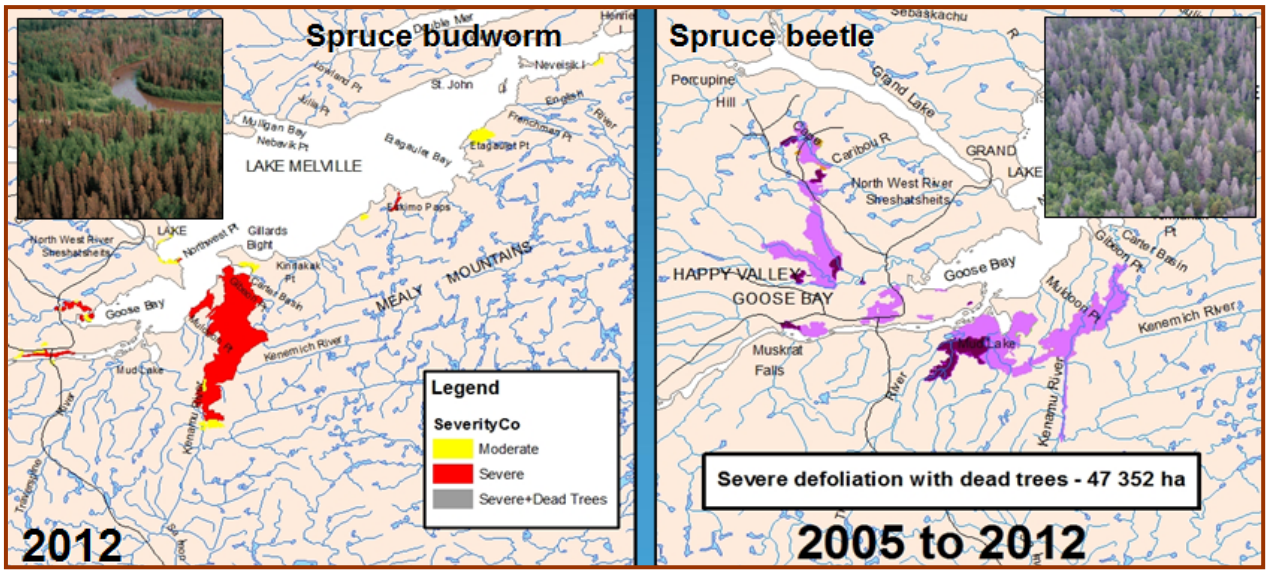
The average numbers of moths caught per trap at each location were placed into arbitrary classes. For spruce budworm an increase of one to two classes was noted in trap catches in western and central portions of the island with the average number of moths per trap increasing from 19.6 to 34.6 moths. In Labrador, trap catches in areas with active spruce budworm populations ranged from an average of 408 to 867 moths per trap.



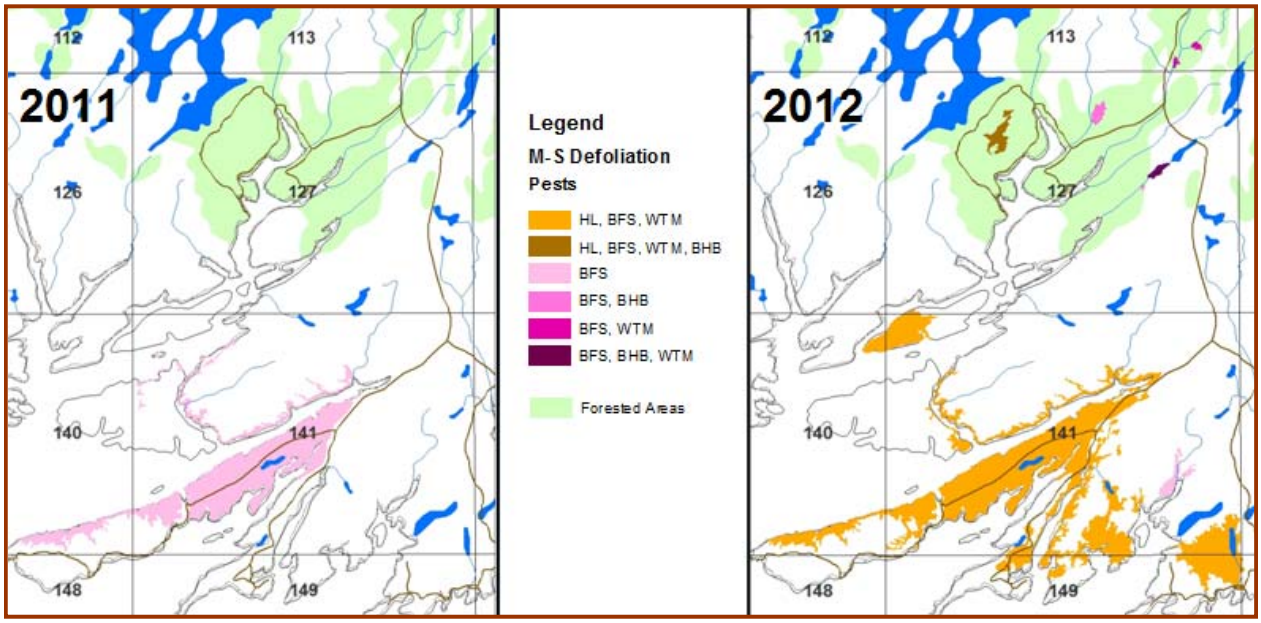
For hemlock looper, a general decrease in the average number of moths per trap was noted at most locations. Exceptions included the Zinc Mine Road area on the Northern Peninsula (318 moths/trap); the St. Albans area on the south coast (491 moths/trap); and the Little Harbour area on the isthmus of the Avalon Peninsula (260 moths/trap). Despite the handful of locations with higher trap catches, there was an overall decrease in the average number of moths per trap on the island with 60.4 moths/trap in 2011 and 37.6 moths/trap in 2012. In Labrador, the average number of moths/trap at locations assessed ranged from 1 to 8 moths.



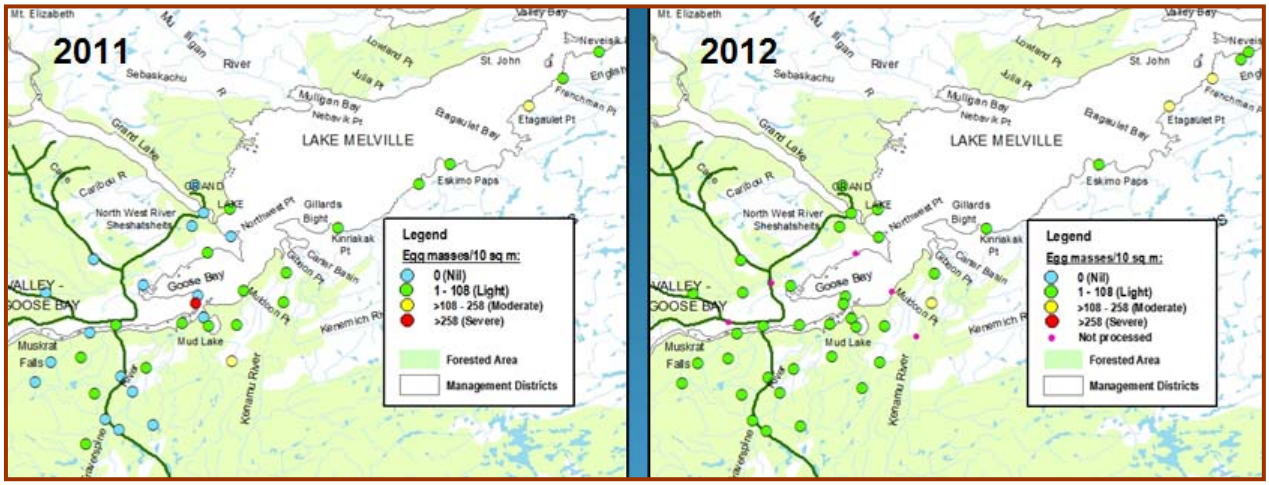
b) Aerial defoliation survey results – Spruce budworm populations were expected to decline in Labrador in 2012, however, they rebounded again especially around the Kenamu River area. A total of 33,255 ha of moderate-severe defoliation were mapped compared to 21790 ha in 2011. Small pockets of spruce budworm defoliation were found again in the NW River and Shashatshiu areas. In 2012, defoliation was also observed along the Churchill and Goose Rivers. The area damaged by spruce beetle in Labrador also increased – this area has grown from approximately 11,000 to 47,374 ha over the last seven years.



On the island, moderate to severe defoliation continued to be found along the south coast in the Connaigre Peninsula area. In 2011, 12,937 ha of damage caused by balsam fir sawfly were mapped. In 2012, this area increased to 28,077 ha. This time defoliation was caused by multiple defoliators (i.e. hemlock looper, whitemarked tussock moth, eastern black-headed budworm and balsam fir sawfly). Another 1167 ha of moderate to severe defoliation was also mapped in the St. Albans area north of the Connaigre Peninsula.

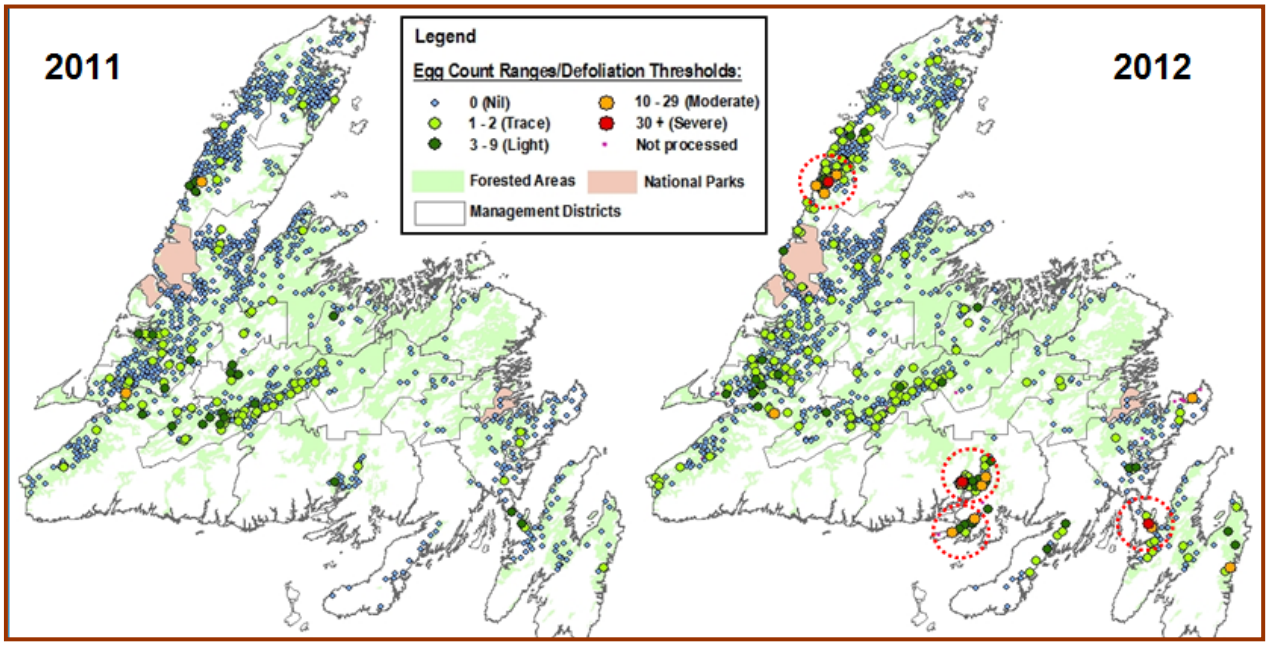


c) <u>Fall forecast survey results</u> – <u>Spruce Budworm (Egg Mass Survey)</u>: Whole branches collected from forty locations (one branch/tree; 3 trees/location) were used to determine the number of egg masses found per 10 sq m of foliage. Results indicate that populations will remain active again in the Goose Bay area in 2013. A comparison at a subset of locations between the numbers of egg masses found on branch samples in late August versus egg masses found from the same trees in mid-October was conducted. Early indications suggest fewer egg masses are found later in the fall due to natural degradation. For this reason the egg mass densities forecasted in 2012 may be lower than actual numbers.



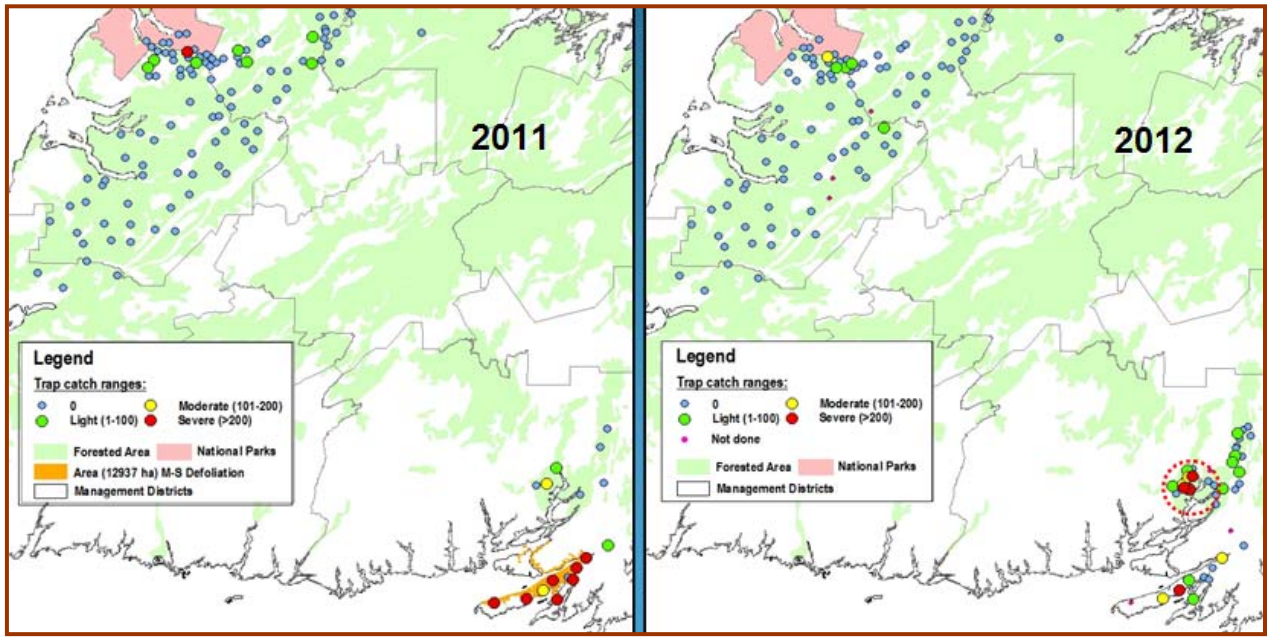
On the island 12 location in areas with higher pheromone trap catches were also sampled – no egg masses were found.

<u>Hemlock Looper (Egg Survey):</u> Whole branches (one branch/tree; 3 trees/location) were collected from 962 locations on the island. These were used to forecast population/damage levels for 2013 based on the total number of eggs found on 3 branches per location. Results indicate that hemlock looper populations remain low across much of the island with 773 locations being Nil (no eggs), 137 being Trace (1-2 eggs), 36 being Light (3-9 eggs), 13 being moderate (10-29 eggs), and 3 locations having 30+ eggs capable of causing severe defoliation. Areas with a moderate to severe forecast included the same areas found to have higher pheromone trap catches - Zinc Mine Road (Northern Peninsula); St. Albans and Connaigre Peninsula (South coast); and Little Harbour (isthmus of the Avalon Peninsula).

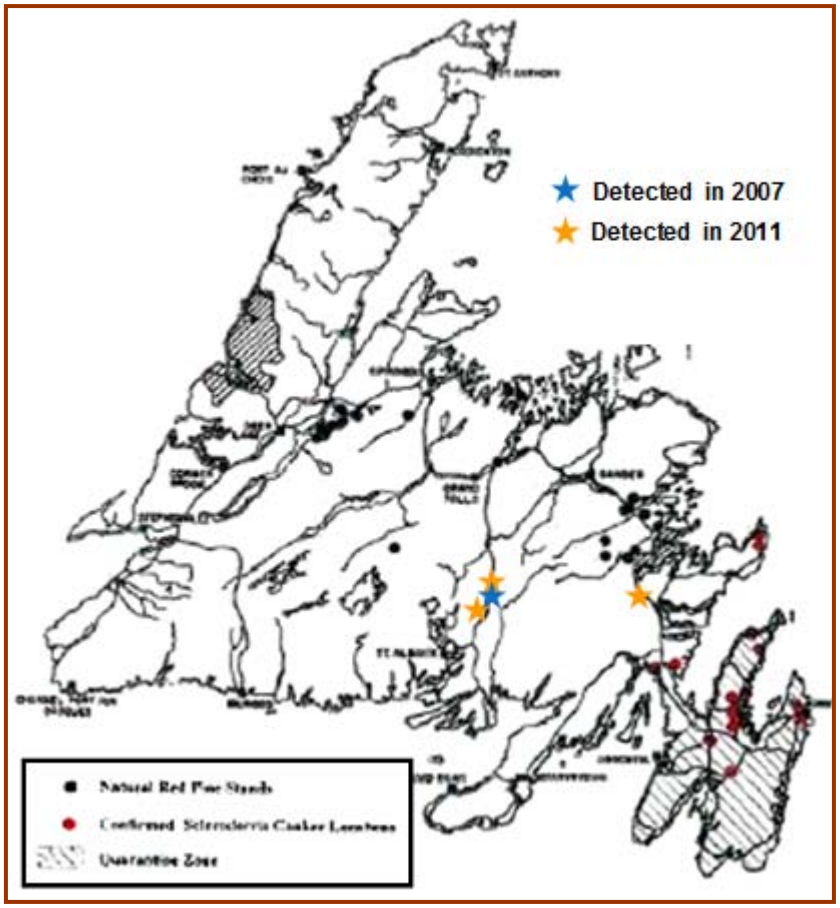


Thirty-four locations were also assessed in Labrador for hemlock looper populations – no eggs were found at any of these locations.

Balsam Fir Sawfly (Egg Survey): 50-cm branches collected from 126 locations (5 trees/location; one branch/tree) on the island were used to forecast population/damage levels for balsam fir sawfly - 104 locations were Nil, 12 were Light, 6 were Moderate, and 4 were Severe. Overall, a decrease in BFS populations was noted on the Connaigre Peninsula, low populations are still present south of Gros Morne National Park, and an increase in populations was noted in the St. Albans area.

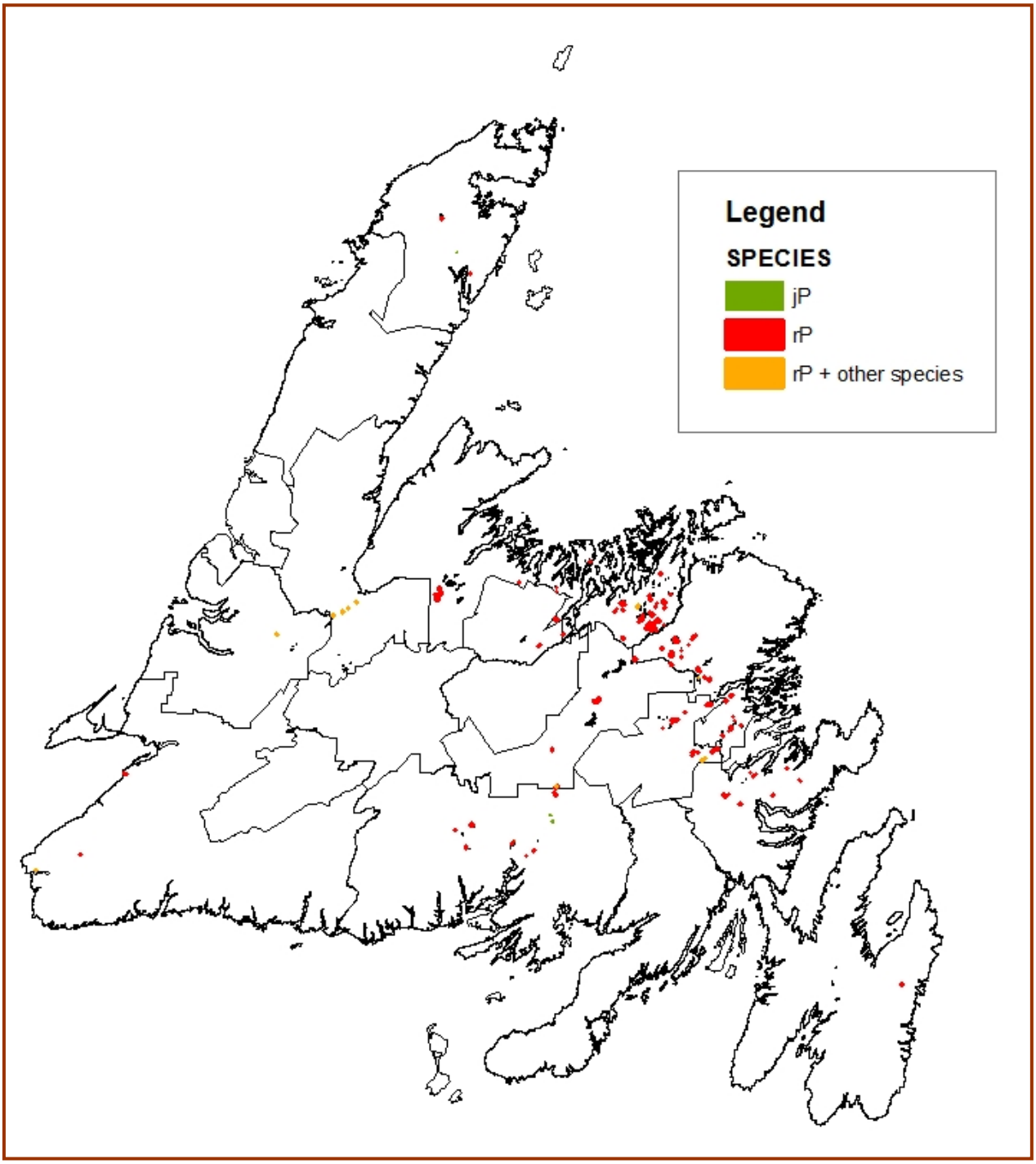


c) <u>Special surveys</u> – *<u>Scleroderris Canker (European Strain)</u>*: The European strain of Scleroderris canker was first found in St. John's in 1979. This introduced disease poses a significant threat to indigenous pine of ecological significance and planted red pine which represents a $3.1 million dollar investment. A concerted effort has been made to contain the disease through regulation and sanitation. This was successful for approximately 25-years, however, in 2007 this disease was found 150 km outside the quarantine zone in the Berry Hill Pond area. This site was sanitized in 2008, however, in 2011 three more sites (Berry Hill Pond 2, Conne River, and White Hills) were detected and confirmed positive.



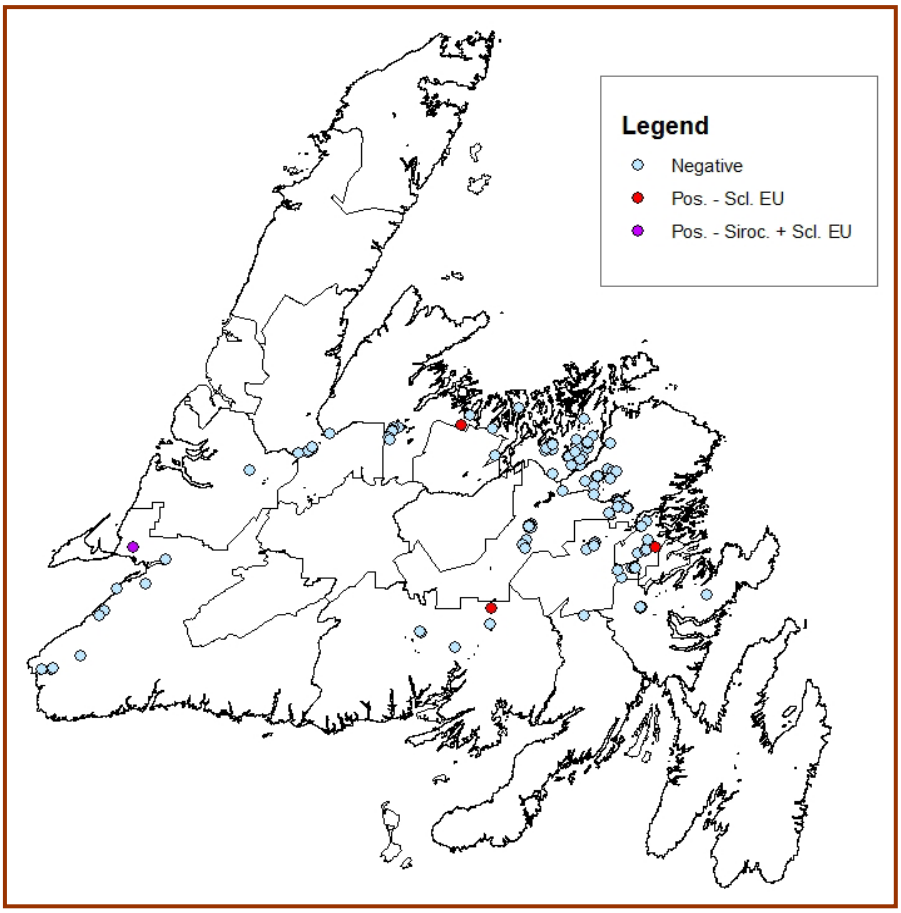
The obvious question being asked was whether this disease was present at other locations in the Province? To answer this, a directed survey to monitor for Scleroderris EU in other susceptible stands was conducted in 2012.

Forest inventory and silvicultural records were used to identify 463 locations were either red pine or jack pine was the primary species. These locations included plantations, as well as, sites were indigenous red pine was present.



One hundred and eighty-two or 40% of these areas were assessed from the air and from the ground for symptoms of damage (yellowing or reddening of needle bases; discolored foliage and dead candles, dead tops or trees, presence of pycnidia).

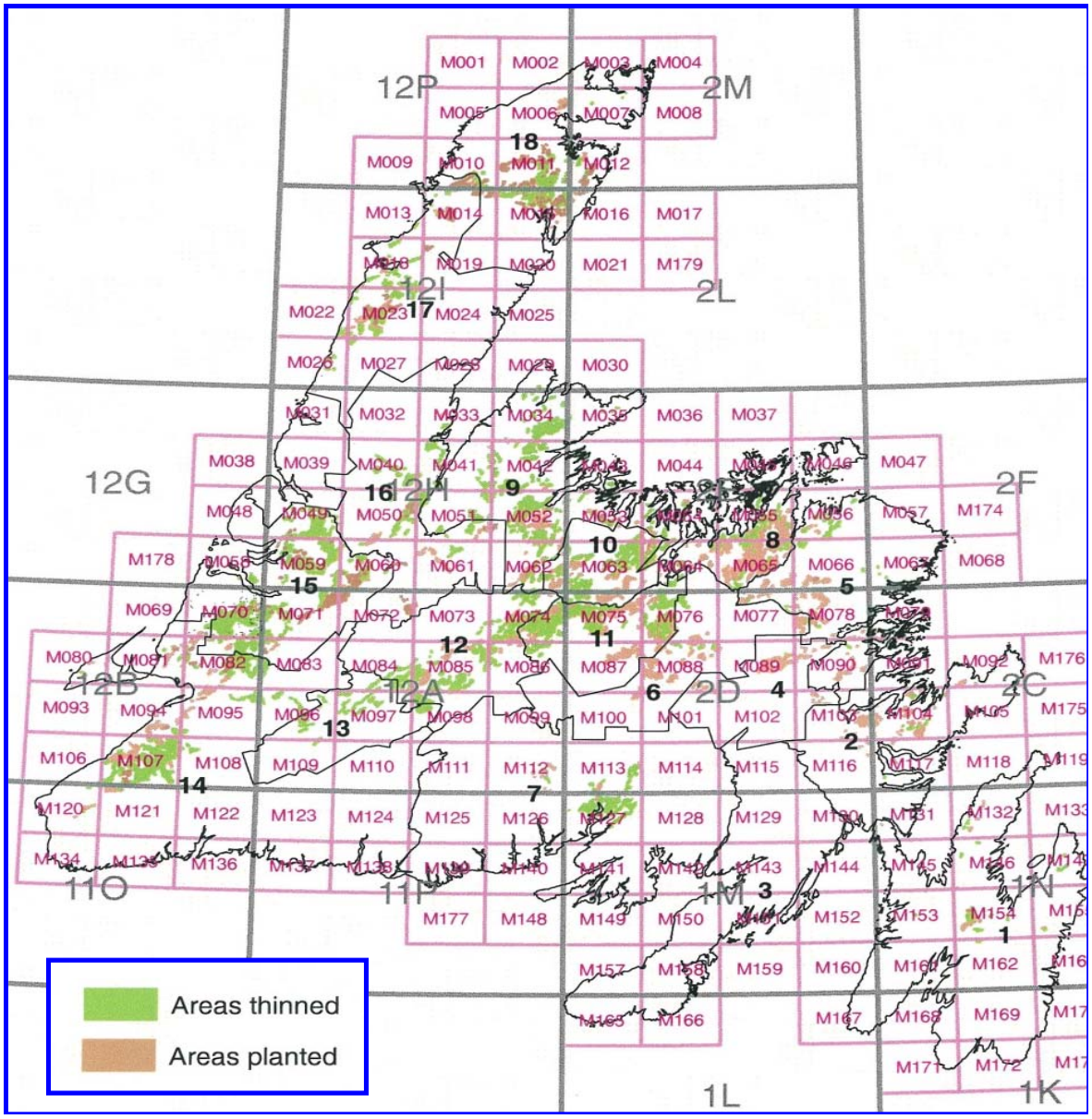
Branch samples were collected from suspect sites for subsequent lab analysis by Dr. Gary Warren of the Canadian Forest Service and by the Canadian Food Inspection Lab in Ottawa.



Fortunately the disease was undetected at 178 locations, however, an additional 4 sites were found to be positive. Somewhat disconcerting was the fact that these sites were a considerable distance apart. This certainly raises the question as to the mechanisms or pathways involved in the movement or spread of this disease? Sites that were positive varied in size from 3 to 10 ha and with the exception of one site (63 years old), the trees were 20 to 30 years of age.

At the positive site on the west coast, Sirococcus shoot blight was the disease most prominent. This is the first time that this disease has caused widespread damage on red pine in the Province (personal communications – Dr. Gary Warren). Sanitation has already been initiated at this site through the harvesting and removal of the cut logs. The cut tops and branches left on site will be burned in 2013. Combined with the sites detected in 2011, there are still six sites with Scleroderris EU on the island. Sanitation is to be done at these six sites – in the interim the CFIA will put prohibitions of movement in place to restrict the movement of living pine from these areas and a 1-km buffer.

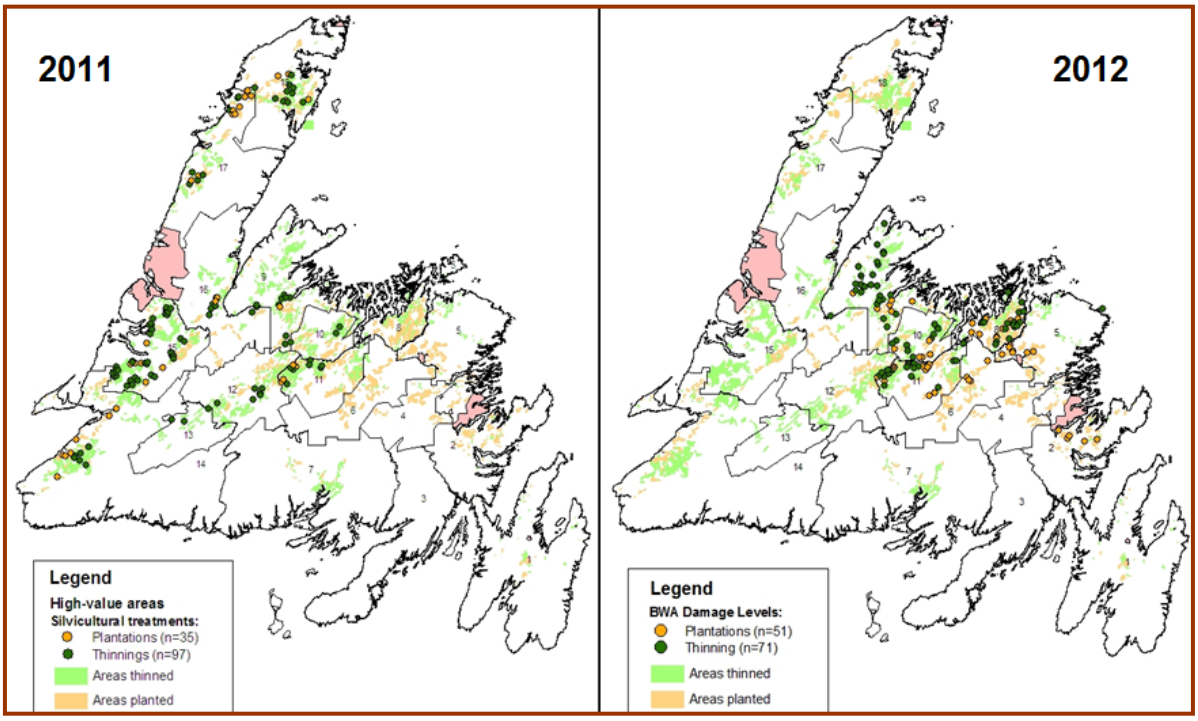
Pest Detection in High-Value Areas: Given the significant silvicultural investment ($11-12 million/year) being made and the fact that these areas represent 20% of the forest considered to be productive and operationally available for harvest, a directed survey in high-value area (i.e. plantations and thinnings) was initiated in 2011.



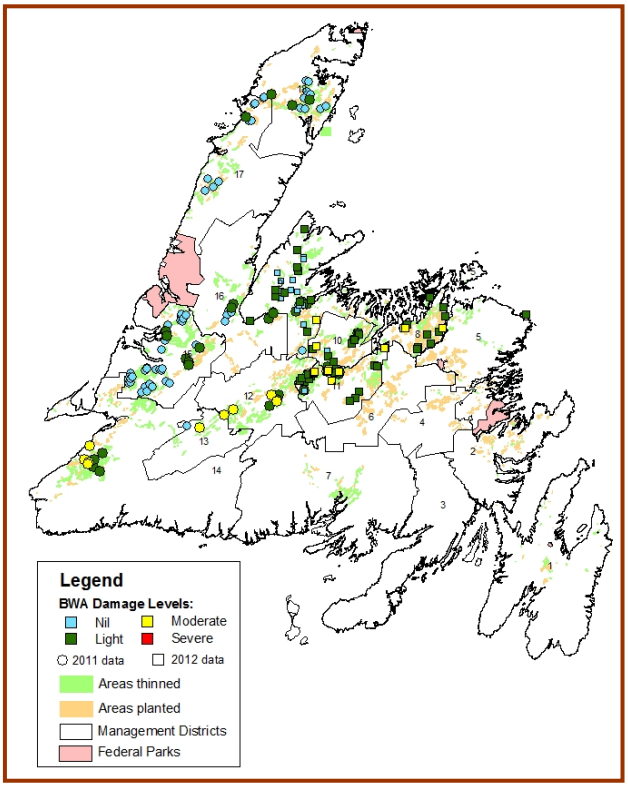
In 2011, pest assessments were conducted in 97 thinnings and 35 plantations in western and central portions of the province. In 2012, assessments were continued in central and eastern portions of the province in 71 thinnings and 51 plantations.

The most common pest damage noted in balsam fir thinnings in 2011 and 2012 was twig damage caused by the balsam woolly adelgid (BWA) and moose browse. In plantations, the most common pest occurrences included spruce bud midge, needle rust and damage from galling insects.

Where BWA was known to be a common pest, an unbiased sampling of 25 to 75 trees was also done at locations with a high composition of balsam fir. This additional assessment was used to determine not only the presence, but the damage levels associated with this pest.



Damage classes modified from work done by Schooley and Bryant (1978) were used to classify damage in the upper and lower half of each tree as Nil, Light, Moderate, Severe, or Dead and an average damage per tree calculated. An overall rating of BWA damage for each location was then calculated based on a weighted average for all trees. Results from assessments conducted in high-value areas in 2011 and 2012 indicate that BWA damage levels are higher in south-western and central portions of the province.



3. *Next Steps*

The above provided a brief summary of the preliminary results from the 2012 forest insect and disease control and monitoring program conducted in Newfoundland and Labrador. Work is still on-going to complete the analyses and assessment of the 2012 results. Final results will be provided in the Provinces annual forest insect and disease report. Supplementary sampling is also underway in areas forecasted to have moderate to severe populations of hemlock looper and balsam fir

sawfly in 2013. This information will be used to better delineate the areas affected. These areas will then be examined with respect to predicted impacts on forest management objectives and the potential spread of these pests to other significant susceptible forest stands. If protection is deemed necessary, protection program planning will be initiated.

NOVA SCOTIA REPORT

Tanya Borgal

Nova Scotia Department of Natural Resources

The **Spruce Budworm (*Choristoneura fumiferana*)** has caused more damage to Nova Scotian softwood forests than any other insect. Since the previous outbreak in the 1970s, spruce budworm population levels have decreased dramatically, with low moth catches being recorded throughout the province. This year Forest Health staff monitored 148 traps province wide with 71% positive, which was the highest percentage seen since 1994. Since 1997, with the exception of 2010, the average number of moths caught has consistently remained below or equal to one moth per trap. This year the average moth catch increased to 5.5 moths per trap. No overwintering larvae were detected during this year's L2 branch surveys.

Jack Pine Budworm (*Choristoneura pinus pinus*) defoliation was first detected in 2005 within a mature white pine stand in the Western Region of the province. The following year, Forest Health began using pheromone traps to monitor jack pine budworm populations. Since that time the percentage of positive traps has remained above 75% until 2010 when it dropped by almost half to 36%, rising to 48% in 2011and dropped again to 30% this year. The average number of moths per trap has decreased to an average of one moth per trap. Branch samples were collected from three sites within the area with the highest moth catch (18 moths) and assessed for overwintering larvae. The mean number of second instar larvae per square meter of bark was 39.79.

Eastern Blackheaded Budworm (*Acleris variana*) eggs were detected at 94.1% of the sites surveyed in the Eastern region in 2012. This is a slight increase from 83.9% in 2011. Egg numbers still remain low for a mean of 2.2 eggs per 45 cm branch.

The **Brown Spruce Longhorn Beetle (*Tetropium fuscum*)**, native to north and central Europe, arrived in Halifax in the 1990s. As part of a joint effort, the Nova Scotia Department of Natural Resources, the Canadian Food Inspection Agency and Canadian Forest Service monitor the spread of the beetle within the province. In 2012, the detection survey for the brown spruce longhorn beetle continued to include extensive trapping throughout Atlantic Canada. This year's survey resulted in 28 new positive locations outside the current containment area. BSLB can now be found in the counties of Halifax, Hants, Pictou, Colchester, and Richmond for a total of 93 positive sites outside of the current containment area. In 2011, there was a positive find in New Brunswick located near a campground in Kouchibouguac National Park. This year CFIA, Parks Canada and NRCan-CFS completed extensive trapping within the park and no BSLB were detected. Additional pheromone traps were also deployed throughout Atlantic Canada in Prince Edward Island, New Brunswick and Newfoundland and Labrador and all were negative for brown spruce longhorn beetle.

Spruce Beetle (*Dendroctonus rufipennis*) activity in Nova Scotia has been both chronic and widespread. There has been mortality of mature and over-mature white and red spruce province wide. Forest Health utilizes an array of 18, long term, fixed radius plots to track spruce beetle populations in red and white spruce stands in the Central Region. At each plot, all spruce trees greater than 10 cm in diameter were counted and labeled. Plots are visited annually, at which time the health status of each labeled spruce is determined. In 2011, 21.5% of white spruce and 6.3% of red spruce were either infested with or had been killed by spruce beetle. This is down from 2010 when the percent of infested and beetle killed trees were 44.8% and 10% for white and red spruce respectively. The percentage of beetle killed white spruce trees has also dropped by almost four fold and red spruce by half. This can be attributed to the fact that many of the trees previously marked as dead were recorded as either missing or not found due to factors such as blow down. These plots are still being assessed this year and this will be the final year for these plots. The plan is to establish a new set of plots across the province because the current ones are reaching the end of their lives and usefulness.

In 1995, Forest Health established a pheromone monitoring system to detect **Gypsy Moth (*Lymantria dispar*)** in Nova Scotia. Our survey is conducted in two parts: multipher and delta traps. Multipher traps are deployed at designated sites province wide to monitor population trends. In 2012, 20 traps were placed; 70% of these traps were positive. There were a total of 3791 moths caught this year. Based on our 2012 survey results, trap catches increased in Inverness, Colchester and Annapolis Counties and decreased in Guysborough and Halifax counties. Delta traps were also placed in towns outside the regulated zone to determine if the population is spreading into new areas. Based on these trap results, moths were detected in Antigonish, Guysborough and Inverness counties. However, the average moth catch per trap is below one.

Since 1961 the **Hemlock Looper (*Lambdina fiscellaria fiscellaria*)** has defoliated approximately 135,000 hectares in Nova Scotia. Control programs were conducted in the Cape Breton Highlands in 1996 and 1997. Since then hemlock looper numbers have remained at low levels. Survey data from this year show the average trap catch has decreased from 89 moths per trap recorded last year (2011), to 23 moths per trap. The overwintering egg survey is in progress.

Recorded outbreaks of the **Balsam Fir Sawfly (*Neodiprion abietis*)** in Nova Scotia date back to 1942. Our overwintering egg survey for 2012 included 149 sites, 46% of which were positive, down from 59% in 2011. The mean eggs per 100 cm branch have decreased to 4.98, compared to 25.4 in 2011.

Damage due to **Balsam Woolly Adelgid (*Adelges piceae*)** can be found throughout the province. In the fall of 2009, 14 permanent monitoring plots were established. These plots are located within the nine provincial ecoregions and whenever possible paired with existing forest inventory research permanent sample plots in order to compare the impact of the adelgid on the growth, volume, and yield of balsam fir. This year an additional five plots were established in order to have two plots per ecoregion, for a total of 18 plots across the province. Note that one of the plots established in 2009 was lost due to harvesting. In the spring of 2012 overwintering survival was monitored. The population had increased at six plots and no change was found at seven plots. There were no decreases this year. Mortality of overwintering nymphs occurs below -20^{o}C. Examining the recorded winter temperatures within the plots, decreases were not expected due to cold winter temperatures being at or above -20^{o}C during the winter of 2011-2012.

The last **Whitemarked Tussock Moth (*Orgyia leucostigma*)** outbreak occurred in 1998 covering 1.4 million hectares. Approximately 60,000 hectares were treated with Foray 48B. Since that time two mini population eruptions have occurred; Cape Breton in 2005 and Guysborough in 2007. An overwintering egg mass survey was conducted in 2012 with 236 sites as of mid-January 2013 assessed. This survey is still in progress, however, the results to date show that the percentage of sites where egg masses were detected remains quite low for only 2.5% of the sites assessed having egg masses.

Forest Health monitors **Balsam Twig Aphid (*Mindarus abietinus*)** and **Balsam Gall Midge (*Paradiplosis tumifex*)** populations in a general way by assessing their presence on balsam fir branch samples collected for our balsam fir sawfly survey. This is not a predictive survey; it simply quantifies the damage that occurred the previous summer. Each branch is visually inspected for balsam twig aphid damage. In 2012, of the 149 sites surveyed, there were four sites with balsam twig aphid affected shoots and seven sites that had balsam gall midge affected shoots.

NEW BRUNSWICK REPORT

Jeremy Gullison

New Brunswick Department of Natural Resources

Executive Summary

This report provides an overview of the status of forest insect and pest conditions in New Brunswick (NB) in 2012, and highlights many of the pest management activities of the NB Department of Natural Resources' Forest Pest Management Section (FPMS). It is not intended to itemize all details for each survey conducted, except where it is needed to provide additional context to a particular pest problem. Where required, the reader can contact FPMS for further information.

From the 1950s to the 1990s, **spruce budworm** was the most serious forest pest in NB, and across many jurisdictions in eastern North America. No defoliation has been detected in NB since 1995. Since 1997, there has been an irregular though gradually increasing trend of populations as indicated by annual changes in moth catches in a pheromone trapping survey, particularly in the northern part of the province. This trend has gained more attention in light of the increasing outbreak in Québec, with defoliation mapped only 40 km from the NB border in 2012. FPMS significantly increased its monitoring effort of spruce budworm in 2012. Sampling was conducted throughout the province, regardless of land ownership and included defoliation assessments. No defoliation was observed and spruce budworm was detected at trace to very low overwintering larval counts at 6% of 422 plots sampled. Positives were concentrated in, but not exclusive to northern NB. Further supplementary sampling is also conducted by J.D. Irving, Limited on its own freehold lands. In light of the outbreak in Québec, and based on survey results to date, FPMS anticipates the first pockets of light defoliation might be found in 2013 or 2014 in northern NB, the first time since the collapse of the last outbreak in 1995.

In 2011, a single **brown spruce longhorn beetle** was found in Kouchibouguac National Park, most likely transported to the park in a piece of firewood from Nova Scotia. In the fall of 2011, the Canadian Food Inspection Agency in collaboration with Parks Canada and the Canadian Forest Service collected logs from sixteen trees with symptoms of brown spruce longhorned beetle (BSLB) attack and placed them in facilities where scientists observed for beetles emerging from the logs. No BSLB were detected in these. In 2012, approximately 100 pheromone traps within Kouchibouguac National Park also failed to catch a beetle. At this time, it is still uncertain whether the BSLB find in Kouchibouguac is indicative of an established population or was merely intercepted when it emerged from a piece of firewood. In 2012, FPMS conducted visual assessments of spruce trees at 282 locations throughout the province looking for signs and symptoms of BSLB attack (in conjunction with pheromone trapping surveys). No suspect trees were found.

In 2011, the NB Government conducted a limited aerial biological control program against **balsam fir sawfly** on 7,282 ha of the Crown forest using Abietiv™, a federally-registered biological insecticide that is based on a naturally occurring balsam fir sawfly virus. J.D. Irving, Limited also contracted (separately) to have control applied on some of their freehold land. Coincidently, natural virus was attributed with causing a population collapse that same year. In 2012, a ground-based defoliation survey conducted in south-eastern New Brunswick reconfirmed the previous year's forecast of a population collapse, with only light scattered defoliation detected in a small geographic area between St. Martin and Saint John. As such, no forecast survey was required in 2012.

Sirococcus shoot blight is a fungal disease affecting primarily red pine. Years with wet weather in May and June often result in intensification of disease symptoms (branch dieback and, after successive attacks, tree mortality). In 2012, appropriate methodology was developed to evaluate the severity and distribution of the disease in red pine stands. Assessments by FPMS and Regional Pest Detection Officers revealed that Sirococcus is widespread and a large portion of assessed stands are at a high risk of experiencing tree mortality within the next five years.

In 2012, many **other insect and disease pests** were monitored through targeted and/or general surveillance surveys. Damage from the following pests was observed in 2012: forest tent caterpillar, balsam gall midge, balsam woolly adelgid, larch casebearer, foliar diseases including red flag on balsam fir and balsam fir tip blight, satin moth, Bruce spanworm, hickory tussock moth, birch skeletonizer, birch leafminers, white pine weevil, fall webworm, and pitch nodule makers, with all but balsam gall midge being localized in extent. This report describes the status of many of these pests and several others.

This report also describes the status on several **invasive alien species** that have not been detected in New Brunswick to date but have been found in other jurisdictions in north-eastern North America and which have the potential to cause significant damage to the forests of NB. While these species spread naturally, human assisted movement through transportation of infested wood commodities (e.g., firewood, logs, landscape nursery stock) is the most important pathway for the long-range dispersal of these pests.

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.

The Department of Natural Resources' (DNR's) Forest Pest Management Section (FPMS) has the mandate of protecting New Brunswick's forests from insects and disease. For regulated, non-native pests, DNR maintains liaison with the Canadian Food Inspection Agency (CFIA) which is responsible, under the federal Plant Protection Act, for preventing the introduction into Canada, spread within Canada, and spread from Canada, of non-native pests.

The first line of defense in any forest pest management program is an effective detection, monitoring and forecasting system. This system not only detects the presence of various forest pests, but it also measures changes in pest populations and damage levels over time. 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. 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 trigger the implementation of other methods to forecast levels of damage expected the ensuing year.

One of the cornerstones of the FPMS' pest monitoring program is the use of such 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.

As a consequence of finite resources, formal monitoring and forecast surveys are only conducted for a limited number of targeted pests on an annual basis. General surveillance of forest conditions while conducting targeted surveys, and collaboration with other DNR staff (e.g., Regional Pest Detection Officers), members of forest industry, and the general public greatly enhance FPMS' ability to detect pest outbreaks and respond as needed. These collaborative efforts were further facilitated by an improved process to log inquiries and observations from other agencies and individuals, including documentation of photos and samples collected to aid in pest identification. This tracking system has enabled, where needed, the timely follow-up by FPMS staff. Worth noting is the fact that since insect and disease pests do not respect ownership boundaries, survey activities conducted by FPMS are done on crown land, industrial freehold and private woodlots.

This report provides an overview of the status of forest insect and pest conditions in New Brunswick in 2012, and highlights many of the pest management activities of FPMS. It is not intended to itemize all details for each survey conducted, except where it is needed to provide additional context to a particular pest problem. Where required, the reader can contact FPMS for further information.

Pests of Softwoods

Balsam Fir Sawfly (*Neodiprion abietis* [Harris]): Balsam fir sawfly is a native insect found in southern Canada and northern United States. Its main host is balsam fir. The larvae feed on older needles leading to reduced volume increment, weakened trees and sometimes tree mortality. A major concern is the loss of wood volume due to reduced growth increment that occurs in balsam fir stands thinned to maximize tree growth. In New Brunswick, it has never been recorded at large outbreak levels. Elsewhere, historic outbreaks have tended to be small, and collapsed within five years due to natural controls. The exception

has been an unprecedented 20-year outbreak on the island of Newfoundland where they resorted to aerial control using a naturally occurring virus in the form of a registered insecticide called Abietiv™.

In New Brunswick, defoliation by balsam fir sawfly was mapped in 2010 using ground and aerial-based surveys over an area estimated to be 278,300 ha. A subsequent egg survey delineated detectable populations over a total area of about 181,800 ha, representing an infestation of unprecedented size in New Brunswick. In 2011, the provincial government conducted a limited aerial biological control program on 7,282 ha of crown forest using Abietiv™, a federally-registered biological insecticide that is based on a naturally occurring balsam fir sawfly virus. J.D. Irving, Limited also contracted (separately) to have control applied on some of their freehold land. Larval disease was later detected throughout both treated and untreated plots, suggesting a potential population collapse. A subsequent egg survey indicated a significant decrease in the overall extent and severity of infestation expected for 2012 and so no control action was conducted. In 2012, a ground-based defoliation survey conducted in south-eastern New Brunswick reconfirmed the previous year's forecast of a population collapse, with only light scattered defoliation detected in a small geographic area between St. Martin and Saint John. As such, no egg survey was required in the autumn of 2012.

Balsam Fir Tip Blight (*Delphinella balsameae* [Waterman] E. Müller): This fungal disease kills the needles and current year's shoots, with generally only a few branches per tree affected. In 2012, balsam fir tip blight was common on scattered balsam fir trees throughout the province, with several isolated stands having more severe symptoms in northern New Brunswick.

Balsam Gall Midge (*Paradiplosis tumifex* Gagné): This insect is not considered a significant forest pest, but like the balsam twig aphid it can be a very serious problem for Christmas tree growers as it kills the current year's needles, causing them to drop off, rendering Christmas trees unsightly for sale. As such, FPMS annually evaluates the severity and distribution of this insect pest while conducting other operational surveys. The insect has been in an outbreak phase for the last 7 years, persisting into 2012. Of 281 fir plots assessed throughout the province, 91% had detectable levels of damage from this pest.

Balsam Twig Aphid (*Mindarus abietinus* Koch): This insect is also not considered a significant forest pest, but like the balsam gall midge, can be a very serious problem for Christmas tree growers. Like the balsam gall midge, feeding damage by this insect pest renders Christmas trees unsightly for sale. Like the balsam gall midge, FPMS evaluates the status of this insect pest while conducting other operational surveys. Of 281 fir plots assessed throughout the province, only 13% had detectable levels of damage from this pest.

Balsam Woolly Adelgid (*Adelges piceae* [Ratzeburg]): 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 on balsam fir, especially gouty tops, are noticeable in southern New Brunswick where local tree mortality, severe in some cases, has been reported. Although galling and distorted tops are common, stem attack – a condition that is more associated with tree mortality - has only been observed in one location (Kingsclear). A survey that rated adelgid damage at 83 stands in southern New Brunswick in 2002 was again repeated in 2010. Moderate-severe damage was found in only six of these stands, and in both years, only ~0.5% of balsam fir trees assessed had moderate-severe damage. FPMS field staff and DNR Regional Pest Detection Officers did not report any significant areas of damage by balsam woolly adelgid in 2012.

Brown Spruce Longhorn Beetle (*Tetropium fuscum* [Fabricius]): 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 misidentified as a similar native species. In Nova Scotia, it has

attacked red spruce, as well as white, black and Norway spruce. The CFIA manages this pest by reducing the risk of the beetle spreading outside of the area it now exists using a strategy that regulates movement of specified high-risk spruce materials along with annual surveys and research.

In 2011, a single beetle was found in a trap in Kouchibouguac National Park, most likely transported to the Park in a piece of firewood from Nova Scotia. In the fall of 2011, CFIA in collaboration with Parks Canada and the Canadian Forest Service collected logs from sixteen trees with symptoms of brown spruce longhorned beetle (BSLB) attack and placed them in facilities where scientists observed for beetles emerging from the logs. No BSLB's were detected in these. In 2012, approximately 100 pheromone traps placed within Kouchibouguac National Park also failed to catch a beetle. At this time, it is still uncertain whether the BSLB find in Kouchibouguac is indicative of an established population or was merely intercepted when it emerged from a piece of firewood.

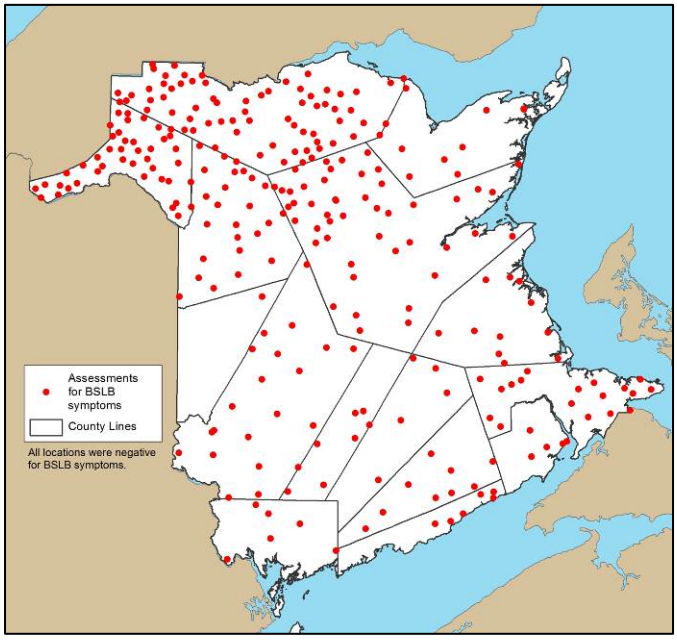


Figure 1. Distribution of FPMS plots assessed for symptoms of brown spruce longhorn beetle attack on spruce in 2012. All plots were negative for the beetle.

In 2012, FPMS also conducted visual assessments of spruce trees at 282 locations throughout New Brunswick for signs and symptoms of BSLB attack (in conjunction with pheromone trapping surveys). No suspect trees were found.

Hemlock Looper (*Lambdina fiscellaria* [Guenée]): This insect is a menacing pest primarily of hemlock and balsam fir. It can kill trees within a single year due to its wasteful feeding habits. Besides consuming entire needles, it also partially eats many needles causing them to die. Severe outbreaks are common in Newfoundland & Labrador and Québec. The only reported outbreak of hemlock looper in New Brunswick occurred from 1989-1993.

A pheromone trapping network of 55 traps distributed throughout the province indicated that looper populations still remained low. However, one trap in northern New Brunswick did have an elevated trap catch of 623 moths. Moreover, a small number of pheromone traps baited for other monitored pests had higher than usual looper moth catches. Usually only incidental numbers of looper moths end up in pheromone traps baited to capture other moth species. As a precaution, 14 locations throughout the province were sampled for overwintering egg populations. Eggs were extracted from branches at 50% (7) of the 14 plots, although only at extremely low densities (0.3-1.3 eggs/100-cm branch). The exception was at the northern location where 623 moths were captured in the looper pheromone trap; in that case the egg density was somewhat elevated at 5 eggs/100-cm branch (interpreted as nil-light defoliation). J.D. Irving, Limited also maintains a second pheromone trapping network on their freehold lands.

Jack Pine Budworm (*Choristoneura pinus* Freeman): This insect is a potentially significant pest of jack pine as evident by periodic severe outbreaks in Ontario and Manitoba. Defoliation by jack pine budworm in New Brunswick has not been reported since 1983; however, monitoring had been conducted annually at a network of pheromone traps since 1997. Overall, the survey results up to 2010 had indicated that jack pine

budworm populations remained at very low levels throughout the zones being monitored. In 2012, no pheromone trapping survey was conducted due to other priorities, however, general monitoring efforts throughout the province in 2012 indicated populations remain at undetectable levels.

Larch Casebearer (*Coleophora laricella* [Hubner]): Damage by this defoliator of larch includes the discoloration of newly flushed needles in late May and early June. Tree growth can be impacted, but risk of tree mortality from defoliation by this pest is low. Defoliation from larch casebearer was widespread throughout southern, and especially, southeast New Brunswick, in June.

Red Flag of Balsam Fir (*Fusicoccum abietinum* [R. Hartig] Prill. & Delacr.): This fungal disease was observed at incidental levels throughout New Brunswick in 2012. It typically only attacks a few branches on isolated balsam fir trees, causing a constriction on affected twigs, resulting in red flags. From a distance, the symptoms look similar to that caused by white-spotted sawyer beetle (*Monachamus scutellatus* [Say]) feeding damage.

Scleroderris Canker of Pine (*Gremmeniella abietina*): The North American race (*var. NA* [Lagerberg] Morelet) of this disease causes cankers and mortality of seedlings of jack pine and red pine, and has been associated with plantation failures in other jurisdictions. It seldom causes mortality to trees over 2 m tall, though branches up to this height are affected. On the other hand, the European race (*var. Eu* [Lagerberg] Morelet) is capable of causing mortality to red pine and Scots pine trees taller than 2 m. The European race of Scleroderris has been confirmed at three sites in north-western New Brunswick within a few kilometers of each other. Two sites contain Scots pine and the other contains red pine. In 2008, dead trees and trees with dead and dying tops were easily seen at the second site (Scots pine). At the third site, the red pine looked remarkably healthy. Quarantine regulations are in place under the federal *Plant Protection Act* administered by the CFIA. No specific surveys have been conducted in more recent years.

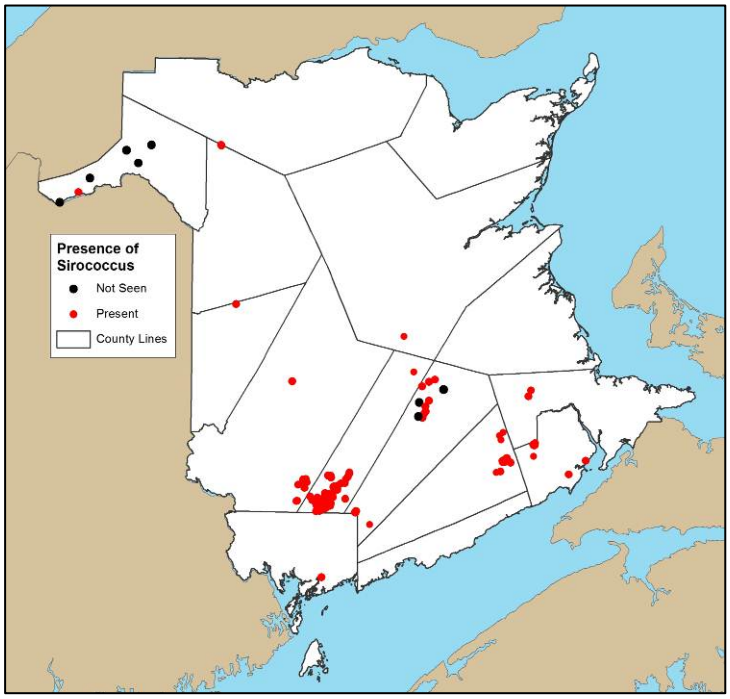


Figure 2. Presence of *Sirococcus conigenus* in red pine stands assessed by DNR in 2012.

Sirococcus Shoot Blight on Red Pine (*Sirococcus conigenus* [Dc.] Cannon & Minter): *S. conigenus* is a fungal disease affecting primarily red pine. Beyond contributing to the native biodiversity of NB forests, red pine provides the raw material for the creation of utility poles for electric power transmission, which are high value forest products. Years with wet weather in May and June often result in intensification of disease symptoms (branch dieback and, after successive attacks, tree mortality).

A survey methodology was developed to evaluate the severity and distribution of Sirococcus disease in the province, after a review of the scientific literature and many on-site visits to refine the approach. A two-person crew did a walk-through of red pine stands delineated on maps from forest inventory information, looking for symptoms of Sirococcus disease and its distribution in the stand, and rated the overall crown and

tree condition. Digital photos were taken in each stand, to allow the option of revisiting a subset of stands in future years in order to monitor the progression of the disease and rate of stand deterioration. Finally, each stand was categorized into a risk class, and identified as to whether it had a high risk of mortality within 3-5 years. Efforts were concentrated in southern New Brunswick (Figure 2), in those geographic areas where harvesting was planned or being conducted, in order to provide information to forest industry and DNR for prioritizing stands to harvest. Two hundred and eighteen (218) stands were initially visited, with stands low in red pine content removed from the analysis, leaving 189 stands for a risk rating provided to forest industry and DNR management foresters. Forty percent (40%) of these stands were rated as having a high risk of tree mortality within the next five years. Regional Pest Detection Officers reported *S. conigenus* damage on an additional eight red pine stands scattered throughout southern NB. Sirococcus symptoms are widespread, particularly in southern NB (Figure 2). More information is needed on the distribution of Sirococcus in northern NB.

Spruce Budworm (*Choristoneura fumiferana* [Clemens]): Spruce budworm is a notorious pest of balsam fir and various species of spruce. From the 1950s to the 1990s, it was a perennial pest of the softwood forests of New Brunswick and many other jurisdictions in eastern North America. The last year spruce budworm defoliation was detected in New Brunswick occurred in 1995. Since 1997, there has been an irregular though gradual increasing trend of populations in New Brunswick as indicated by annual changes in moth catches in the pheromone trapping survey. The highest counts tend to be in the northern part of the province (Figure 3) and this trend has gained more attention in light of the increasing outbreak in Québec, including light and moderate defoliation mapped in 2012 on the south-side of the Saint Lawrence River as close as 40km to the NB border. J.D. Irving, Limited also maintains a second pheromone trapping network on their freehold lands.

In response, in 2012, FPMS initially increased its overwintering larval (L2) population forecast survey (Figure 4) from 169 to 303 plots, covering off not only northern New Brunswick but a subset of plots in the south. As well as collecting foliage for laboratory washes, plots were assessed for any evidence of defoliator feeding activity. Trace to very low overwintering L2 counts (≤1 larvae/75-cm branch) were detected at 20 plots, concentrated throughout northern New Brunswick, but also found scattered throughout the rest of the province. Based on these findings, supplementary sampling was then initiated at another 119 plots, concentrated in those geographic zones where spruce budworm was detected. The initial population forecast survey, combined with the supplementary sampling, represented an increased sampling effort of 150% over the previous year. Final results indicated 6% (25) of the 422 plots were positive for

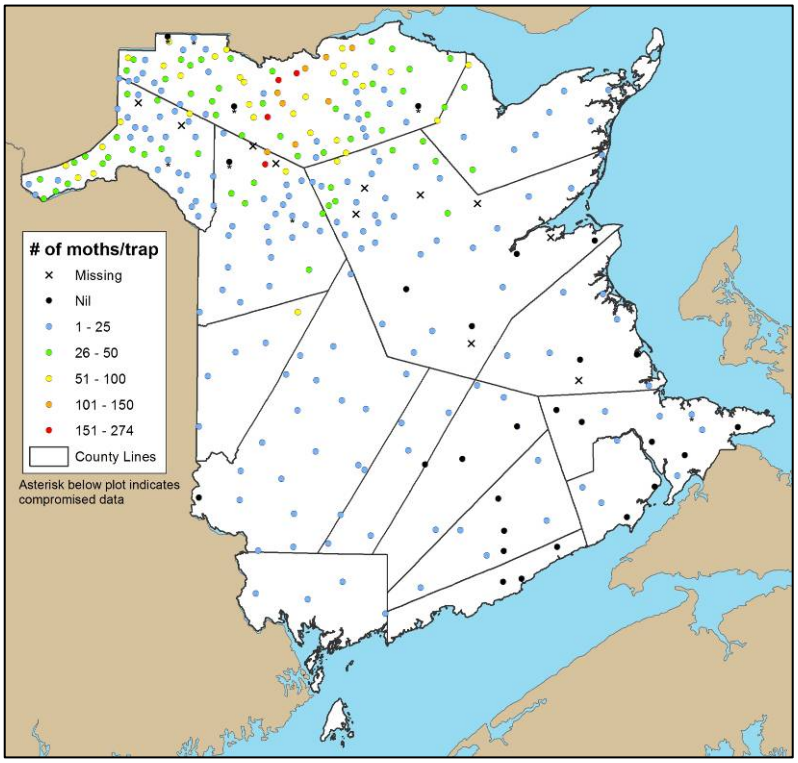


Figure 3. Distribution of spruce budworm pheromone traps and results of the 2012 survey conducted by FPMS.

trace to very low L2 larval counts (≤ 1 larvae/75-cm branch), concentrated in but not exclusive to northern New Brunswick. No spruce budworm defoliation was observed. FPMS sampling was conducted throughout the province, regardless of land ownership. Further supplementary sampling is also conducted by J.D. Irving, Limited on its own freehold lands.

Of additional interest is the fact incidental levels of overwintering spruce coneworm (*Dioryctria reniculelloides* Mutuura and Munroe) were found on lab-processed foliage collected at 3 plots south of Campbellton; and a fourth location near Kedgwick was subsequently found positive for spruce coneworm in the course of FPMS providing in-kind lab support to a Canadian Forest Service research scientist's project. Except for these locations, FPMS have not seen spruce coneworm larvae in its spruce budworm L2 laboratory washes in almost 20 years. Spruce coneworm has been historically linked to population outbreaks of spruce budworm. In light of the outbreak in Quebec, and based on all the ongoing survey evidence collected by FPMS and industrial collaborators, the spruce budworm is undoubtedly an imminent threat to the province's forests. FPMS anticipates the first detectable pockets of feeding larvae (3rd-6th instar stages) and/or of light defoliation could be found in 2013 or 2014, the first time since the collapse of the last outbreak in 1995.

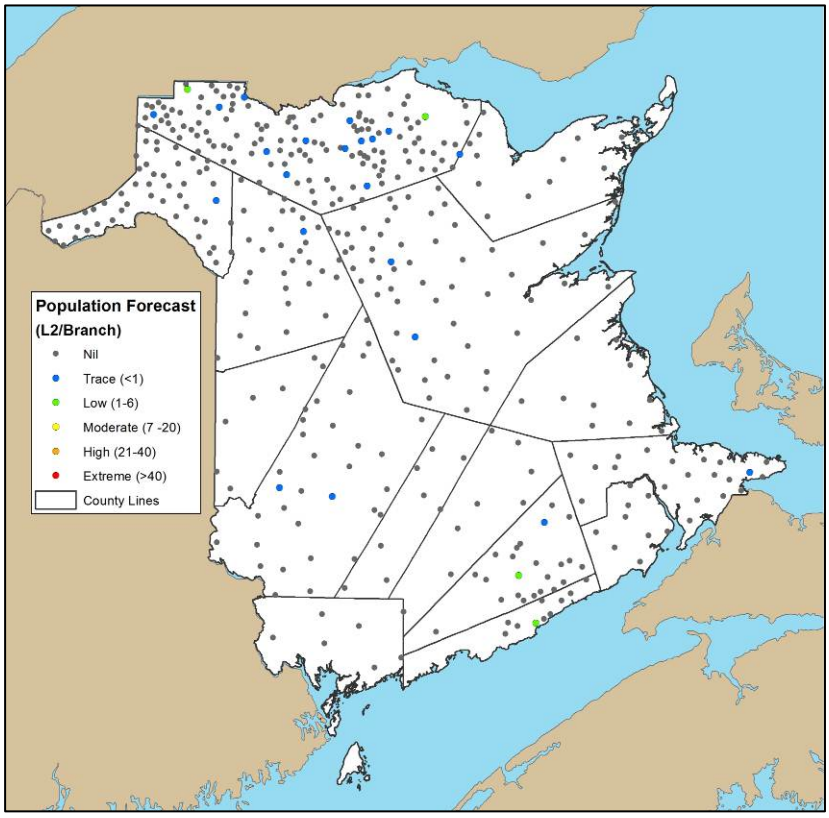


Figure 4. Distribution of plots sampled for overwintering spruce budworm (L2) larvae during the 2012 initial forecast survey and supplementary surveys conducted by FPMS.

Surveillance activities tentatively planned for 2013 include the continuation of a pheromone trapping network throughout the province, continued establishment of even more overwintering (L2) larval sampling plots, enhanced general monitoring for detection of any potential pockets of feeding larvae (3rd-6th instar stages), and aerial and ground-based defoliation assessment surveys.

Whitemarked & Rusty Tussock Moths: Both of these pests feed on many species of hardwood and softwood. Most significant damage occurs on balsam fir, and under extreme populations, trees can be killed in a single season. The last outbreak of whitemarked tussock moth (*Orgyia leucostigma* [J. E. Smith]) happened in the 1970s when defoliated area peaked in 1976 at approximately 200,000 ha. In contrast, rusty tussock moth (*Orgyia antiqua* [L.]) outbreaks are usually small and of short duration.

A pheromone trapping network at 69 plots were maintained to monitor and analyze population trends of these two insects, and population levels are tracked through a general monitoring program conducted throughout the province. For both species, the frequency at which low numbers of larvae and cocoons were encountered while conducting general monitoring in the field was elevated, especially in a geographic area

of north-central New Brunswick. This area will be closely monitored in 2013 to ensure populations do not reach levels capable of causing significant damage.

Pests of Hardwoods

Birch Skeletonizer (*Bucculatrix canadensisella* Chambers): The larvae of this insect pest produce oval-shaped white silken moulting webs on the leaves, and skeletonize birch leaves, causing them to turn brown, dry out and prematurely drop off the trees. The larvae then drop to the ground to pupate and spend the winter. Populations tend to build up fairly quickly and then decline within a couple of years. Since the insects are late (September) feeders, trees have already produced their food for the year and so the trees' general health is not threatened. In 2012, defoliation on white and other birch species was detected in southern New Brunswick in the Fredericton-Oromocto area.

Bruce Spanworm (*Operophtera bruceata* [Hulst]): This pest will defoliate many hardwood species, but sugar maple, aspen and beech are favoured hosts. Damage is observed in the spring and early summer. Damage by the Bruce spanworm rarely results in tree mortality. Regional Pest Detection Officers reported that several stands of sugar maple were defoliated by this pest in northern New Brunswick in 2012.

Butternut Canker (*Ophiognomonia clavigignenti-juglandacearum* [N.B. Nair, Kostichka & J.E. Kuntze] Broders & Boland): This non-native disease is causing severe mortality of butternut trees throughout their range. It was first confirmed present in New Brunswick in 1997, and has since been found at 27 locations by the Canadian Forest Service, and is thought to be more widespread. 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 2005, butternut was added to the List of Wildlife Species at Risk under the Canadian *Species at Risk Act*, partly because of the presence of butternut canker.

European Gypsy Moth (*Lymantria dispar* [L.]): The European gypsy moth is an exotic forest pest regulated by the CFIA under the federal *Plant Protection Act*. This insect is capable of feeding on several hundred different species of plants and shrubs ranging from ornamentals to forest trees. Many hardwoods, such as oak, poplar and birch are favoured hosts. CFIA is proposing to expand the regulated area in 2013 to include all of Kent County and the southern part of Northumberland County based on finds of life stages showing evidence of reproducing populations in these areas. This would make the northern counties of Victoria, Madawaska, Restigouche, Gloucester and the north-western part of Northumberland County the only parts of New Brunswick not regulated for European gypsy moth. Monitoring efforts by FPMS (including a pheromone trapping network of 78 plots), as well as reports from industry, colleagues and the public suggest populations remained low in the regulated part of the province.

Fall Webworm (*Hyphantria cunea* [Drury]): This insect creates unsightly silken webs in the late summer on many species of hardwood trees including apple, ash, alder, beech, birch, cherry, elm and oak. However, because the damage is caused toward the end of the growing season, there is little long-term damage to the trees. Fall webworm webs were common throughout the Lower Saint John River Valley in 2012.

Forest Tent Caterpillar (*Malacosoma disstria* Hubner): This insect generally defoliates poplar, but will attack numerous hardwood species during an outbreak. The last two major outbreaks (1979-1984 and 1991-1996) of forest tent caterpillar in New Brunswick lasted about six years each and covered hundreds of thousands of hectares. Severely defoliated trees can produce another crop of leaves within the same growing season, and therefore can withstand the infestation fairly well. In 2011, the total area defoliated by forest tent caterpillar was ~7,500 ha in areas around Bathurst. Pheromone trap catches in 2011 suggest an increase in forest tent caterpillar populations throughout most of New Brunswick, particularly in the

eastern half of the province. However, ground surveillance in 2012 only detected defoliation mostly confined to the Bathurst area of north-eastern New Brunswick except for one small pocket near Escuminac, also in northeastern New Brunswick. Elsewhere, monitoring efforts by FPMS as well as reports from industry, colleagues and the public suggest populations remained low. However, the pheromone trapping network of 78 plots distributed throughout the province did suggest trap catches were elevated at a number of locations in both north-east and north-west New Brunswick. As such, those areas will be closely monitored in 2013 to ensure populations are not on increasing to significant levels to cause defoliation.

Satin Moth (*Leucoma salicis* [L.]): This insect, originally from Europe and first observed in the Maritimes in 1930, primarily feeds on leaves of poplar and willow. Outbreaks are generally localized and of short duration and it rarely kills trees. Two pockets of satin moth defoliation were found on aspen in north-west New Brunswick. One of these pockets was first detected by Acadian Timber in an area north of Sisson Brook/Plaster Rock; the second pocket (mapped and reported by J. D. Irving, Limited) was geographically adjacent to the first location and was ~250 ha in size. A third pocket of satin moth defoliation was detected by FPMS on aspen and white birch in northeast New Brunswick, in an area east of Bathurst Mines.

Hickory Tussock Moth (*Lophocampa caryae* Harris): This insect is found from Nova Scotia to the North Carolina Mountains, Ontario, Wisconsin, and Texas. The caterpillars feed on the leaves of several hardwoods, including: ash, elm, oak, willow and others; but hickories, walnut and butternut are preferred. Populations may occasionally cause local defoliation but do not persist long and control is usually not necessary; hence, the insect is not regarded locally as a pest of concern to the forest industry. The main concern is due to the numerous hairs on the caterpillar's body (and pupae) that cause allergic reactions such as itchy rashes to some people who handle them, especially children. Heightened media coverage on this insect in New Brunswick and the neighbouring State of Maine in 2011 and 2012 spurred FPMS to track the insect's status and provide factual background details to health and education professionals, who were receiving numerous inquiries from concerned parents in those school districts in southern New Brunswick where localized pockets of hickory tussock moth were observed.

Large Aspen Tortrix (*Choristoneura conflictana* [Walker]): Outbreaks of this insect occur periodically throughout the range of its preferred host, trembling aspen. High populations are rare in the Maritimes and when they do occur they are usually associated with localized outbreaks of short duration. In 2010, small pockets of defoliation caused by large aspen tortrix were observed in western New Brunswick in the vicinity of Woodstock and near Florenceville. In 2011, the total area of defoliation was mapped over 785 ha near Canterbury and Meductic in south-central New Brunswick. Light defoliation was detected on the tip of the panhandle (Glassier Lake) in northwest New Brunswick in 2012.

Miscellaneous Observations

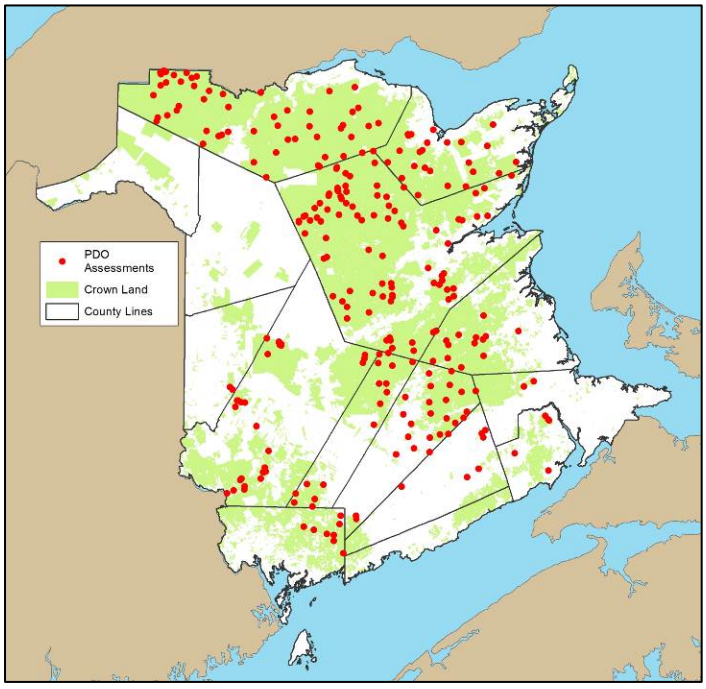


Figure 5. Plantations and thinnings assessed by DNR's Regional Pest Detection Officers in 2012.

Most of the pest-targeted surveys conducted by FPMS, and much of the general surveillance activities conducted by FPMS, DNR's Regional Pest Detection Officers, forest industry and other collaborators are incorporated within this report. The benefit of many trained eyes in the woods greatly enhances the forestry community's ability to detect and where needed, respond to pest problems as they occur. Beyond their ongoing contributions to general pest surveillance, Regional Pest Detection Officers also specifically conducted pest assessments in 272 high-value plantations and thinned stands on Crown Land (Figure 5). The most common damage encountered was caused by balsam gall midge (balsam fir), white pine weevil (white pine, Norway spruce, white spruce), Sirococcus shoot blight (red pine, white spruce), pitch nodule makers (*Petrova spp.*, jack pine), and birch leafminers (white birch), though in general, Crown plantations and thinnings are in very good health.

Invasive Alien Species of Concern

There are several invasive alien species that have not been detected in New Brunswick to date but have been found in other jurisdictions in north-eastern North America and which have the potential to cause significant damage to the forests of New Brunswick. While these species spread naturally, human assisted movement through transportation of infested wood commodities (e.g., firewood, logs, landscape nursery stock) is the most important pathway for the long-range dispersal of these pests.

Asian Longhorned Beetle (*Anoplophora glabripennis* [Motschulsky]*:* This destructive wood-boring pest of maples and other hardwoods was first discovered in North America at Brooklyn, NY in 1996, likely transported in wood pallets or wood packing material from Asia. The only incidence of ALHB in Canada was in Toronto and Vaughan, Ontario in 2003 which triggered an aggressive eradication effort led by the CFIA. The last detection of Asian longhorned beetle within Canada was in 2007. The closest US detection is the City of Boston as well as Worcester County, Massachusetts where control efforts are currently underway. The CFIA conducts annual monitoring for Asian longhorned beetle within New Brunswick.

Beech Leaf-mining Weevil (*Orchestes fagi* [L.]): This native insect of Europe was recently detected in Halifax, NS where it appears to have been causing severe defoliation of beech for a number of years and some of the trees are beginning to die. In Europe, it is a common pest of beech trees but is rarely an important forest pest. The CFIA is currently assessing the significance of this pest to Canada. Delimitation surveys will be required to determine if this insect is confined to the Halifax area or is more widespread.

Emerald Ash Borer (*Agrilus planipennis* Fairmaire): This beetle was first discovered in Canada and the USA in 2002 and has since killed millions of ash trees throughout Ontario, Quebec and the US. It poses a significant economic and environmental threat to urban and forested areas. The closest detection to New Brunswick within Canada has been within the village of Saint-Mathias-sur-Richelieu, Quebec (just to the east of Montreal). The closest detections within the US have been from Albany County in central NY State and Berkshire County in western Massachusetts. The CFIA conducts annual monitoring for emerald ash borer within New Brunswick.

European Wood Wasp (*Sirex noctilio* Fabricius): This insect was reported as established in New York State in 2005 and has the potential to cause significant mortality of pines as it has done in several Southern Hemisphere countries. In northeastern North America, it has been found in southern Ontario, western Quebec, southern Connecticut, western Vermont and northern Pennsylvania. The CFIA conducts monitoring for European wood wasp in New Brunswick.

Hemlock Woolly Adelgid (*Adelges tsugae* [Annand]): This pest was introduced to eastern North America from Asia in 1950 and has since caused extensive mortality and decline of hemlock trees in the eastern US. Hemlock decline and mortality typically occur within four to ten years of infestation with stressed trees succumbing more quickly. The closest population of hemlock woolly adelgid to New Brunswick is currently within Maine where it has become established as far north as Lincoln County. No established populations of this pest have been found in eastern Canada, though a detection was made in June of 2012 in Etobicoke, Ontario. Surveys of hemlock stands in southern New Brunswick conducted in 2005 and 2007 by FPMS failed to detect the adelgid. The CFIA also conducts monitoring for hemlock woolly adelgid within New Brunswick every two to three years.

Pine Shoot Beetle (*Tomicus piniperda* L.): First discovered in Ohio, US in 1992, this non-native insect has gradually spread into Québec and western Maine. In Ontario, it has been found in association with mortality in Scots, red, white and jack pines. It is considered a pest of quarantine significance and is regulated by the CFIA under the federal *Plant Protection Act*. The CFIA conducts monitoring for pine shoot beetle in New Brunswick.

SESSION III: SPRUCE BUDWORM

Chair: *Lise Caron*
Natural Resources Canada, Canadian Forest Service

SÉANCE III : LA TORDEUSE DES BOURGEONS DE L'ÉPINETTE

Présidente : *Lise Caron*
Ressources naturelles Canada, Service canadien des forêts

GENOMICS TOOLS FOR SPRUCE BUDWORM MANAGEMENT IN THE GENOMICS ERA

Michel Cusson

Natural Resources Canada, Canadian Forest Service, Laurentian Forestry Centre

ABSTRACT

In North America, few forest pests have drawn as much attention as the spruce budworm (SBW), *Choristoneura fumiferana*. This insect is considered the most devastating native pest of Canada's spruce-fir forests, accounting for ~40% of the 81–107 million m^3 of timber lost, on average, to insects and diseases each year. In eastern Canada, its populations rise to outbreak levels every 30 to 40 years, resulting in significant tree mortality and economic losses. In western Canada, *C. fumiferana* is also an important defoliator, but additional *Choristoneura* species tend to play a more dominant role. Even though knowledge on the SBW has made spectacular progress during the past 50 years, many questions remain about its biology and ecology, and current management approaches are still dominated by the application of pesticides where populations have reached outbreak levels. Taking a step towards unlocking the secrets of the budworm's phenomenal success and developing alternative management strategies, the Budworm Genomics Consortium undertook the sequencing and assembly of its genome. This and related genomics-based efforts offer new prospects for improving SBW management, through both the development of novel pest control products and the generation of eco-genomics data that can be used to fine-tune decision support systems.

RÉSUMÉ

En Amérique du Nord, peu de ravageurs forestiers monopolisent l'attention générale autant que la tordeuse des bourgeons de l'épinette (TBE), *Choristoneura fumiferana*. On dit de cet insecte qu'il est le ravageur le plus dévastateur des forêts de sapins et d'épinettes au Canada, et on lui attribue, en moyenne, ~40 % des 81–107 million m^3 de bois perdu en raison des insectes et des maladies chaque année. Dans l'est du Canada, ses populations atteignent des niveaux épidémiques tous les 30 à 40 ans, entraînant la mortalité des arbres et des pertes économiques considérables. Dans l'ouest du Canada, *C. fumiferana* est aussi un défoliateur redoutable, mais d'autres espèces du genre *Choristoneura* jouent un rôle plus important. Bien que nos connaissances sur la TBE aient progressé de façon spectaculaire au cours des 50 dernières années, plusieurs questions concernant sa biologie et son écologie demeurent sans réponse. De plus, nos pratiques de lutte demeurent axées sur l'application de pesticides lorsque les populations ont atteint un niveau épidémique. Pour aider à faire la lumière sur les secrets du succès phénoménal de cet insecte et à développer des stratégies de lutte alternatives, le Consortium sur la génomique de la tordeuse a entrepris le séquençage et l'assemblage de son génome. Ce projet et des études connexes offrent de nouvelles avenues pour l'amélioration des pratiques de gestion de la TBE, tant par le développement de nouveaux produits antiparasitaires que par la production de données écogénomiques pouvant être utilisées pour peaufiner les systèmes d'aide à la décision.

HISTORICAL SPATIAL ANALYSIS (HSA) OF SPRUCE BUDWORM (SBW) DEFOLIATION – MOTIVATION, LIMITATIONS, INSIGHTS, POTENTIAL

Richard A. Fleming[1]***, Jean-Noël Candau***[1] ***and David Gray***[2]

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ABSTRACT

HSA, as currently practised for spruce budworm (SBW), refers to the use of spatio-temporal statistical methods to reveal spatial and temporal patterns in the records of the annual aerial surveys of spruce budworm defoliation data. A crucial first step in HSA is often summarizing these extremely complex patterns in ways conducive to direct examination and statistical analysis. Further analyses are typically guided by taking a holistic approach to SBW ecology and the SBW outbreak cycle so attempts are made to include other relevant spatio-temporal data (e.g., forest condition, current climate, future climate warming scenarios) when available. These additional analyses delve deeper into the spatio-temporal statistical relationships and have formed the basis for forecasting changes to the general patterns of SBW defoliation in future climates. Thus HSA can provide relatively cheap, immediate, and rough forecasts of future SBW impact on the forest. Besides other motivations for HSA, this talk also discusses some of the insights gained and forecasts made, and finishes with some key limitations of the approach and avenues for potential improvement.

RÉSUMÉ

L'ASH, telle qu'elle est pratiquée à l'heure actuelle pour la tordeuse des bourgeons de l'épinette, consiste à utiliser des méthodes statistiques spatio-temporelles pour révéler des tendances spatiales et temporelles dans les données des relevés aériens annuels de la défoliation par la tordeuse des bourgeons de l'épinette. Une première étape essentielle de l'ASH consiste souvent à résumer ces tendances extrêmement complexes de manière à ce qu'elles se prêtent à l'examen direct et à l'analyse statistique. Les analyses ultérieures sont habituellement guidées par une approche holistique à l'écologie de la TBE et au cycle de ses éclosions; on cherche donc à y inclure d'autres données spatio-temporelles pertinentes (p. ex. état des forêts, climat actuel, scénarios de réchauffement futur du climat) lorsqu'elles sont disponibles. Ces analyses supplémentaires permettent d'approfondir les relations statistiques spatio-temporelles et ont servi de base à la prévision des changements dans les tendances générales de la défoliation par la TBE en fonction de l'évolution future des climats. Ainsi, l'ASH peut fournir des prévisions relativement bon marché, immédiates et approximatives de l'impact futur de la TBE sur la forêt. Outre les autres motivations à l'utilisation de l'ASH, cette conférence porte aussi sur certaines des connaissances acquises et des prévisions effectuées et s'enchaîne par une présentation des principales limitations de l'approche et des moyens possibles de l'améliorer.

ECOLOGY AND MANAGEMENT OF RISING SPRUCE BUDWORM OUTBREAKS

Jacques Régnière

Natural Resources Canada, Canadian Forest Service, Laurentian Forestry Centre

NOT AVAILABLE

DECISION SUPPORT FOR EASTERN SPRUCE BUDWORM

Kevin Porter

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NOT AVAILABLE

BUDWORM NATION

Vince Nealis

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ABSTRACT

Budworms in the genus *Choristoneura* are significant disturbance agents in northern conifer forests. Their similar life histories lend themselves to comparative analysis of population behaviour. This perspective allows common methods and models to be applied in different ecological contexts enhancing our interpretation of population dynamics and providing novel insights of process and pattern at variable spatial and temporal scales.

RÉSUMÉ

Les tordeuses de bourgeons du genre *Choristoneura* sont des agents perturbateurs importants dans les forêts de conifères nordiques. Leurs cycles biologiques semblables se prêtent à des analyses comparatives du comportement des populations. Ce point de vue permet d'utiliser des méthodes et des modèles communs dans différents contextes écologiques, ce qui rehausse notre interprétation de la dynamique des populations et ouvre de nouvelles perspectives en matière de processus et de modèle à des échelles spatiales et temporelles variables.

SESSION IV: EASTERN PEST MANAGEMENT ISSUES

SÉANCE IV : LA RÉPRESSION DES RAVAGEURS DANS L'EST

FORUM 2012

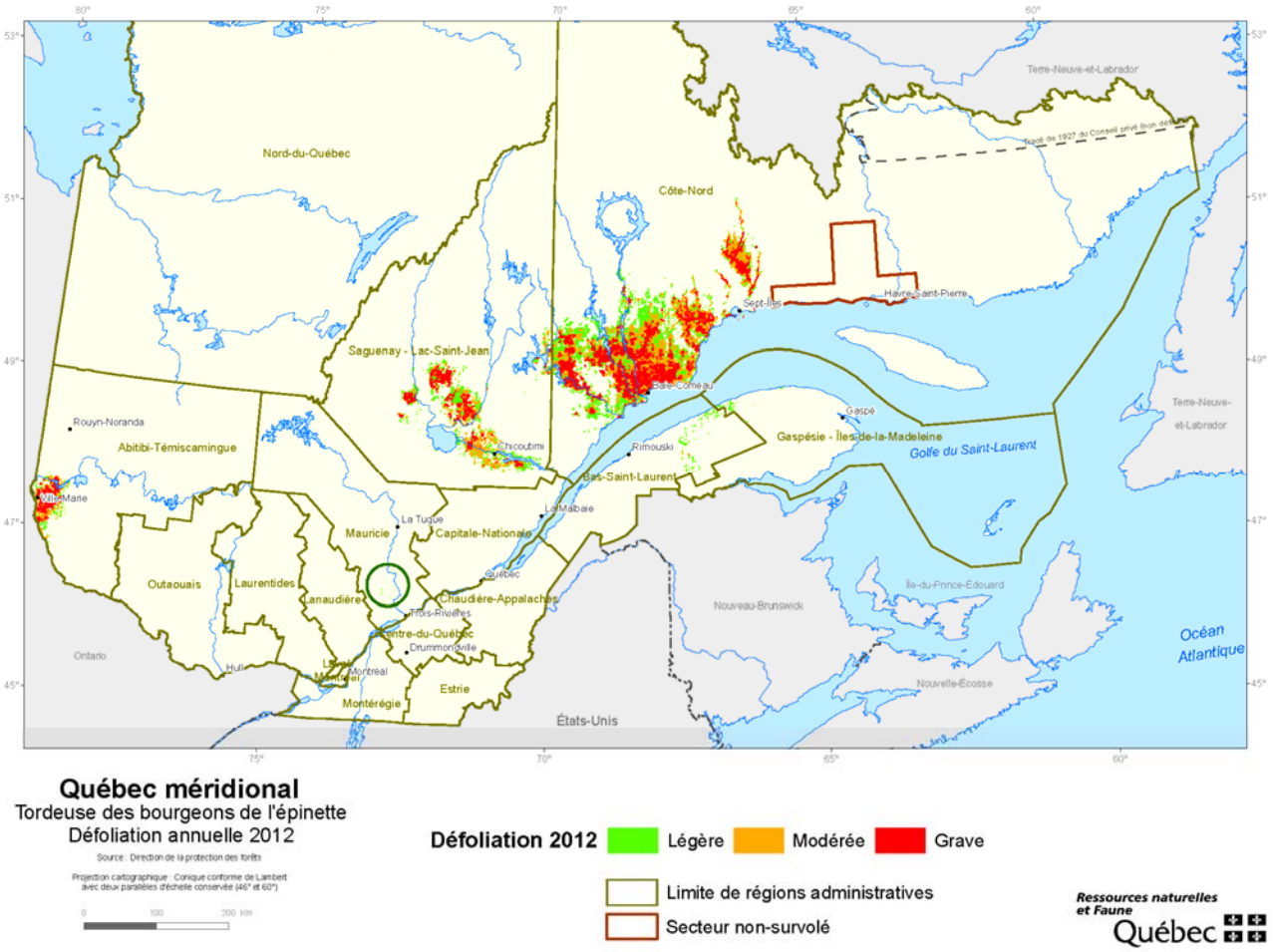
RAPPORT DU QUÉBEC

Louis Morneau

Ministère des Ressources naturelles et de la Faune du Québec

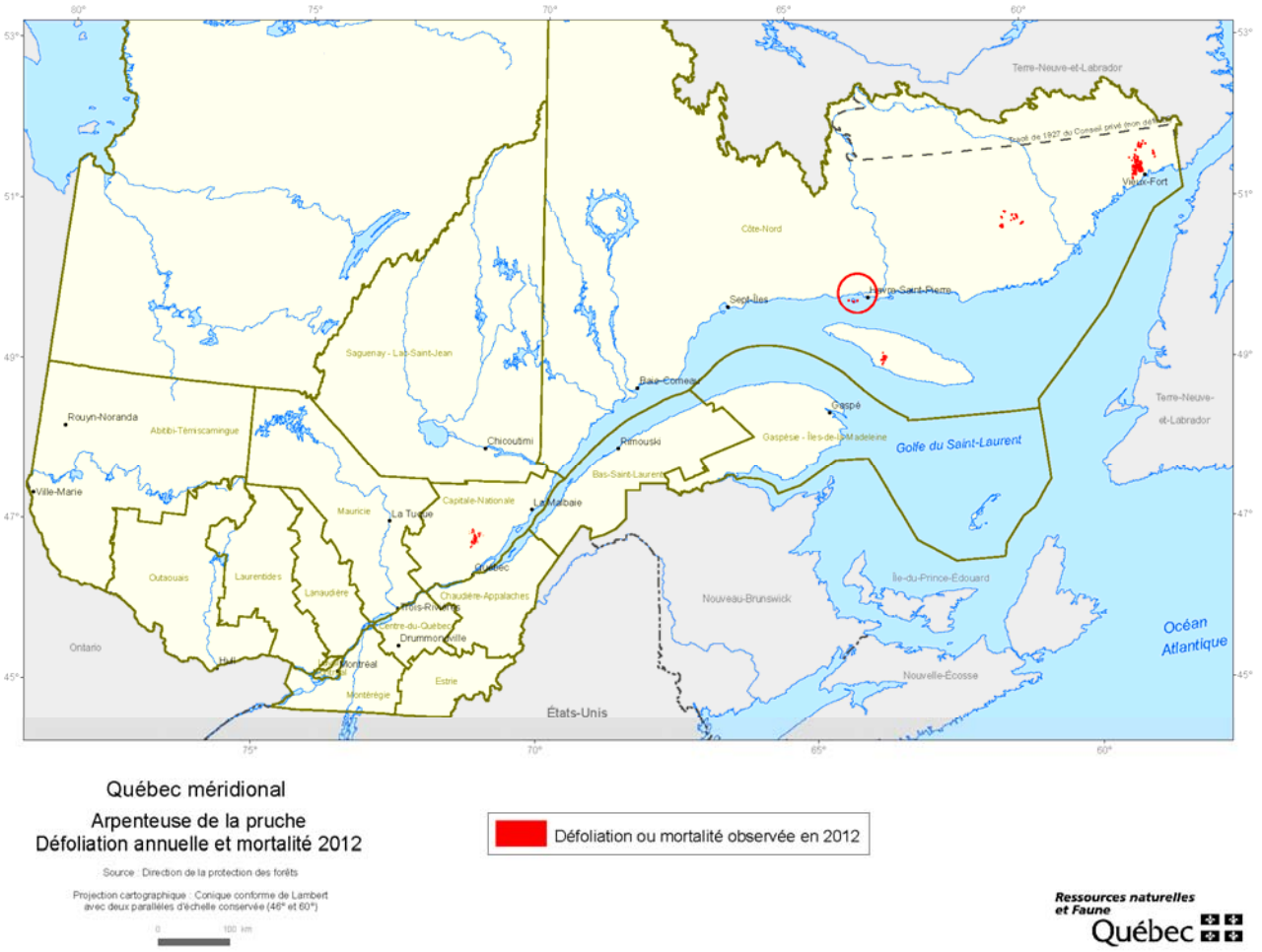
Le mandat de détection des insectes et maladies dans les forêts québécoises est assumé chaque année par la Direction de la protection des forêts (DPF) du ministère des Ressources naturelles (MRN). Cette activité permet notamment d'identifier et de localiser les infestations d'insectes forestiers à caractère épidémique et de suivre leur évolution à l'aide de réseaux de surveillance provinciaux et de relevés aériens des dommages. La collecte des données sur les insectes et les maladies est effectuée par 16 techniciens régionaux. La DPF planifie, coordonne et supervise les activités des relevés et fournit le soutien technique aux équipes régionales. Son laboratoire réalise les diagnostics entomologiques et pathologiques pour l'ensemble du Québec. La DPF fournit également son expertise dans les programmes spéciaux d'évaluation de dommages ou de récupération de matière ligneuse mis en place à la suite d'importantes perturbations naturelles (chablis, verglas, feux, etc.). En 2012, les techniciens en protection des forêts ont visité 2 771 sites d'observation, dont 567 plantations de pins, d'épinettes, de mélèzes et de feuillus. De plus, le personnel a effectué des relevés aériens afin de détecter et de circonscrire les dégâts causés par la tordeuse des bourgeons de l'épinette, l'arpenteuse de la pruche et la cochenille-tortue du pin, ce qui a requis près de 350 heures de vol. Enfin, 21 pépinières publiques et privées ont fait l'objet d'inspections phytosanitaires. Des lots totalisant quelque 172 millions de plants ont été examinés lors des inspections de certification et quelque 9,6 millions de plants ont fait l'objet d'inspections d'automne.

La **tordeuse des bourgeons de l'épinette** (TBE), *Choristoneura fumiferana*, demeure le principal ravageur des résineux dans la province. Les superficies défoliées par la TBE en 2012 totalisent 2 226 128 hectares (carte 1) comparativement à 1 642 957 hectares en 2011 et 765 740 hectares en 2010. Les régions les plus touchées sont la Côte-Nord, le Saguenay–Lac-Saint-Jean et l'Abitibi-Témiscamingue. La répartition des dommages dans ces régions est, respectivement, de 78 %, 17 % et 4 % du total provincial. Les infestations relevées dans les régions de la Mauricie et des Laurentides ont diminué par rapport à 2011 alors que celles qui persistaient depuis plusieurs années dans l'Outaouais se sont finalement résorbées. Tel qu'anticipé lors des relevés de prévisions de l'automne 2012, des dommages ont été délimités pour une première année dans les régions du Bas-Saint-Laurent et de la Gaspésie–Îles-de-la-Madeleine. Ailleurs au Québec, aucune aire défoliée n'a été détectée par le survol aérien. Un programme de pulvérisations aériennes contre la TBE a été mis en œuvre en 2012 pour une quatrième année consécutive dans la région de la Côte-Nord et pour une troisième année dans la région du Saguenay–Lac-Saint-Jean. La Société de protection des forêts contre les insectes et maladies (SOPFIM) est l'organisme mandaté par la ministre pour élaborer et réaliser le plan d'intervention annuel. Des arrosages d'un insecticide biologique, le *Bacillus thuringiensis* var. *kurstaki* (*Btk*), ont été réalisées du 23 mai au 17 juin sur une superficie totale de 98 044 hectares. Le site Internet de la SOPFIM (www.sopfim.qc.ca) contient de plus amples renseignements sur les résultats du plan d'intervention 2012.



Carte 1. Défoliations causées par la tordeuse des bourgeons de l'épinette au Québec en 2012

Deux nouveaux foyers épidémiques de l'**arpenteuse de la pruche**, *Lambdina f. fiscellaria*, ont été répertoriés dans la province en 2012. Dans la région de la Capitale-Nationale, la défoliation s'étend sur 3 379 hectares alors que dans la région de la Côte-Nord, le foyer épidémique couvre 2 677 hectares sur l'île d'Anticosti (carte 2). Seule de la mortalité est encore visible dans les peuplements touchés depuis 2009 sur la Basse-Côte-Nord (secteurs de Vieux-Fort et de La Romaine) et sur les îles de Mingan.



Carte 2. Défoliations causées par l'arpenteuse de la pruche au Québec en 2012

Une infestation de la **tordeuse à tête noire de l'épinette**, *Acleris variana*, a été détectée en 2012 dans l'est de la province. Les défoliations sont majoritairement à un niveau léger de dommage et s'étendent sur 12 127 hectares dans les régions du Bas-Saint-Laurent et de la Gaspésie–Îles-de-la-Madeleine, à l'est de Causapscal et à l'ouest de la rivière Nouvelle. La surveillance de ce secteur se poursuivra en 2013 pour connaître la tendance évolutive de l'infestation.

Le relevé aérien des dommages a permis de délimiter 597 hectares de dégâts causés par la **cochenille-tortue du pin**, *Toumeyella parvicornis*, sur le pin gris dans la région de l'Abitibi-Témiscamingue, au sud de Rouyn-Noranda. Les superficies touchées comportaient en général plus de 75 % de mortalité des arbres. L'insecte a aussi causé localement de la mortalité de pins gris dans la région des Laurentides, au nord de Mont Saint-Michel.

Une infestation importante de la **chenille à houppes rousses**, *Orgyia antiqua*, a été observée dans la région de la Capitale-Nationale en 2012, dans les mêmes secteurs que l'épidémie d'arpenteuse de la pruche. Les dommages de l'insecte s'ajoutaient à ceux de l'arpenteuse. Dans la région du Bas-Saint-Laurent et de la Gaspésie–Îles-de-la-Madeleine, la chenille à houppes rousses a été remarquée dans le centre de la

péninsule gaspésienne. Dans ce secteur, elle a contribué aux dommages causés par la tordeuse à tête noire de l'épinette.

Aucune défoliation par la **tordeuse du pin gris**, *Choristoneura p. pinus*, n'a été détectée par le relevé aérien des dommages en 2012. Les relevés terrestres confirment encore la présence locale de l'insecte dans un site au Saguenay–Lac-Saint-Jean et ce, depuis 2004. Les captures de papillons dans les pièges à phéromones demeurent faibles.

Des dommages locaux par la **livrée des forêts**, *Malacosoma disstria,* ont été notés dans l'ouest de la province. Dans la région du Nord du Québec, des défoliations de niveaux légers à modérés ont été observées dans un secteur au nord-est de Matagami alors que, dans la région de l'Abitibi-Témiscamingue, de faibles dommages étaient rapportés au sud-est de Ville-Marie.

L'**arpenteuse de Bruce**, *Operophtera bruceata*, a causé des défoliations, souvent de niveau modéré, sur l'érable à sucre dans les régions de l'Estrie et de la Montérégie. Les dommages par l'insecte sont aussi plus fréquents dans certains secteurs des régions de la Capitale-Nationale et de la Chaudière-Appalaches et parfois jumelés avec ceux d'un autre défoliateur hâtif, l'**arpenteuse d'automne**, *Alsophila pometaria*. Les dégâts par l'arpenteuse de Bruce observés dans les régions de la Mauricie et du Centre du Québec ont été moins importants qu'en 2011. La chenille a aussi causé des défoliations légères dans les régions des Laurentides, de l'Outaouais et de la Gaspésie–Îles-de-la-Madeleine.

L'Agence canadienne d'inspection des aliments (ACIA) a confirmé la présence de l'**agrile du frêne**, *Agrilus planipennis*, dans la région de la Montérégie, au Québec, en juin 2008. En 2012, la DPF a installé huit pièges pour détecter cet insecte hors de la zone réglementée de Gatineau. Tous les pièges installés ont capturé des adultes de l'agrile du frêne. L'ACIA a confirmé cette année la présence de l'agrile du frêne à Laval, Longueuil, l'Ange-Gardien et Chelsea dans la MRC des Collines-de-l'Outaouais, ainsi que dans le canton de Lochaber dans la MRC de Papineau.

Les pins blancs de plusieurs régions de la province présentent depuis quelques années, dès le mois de mai, une maladie de feuillage très préoccupante. Celle-ci débute par le brunissement des aiguilles du tiers inférieur de la cime, qui finissent par tomber prématurément au mois de juin. Les maladies fongiques associées à cette maladie sont la **brûlure en bandes brunes**, *Lecanosticta acicola (*téléomorphe : *Mycosphaerella dearnessii),* la **brûlure en bandes rouges**, *Dothistroma septosporum* (téléomorphe : *Mycosphaerella pini*), le **rouge des aiguilles** (*Canavirgella bandfieldii*) et quelques autres champignons et insectes secondaires.

Sur le pin rouge, on observe également une problématique sur le feuillage semblable à celle trouvée sur le pin blanc. Au courant de l'été, les aiguilles se décolorent à cause de la présence de trois organismes : la brûlure en bandes rouges, la brûlure en bandes brunes et un insecte, le **charançon gallicole du pin**, *Podapion gallicola*. Au mois de septembre 2012, suite à l'été particulièrement sec, des pins rouges affectés commençaient à dépérir. Les symptômes ont continué à progresser, jusqu'au retour de la pluie en octobre. Le **chancre diplodien** et la **brûlure des rameaux**, tous deux causés par *Diplodia pinea*, ont été relevés dans plusieurs plantations de pins rouges dans la région de l'Outaouais.

La **brûlure des pousses** sur le sapin baumier causée par *Delphinella balsamea* était observée de nouveau sur les aiguilles de l'année et sur la nouvelle pousse dès la fin du printemps dans les régions du Bas-Saint-Laurent et de la Gaspésie–Îles-de-la-Madeleine. Dans certains secteurs, les dommages causés par *D. balsamea* variaient de léger à modéré.

Abstracts / Résumés

FORUM 2012

En 2012, le Québec a connu des températures exceptionnelles dès le printemps. Une **canicule printanière** a été répertoriée en mars dans tout l'est du Canada. À plusieurs endroits au Québec, la température a atteint plus de 15°C à chaque jour entre le 18 et le 23 mars alors que la normale est de 1°C. Les températures les plus élevées ont été enregistrées dans les régions de l'Abitibi-Témiscamingue, de la Mauricie et du Saguenay–Lac-Saint-Jean. Cette canicule a entraîné la fonte rapide de la neige et le débourrement hâtif des bourgeons des arbres et des insolations sur les troncs, ce qui les exposa à des gels dont celui de la fin d'avril qui occasionna des dommages importants.

Les mois de juin et de juillet 2012 ont été caractérisés par un temps chaud et sec ainsi que des épisodes de canicule sur tout le territoire québécois. Ainsi, des symptômes de **sécheresse** dus au stress hydrique ont été observés sur plusieurs essences de feuillus. Ils se présentent comme une décoloration du feuillage, un flétrissement et un dessèchement suivi d'une chute prématurée des feuilles. Dans certains cas, la sécheresse a causé la mort des rameaux de l'année ce qui pourra avoir des répercussions plus importantes dans les années à venir. L'Outaouais a été la région la plus affectée au Québec.

Quelques tempêtes de **vents violents** se sont abattues sur le Québec au cours de l'année 2012. La région du Saguenay–Lac-Saint-Jean a été celle la plus touchée en 2012. D'autres superficies ont été affectées totalisant plus de 4 000 hectares et ont nécessité des travaux de récupération et de remise en production.

Bilans du relevé des insectes et maladies des arbres du Québec :
http://www.mrn.gouv.qc.ca/forets/fimaq/insectes/fimaq-insectes-portrait.jsp

Cartes des relevés aériens de défoliation :
http://www.mrn.gouv.qc.ca/forets/fimaq/insectes/fimaq-insectes-portrait-releves.jsp

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Quebec pest reports:
http://www.mrn.gouv.qc.ca/forets/fimaq/insectes/fimaq-insectes-portrait.jsp

Aerial survey maps:
http://www.mrn.gouv.qc.ca/forets/fimaq/insectes/fimaq-insectes-portrait-releves.jsp

FORUM 2012

ONTARIO REPORT

Taylor Scarr

Ontario Ministry of Natural Resources

NOT AVAILABLE

SESSION V: NORTH OF 60 REPORTS

SÉANCE V : AU NORD DU 60e PARALLÈLE

NORTHWEST TERRITORIES REPORT

Mike Gravel

Government of the Northwest Territories, Environment and Natural Resources

While 2012 was not an extraordinary year for most forest health agents, one prominent event occurred that has potential long term implications. On September 18, 2012 mountain pine beetle was officially found in the Northwest Territories (NWT).

This year's aerial surveys were carried out between July 8 -18, 2012 with nearly 4,000 kilometers travelled. Some areas in the southern NWT were not surveyed due to smoke visibility issues. Mountain pine beetle pheromone traps were set in early July and retrieved in mid-September.

Overall 272,000 hectares of the NWT were mapped as having spruce budworm, aspen serpentine leafminer or willow leaf blotch miner (Figure 1). The North was predominantly affected by spruce budworm. The Southwest portion of the NWT (Dehcho Region) was predominantly affected by aspen serpentine leafminer, while the Southeast portion of the NWT (South Slave Region) was predominantly affected by willow leaf blotch miner. Mountain pine beetle was discovered in the southeast section of the Dehcho Region.

Mountain Pine Beetle

Mountain pine beetle pheromone baits have been deployed in the NWT since 2009; however, the sites used were mostly based on convenient access along highway routes and no beetles had been discovered. In 2011 Alberta discovered mountain pine beetle 50 kilometers south of the NWT border near the BC and Alberta junction. Alberta offered to assist the NWT in surveying the border area in 2012.

Three areas in the NWT, near the NWT / Alberta/ BC border, had pheromone baits deployed in the summer of 2012 and all three areas had mountain pine beetle in the fall. Each site had various stages of development from adults to well-developed larvae.

The NWT will look to expand its surveying area in 2013 to determine the extent to which the beetle has spread across southern NWT. Research needs and management options will be discussed further to identify the mountain pine beetle management needs into the future.

Spruce Budworm

Spruce budworm has remained at relatively low levels since 2004. In 2012, just over 63,000 hectares was attacked; the majority of area had severe defoliation (39,000 hectares) with another 22,000 hectares of moderate defoliation.

The majority of spruce budworm defoliation occurred in the Sahtu Region (from 64°30'N to 66°30'N). A new area of defoliation was discovered in the Dehcho Region in the Ebbitt Hills. Ongoing defoliation in the North Slave Region and South Slave Region changed little.

Aspen Serpentine Leafminer

Aspen serpentine leafminer has been persisting across the north for a few years. In 2012 however, more area had moderate defoliation than severe. This may be a sign that this insect is starting to lose steam. In total over 167,000 hectares was attacked by aspen serpentine leafminer, nearly 84,000 hectares of which was moderately defoliated and 75,000 was severely defoliated.

Willow Leaf Blotch Miner

Willow leaf blotch miner is another prevalent insect found from the southern NWT to the far north (Inuvik Region). Nearly 42,000 hectares of willow leaf blotch miner was mapped in 2012, the majority of which occurred in the South Slave Region. There was almost a 50/50 split between severe and moderate defoliation. As you move north the intensity of attack decreases and the areas affected are small isolated patches.

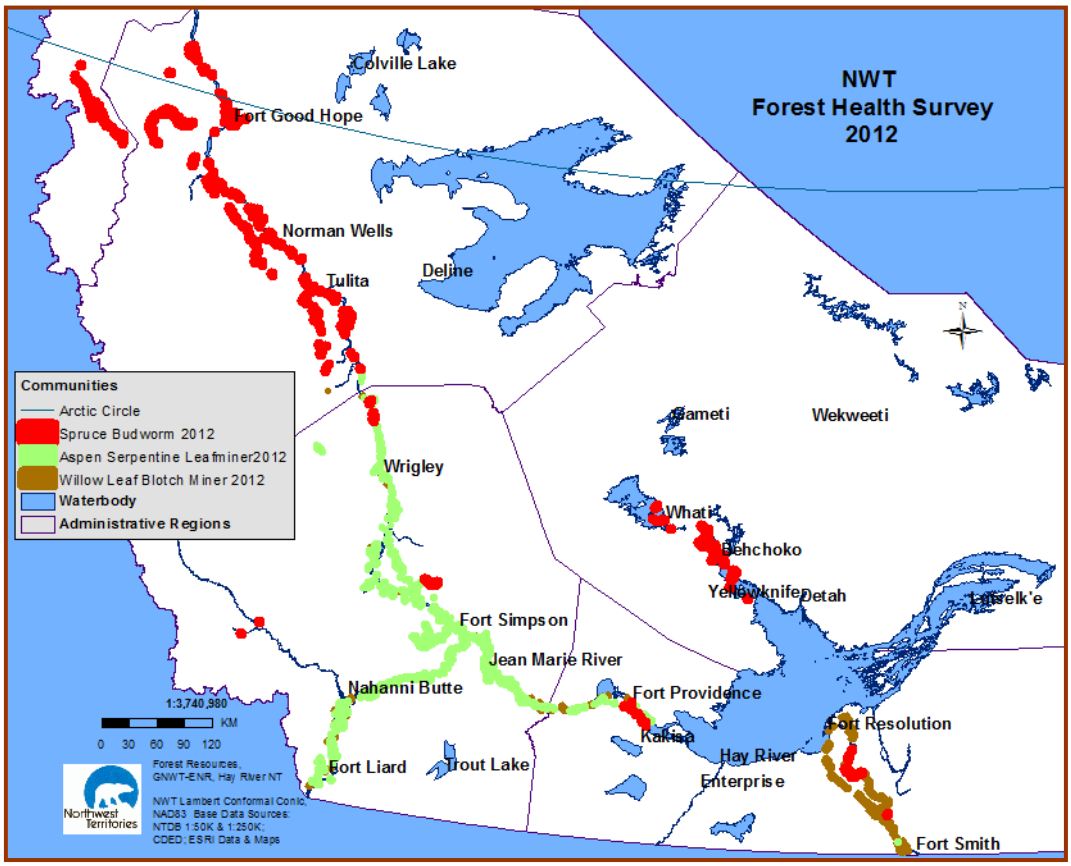

Figure 1. Aerial survey map showing NWT survey results: spruce budworm (red), aspen serpentine leafminer (green), and willow leaf blotch miner (brown).

Forest Health Report 2012

Yukon
Energy, Mines and Resources
Forest Management Branch

Cover photos
Top left photo: Aerial survey of lodgepole pine needle cast in central Yukon
Top center photo: Forest technician setting up mountain pine beetle pheromone bait traps
Top right photo: Aerial survey crew
Background photo: Aerial survey of willow blotch miner in central Yukon

Table of Contents

A Risk-Based Approach to Forest Health Monitoring for Yukon

In 2009, the Government of Yukon's Forest Management Branch (FMB) implemented a risk-based approach to forest health monitoring that is in line with the National Forest Pest Strategy (NFPS), which was approved by the Canadian Council of Forest Ministers (CCFM) in 2006. The NFPS is a proactive, integrated response to forest pests that uses a risk-based framework for coping with native and non-native forest pests in Canada. The intent of the NFPS is to reduce forest health impacts by improving coordination across jurisdictions, enhancing capacity for identifying and assessing forest pest risks, and increasing options and effectiveness of responses to forest pest threats (CCFM, 2007).

Forest pest risk analysis uses scientific information to develop and implement programs to reduce risk associated with forest pests, while also accounting for the uncertainty of future events and outcomes (CCFM, 2007).

In response to the NFPS, FMB developed an annual risk-based forest health monitoring program. The objectives of this risk-based forest health monitoring program are:

1. To provide a Yukon-wide overview of forest health issues;
2. To focus monitoring activities on high-risk forest health agents across forested landscapes that are of the most value to Yukon residents; and
3. To contribute to the NFPS goals, one of which is developing early detection and reporting capacity of forest health pests.

Before 2009, FMB relied heavily on the Canadian Forest Service (CFS), Pacific Region to carry out its forest health program. CFS supported the Yukon Forest Health Program through the Forest Insect Disease Survey Program (FIDS), and when this nation-wide program was terminated in 1995, CFS continued its support through a contribution agreement with Government of Yukon.

Through this agreement, CFS contributed the expertise of their forest health technician to carry out surveys and generate an annual forest health report and FMB funded the fieldwork. CFS work centred around mapping the spruce bark beetle (*Dendroctonus rufipennis*) infestation in southwest Yukon, which is the largest, most intensive spruce bark beetle outbreak ever recorded in Canada. Currently, CFS does not assist Yukon in the same capacity.

Identification of Major Forest Health Agents of Yukon

In 2009, staff from FMB and CFS and a forest consultant listed 10 forest health agents that pose the greatest risk (i.e., extensive mortality or defoliation) to Yukon forests and can be effectively monitored as part of a risk-based forest health monitoring program. Eight of the nine forest pests that will be deliberately targeted through annual monitoring are insects. These insect pests have the capacity to cause significant damage to forest resources, and with their visible damage, they can be effectively monitored.

The only pathogen that will be monitored by FMB is pine needle cast (*Lophodermella concolor*), a pest that can impact large forest areas. Pine needle cast can be effectively monitored because its damage to pine foliage can be very visible. Although root rot (i.e., Tomentosus root disease) and heart rot (i.e., aspen trunk rot) fungi cause more significant damage compared to foliage pathogens, they are more difficult to detect and require specialized ground surveys and expertise. As a result, root and heart rot will not be routinely monitored except in areas affected by timber harvest projects, reforestation efforts and regeneration surveys. Tree dieback due to drought stress was also identified as an additional forest health agent of concern.

Yukon will routinely monitor the following 10 biotic and abiotic forest health agents:[1]

1. **Spruce bark beetle** *(Dendroctonus rufipennis)*
   This bark beetle is the most damaging forest pest of mature spruce (*Picea spp.*) forests in Yukon. A spruce bark beetle outbreak in southwest Yukon that began around 1990 has killed more than half of the mature spruce forest (primarily white spruce [*P. glauca*]) over this 380,000 ha area.
2. **Northern spruce engraver** *(Ips perturbatus)*
   The northern spruce engraver acts as both a secondary bark beetle that attacks trees infested with spruce bark beetle, as well as a primary bark beetle that attacks and kills stressed spruce trees (primarily white spruce). The population of the northern spruce engraver beetle has increased in Yukon as a result of the increased availability of host material associated with the spruce bark beetle outbreak in southwest Yukon. In 2008, infestations by the northern spruce engraver were at their greatest level since the beginning of forest health recording in Yukon; spruce engraver beetle infestation was mapped in southwest Yukon across 3,174 ha (Garbutt, 2009).

[1] Although annual forest health monitoring will focus on forest pests and abiotic factors that pose the greatest risk to Yukon forests, other forest pest activity will be recorded when it is encountered.

3. Western balsam bark beetle *(Dryocoetes confusus)*
This beetle attacks subalpine fir (*Abies lasiocarpa*). Western balsam bark beetle has moved north from B.C. over the last 20 years and has become an active disturbance agent in mature subalpine fir stands in southern Yukon.

4. Budworms *(Choristoneura spp.)*
The budworm guild, consisting of eastern spruce budworm, fir-spruce budworm, two-year cycle budworm and western black-headed budworm, causes similar defoliation damage to spruce, subalpine fir and, to a lesser degree, larch (*Larix laricina*) forests in Yukon. In 2008, eastern spruce budworm damage was mapped across 1,003 ha in Yukon, primarily near Stewart Crossing. Historically, eastern spruce budworm damage has been mapped in the extreme southeast portion of Yukon (Garbutt, 2009).

5. Larch sawfly *(Pristiphora erichsonii)*
This defoliator is the most damaging agent to larch in North America. In the mid- and late 1990s mature larch stands in southeast Yukon were heavily defoliated and experienced some mortality.

6. Large aspen tortrix *(Choristoneura conflictana)*
This defoliator of trembling aspen (*Populus tremuloides*) periodically erupts into outbreaks that result in severe defoliation, branch dieback and sometimes extensive tree mortality. Outbreaks of large aspen tortrix have occurred in several places throughout southern Yukon, including Teslin Lake, Braeburn and Haines Junction.

7. Aspen serpentine leafminer *(Phyllocnistis populiella)*
This insect pest occurs throughout the Yukon range of aspen (*Populus tremuloides*) and also defoliates balsam poplar (*Populus balsamifera*). Currently, a massive outbreak of aspen serpentine leafminer extends from Alaska, through Yukon, and into B.C.

8. Pine needle cast *(Lophodermella concolor)*
This pathogen is the most common cause of premature needle loss to lodgepole pine (*Pinus contorta*) in Yukon (Garbutt, 2009). Pine stands in southeast Yukon are chronically infected, and the disease is becoming increasingly common in central Yukon. In 2008, pine needle cast occurred from the B.C. border to the Continental Divide. The most northern observation of needle cast was observed in young pine stands in the Minto Flats-McCabe Creek area in the Yukon interior (Ott, 2008). The most severe damage in these pine stands covered 477 ha (Garbutt, 2009).

9. Mountain pine beetle *(Dendroctonus ponderosae)*
Though endemic to North America, this bark beetle is not present in Yukon. Most western pines in North America are suitable hosts, but lodgepole pine (*Pinus contorta*) and ponderosa pine (*Pinus ponderosa*) are the most important host species (Logan and Powell, 2001). In western Canada, lodgepole pine is the primary host of this beetle (Campbell et al., 2007; Li et al., 2005).

Mountain pine beetle is currently the most important forest health concern in western Canada. The current outbreak in B.C. is responsible for killing over 18 million hectares of pine forest (Carroll, 2007). Cold-induced insect mortality is considered the most important factor controlling mountain pine beetle dynamics (Régnière and Bentz, 2007). A warming climate is expected to allow the beetle to expand its range into higher elevations, eastward and northward (Carroll et al., 2003; Régnière and Bentz, 2007), potentially as far north as Yukon. Monitoring for mountain pine beetle is a high priority because of its severe impact on pine forests during outbreaks and because of its proximity to the southern border of Yukon.

10. Tree dieback due to drought stress
Because trembling aspen occupies the driest sites in Yukon, dry site aspen stands are expected to be the first stands to exhibit dieback due to drought stress in a warming climate. In 2008, aspen stands exhibiting dieback were scattered along the North Klondike Highway between Whitehorse and Stewart Crossing. Most of these stands were on dry, rocky slopes and bluffs with south and west aspects, although some stands were located on level ground with well-drained gravel soil. Aspen stands experiencing dieback tended to be in an open canopy and were often stunted. Those on the rocky slopes and bluffs typically were adjacent to treeless steppe plant communities which are found on sites too dry for trees to grow (Ott, 2008).

Yukon Forest Health Monitoring Strategy

The monitoring strategy focuses on forest stands throughout Yukon that are most susceptible to the 10 forest health agents of greatest concern. The strategy identifies two monitoring priorities for the next five years. When this period ends and all five zones have been completed, the monitoring strategy will be re-evaluated.

Priorities of the Forest Health Strategy

1. Rotational monitoring of forest health zones
Yukon is divided into five forest health zones (Map 1). In these areas, monitoring focuses on forest stands that are the most susceptible to the 10 forest health agents of greatest concern. Every year, researchers do aerial surveys of at least one forest health zone, and they monitor all communities and highway corridors within all five regions. The majority of accessible commercial forest lands and areas where forest management activities occur are within highway corridors and in close proximity to the communities.

2. Ongoing monitoring of areas of concern
During the monitoring of the five forest health zones, researchers may select disturbances for further monitoring in the same year. If necessary, these disturbances are identified as ongoing monitoring areas to be included along with the forest health zones scheduled for monitoring during the current year. These ongoing monitoring areas help set forest health program priorities.


Map 1:
Forest Health
Monitoring Zones
Yukon, Canada
January 04, 2012
Forest Monitoring Zones
(One zone flown per year)
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Map Grid (1:100,000/map)
Primary Highway
Secondary Highway
BEAUFORT SEA
(ARCTIC OCEAN)
MACKENZIE BAY
Nunavut
ALASKA
(U.S.A.)
Old Crow
Zone 5
Eagle Plains
Zone 3
Dawson City
Keno City
Mayo
Stewart Crossing
Pelly Crossing
Zone 2
Minto
Beaver Creek
Carmacks
Faro
Ross River
Northwest Territories
Burwash Landing
Destruction Bay
Zone 4
Zone 1
Haines Junction
Whitehorse
Carcross
Teslin
Watson Lake
Labiche
PACIFIC OCEAN
British Columbia
1:5,250,000
North American Datum 1983
UTM Zone 8N
0 50 100 200
Km
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Aerial Surveys and Ground Truthing as the Primary Tools for Monitoring

Aerial overview surveys and ground field checks are a relatively simple and low-cost method for effectively monitoring forest health over large areas (Ciesla, 2000; McConnell and Avila, 2004). Aerial overview surveys are also adequate for regional and provincial summaries and to meet national requirements for the Forest Health Network (B.C. Ministry of Forests, Lands and Mines and CFS, 2000).

As a result, aerial overview surveys are the primary tool for monitoring forest health in Yukon. The forest health aerial overview survey standards used by the B.C. Ministry of Forests, Lands and Mines are used in Yukon, ensuring continuity across shared boundaries. Ground field checks are important for validating the data collected from the aerial surveys. Researchers check a portion of surveyed areas to confirm the identity and severity of the pest or disease disturbance.

Standards for conducting aerial surveys

- Use a Cessna 206 or equivalent high-wing, single engine airplane
- Flying height of 800 m above ground level
- Aerial surveyors use 1:100,000 scale maps
- Two qualified aerial surveyors (one positioned on each side of plane)
- Each surveyor oversees a 4-km-wide corridor
- Fly aerial surveys on clear days with sunny skies
- Aerial surveyors map and record the severity and type of disturbance, such as:
  - Dead and dying trees caused by bark beetles
  - Defoliation from insects and diseases such as budworm, leafminers or needle diseases
  - Stressed or dead trees from climatic factors such as flood, drought or windthrow
  - Trees damaged by animals such as porcupine
- Use on-the-ground checks to confirm the type of disturbance recorded from the aerial surveys
- Digitize recorded mapping data and store it in the Government of Yukon Geographic Information System database

Summary of 2012 Forest Health Initiatives

In 2012, FMB forest health initiatives can be summarized in six components.

Component 1: In June 2012, a four-person crew was dispatched by helicopter to assess the survival of MPB populations that had overwintered in trees attacked in 2011. This was followed in July by a two-day aerial survey to map the location, size and severity of discoloured damage found on lodgepole pine that had been attacked and killed by beetles in 2011.

FMB has been actively monitoring the northward expansion of the MPB within the Rocky Mountain Trench of British Columbia since 2011. In June 2011, FMB began the process of conducting a Pest Risk Analysis in order evaluate the threat to Yukon pine forests and develop a management response. The MPB is not currently present in Yukon, but in 2011 aerial surveys mapped MPB infestations within 80 km of the Yukon border. The Pest Risk Analysis was completed in December 2012. A plain language summary of the Pest Risk Analysis Executive Summary is included in this report (Appendix 1).

Component 2: The Government of Yukon Interdepartmental Mountain Pine Beetle Committee hosted a workshop, "The Mountain Pine Beetle and the Potential Northern Expansion Threat to Yukon" on June 19-20, 2012. The objectives of the workshop were:

- to inform stakeholders of the threat of the potential northern expansion of mountain pine beetle to Yukon;
- to provide an update on the work completed by Government of Yukon in monitoring and assessing the northern threat and to give a perspective on the risk to the pine in the north;
- to engage the stakeholders on the risk analysis that the Government of Yukon was undertaking and to gather feedback from stakeholders on what values may be at risk.

Approximately 60 people representing First Nations, municipalities, renewable resource councils, interest groups, government and expert speakers attended the workshop.

Component 3: In early July 2012, an aerial survey was conducted to map outbreaks of large aspen tortrix from Mendenhall west to Haines Junction and the Pelly Crossing area. This survey was followed by a ground assessment of all road-accessible areas of defoliation.

Component 4: In early July 2012, a planned five-day fixed-wing aerial survey to map forest disturbances in the northern portion of Forest Health Zone 2 was interrupted by bad weather. The survey was completed in late August.

Component 5: For the 19th consecutive year, a late August aerial survey was undertaken to map recent mortality caused by spruce bark beetles in southwest Yukon.

Component 6: FMB responded to pest incidence reports from the general public and government agencies regarding wind desiccation on ornamental trees in the City of Whitehorse, dead and dying spruce in the Cowley Creek subdivision south of Whitehorse and outbreaks of the aspen defoliator (large aspen tortrix) in Haines Junction and Pelly Crossing.

Forest Health Aerial Surveys in 2012

In 2012, the northern half of Forest Health Zone 2 was flown using a fixed-wing aircraft (Map 2). Most of the area was flown in an east-west grid pattern, though some contour flying was done in the more mountainous northeast. Bad weather in early July forced the postponement of the survey, and an additional four days of flying in late August was required to complete the project. Instances of disturbance by biotic and abiotic agents were mapped over a total area of 73,052 ha. As in previous years, the aspen serpentine leafminer was responsible for the majority (93%) of pest activity (Table 1). The only other damage of significance resulted from the infection of numerous young lodgepole pine stands in central Yukon by pine needle cast and defoliation of aspen by the large aspen tortrix at Pelly Crossing. Some defoliated birch stands mapped in west central areas were recorded as birch leafroller, but its remote location precluded confirmation from the ground.

Table 1. Area of disturbance by pest, mapped during aerial surveys in Forest Health Zone 2 in 2012

Forest Health Agent	Total Area (ha)
Aspen leaf miner	68,244
Pine needle cast	2,901
Large aspen tortrix	730
Birch leafroller	468
Poplar decline	377
Slide	167
Willow blotch miner	132
Drought - aspen	20
Flood	7
Balsam bark beetle	6

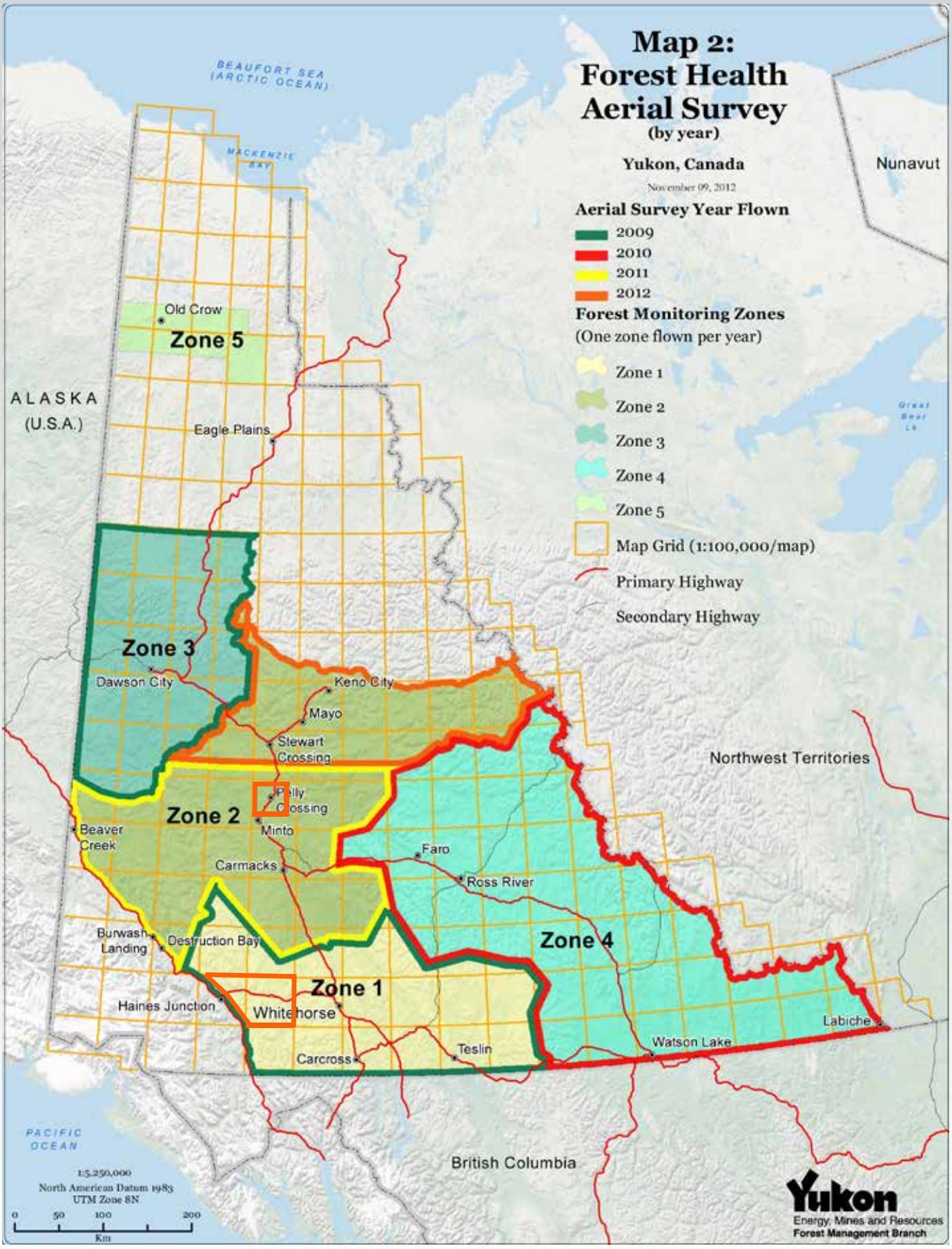
A two-day aerial survey was undertaken in early July to map recent mortality caused by MPB to lodgepole pines in the Rocky Mountain Trench of B.C., southeast of Watson Lake. Cold winter temperatures have slowed the MPB advance and it remains approximately 80 km south of the Yukon border.

A four-hour aerial survey of part of Forest Heath Zone 1 (from Whitehorse to Haines Junction) mapped defoliation caused by the large aspen tortrix. Five large patches of defoliation were mapped over an area totaling 2,765 ha (Table 2) from Mendenhall west to Haines Junction.

In late August, an additional aerial survey was completed to map recent white spruce mortality caused by the ongoing spruce beetle infestation in the southwest. Light mortality was mapped over a total of 263 ha (Table 2), continuing the decreasing trend of the past seven years. This was the last year that the infestation will be flown on a routine basis. Further aerial surveys will be conducted if, and when, new activity is reported.

Table 2. Area of disturbance by pest, mapped during aerial surveys in Shakwak region Forest Health Zone 1 in 2012

Forest Health Agent	Total Area (ha)
Large aspen tortrix	2,765
Spruce bark beetle	263
Flood	3


Map 2:
Forest Health
Aerial Survey
(by year)
Yukon, Canada
November 09, 2012
Aerial Survey Year Flown
2009
2010
2011
2012
Forest Monitoring Zones
(One zone flown per year)
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Map Grid (1:100,000/map)
Primary Highway
Secondary Highway
BEAUFORT SEA
(ARCTIC OCEAN)
MACKENZIE BAY
Nunavut
ALASKA
(U.S.A.)
Old Crow
Zone 5
Eagle Plains
Zone 3
Dawson City
Keno City
Mayo
Stewart Crossing
Northwest Territories
Zone 2
Minto
Beaver Creek
Carmacks
Faro
Ross River
Zone 4
Burwash Landing
Destruction Bay
Zone 1
Haines Junction
Whitehorse
Carcross
Teslin
Watson Lake
Labiche
PACIFIC OCEAN
British Columbia
1:5,250,000
North American Datum 1983
UTM Zone 8N
0 50 100 200
Km
Yukon
Energy, Mines and Resources
Forest Management Branch

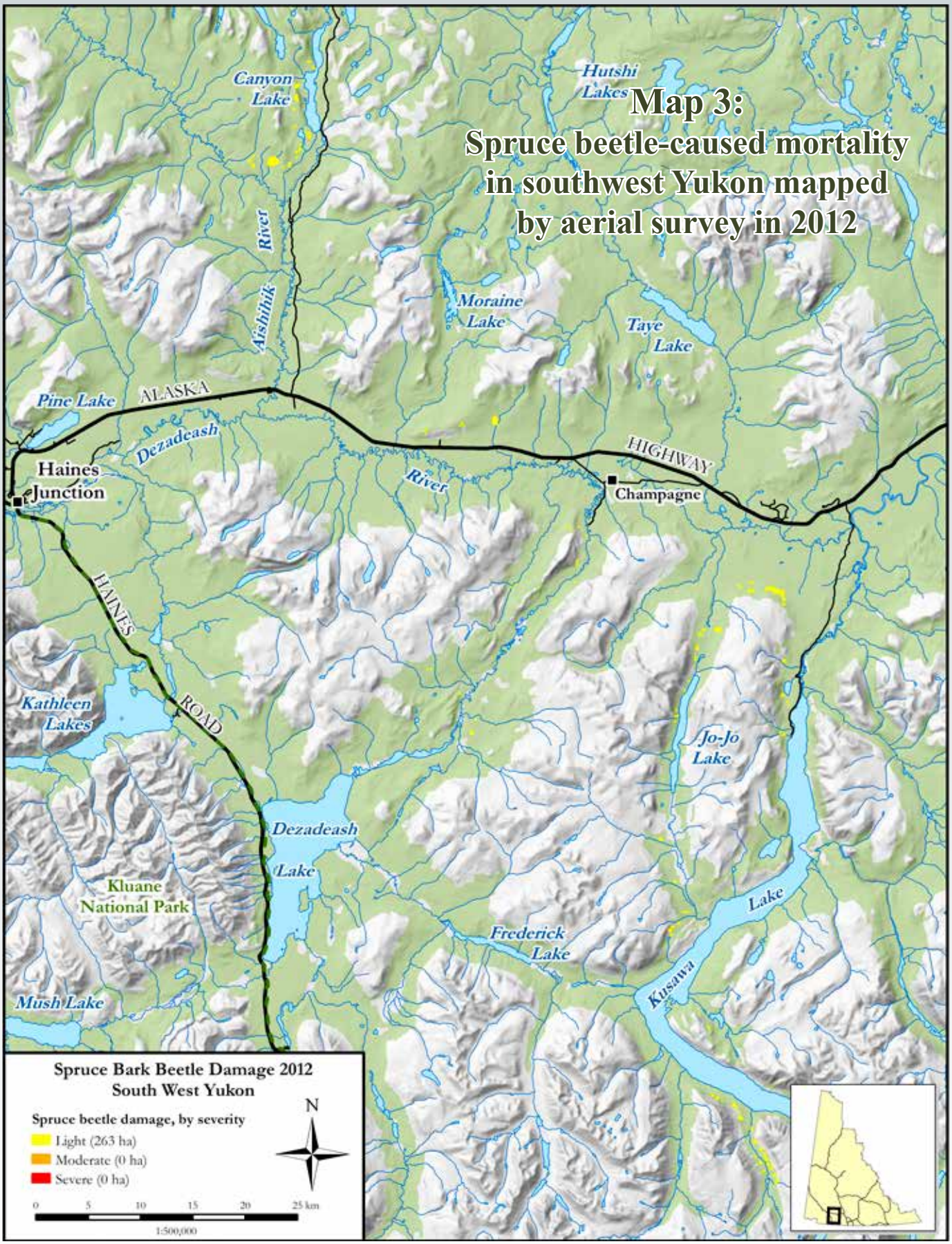
Biotic Pests

Spruce beetle, *Dendroctonus rufipennis*

In its 22nd year (the infestation is suspected to have started in 1990), and covering approximately 400,000 ha, the spruce bark beetle has been the largest (over a contiguous area), most severe and longest lasting spruce bark beetle infestation ever recorded. For the 19th consecutive year, recent spruce beetle-caused white spruce mortality was mapped by fixed-wing aerial survey in southwest Yukon. Recent light damage (<10% of trees in stands killed by 2011 attacks) was mapped over an area totaling 263 ha (Map 3, Chart 1), significantly less than the 414 ha mapped in 2011. This was the eighth consecutive year of decline in the infestation and may finally signal its end.

All of the recent mortality mapped from the air in 2012 was in areas of previous infestation. In all cases infestation levels were significantly less than in 2011. In areas such as the West Aishihik River Valley where the majority of the concentrations of red trees were mapped in 2011, only small spots totaling less than 100 ha were mapped this year (Photo 1). The rest of the red trees were seen between Frederick Lake and Kusawa Lake, extending south along the southwest shore of Kusawa Lake to just south of Devilhole Creek, as well as farther north in the JoJo Lakes area (Map 3).

Because of the low concentrations of attack this year, no ground surveys were undertaken. The greatly diminished beetle population will likely meet with limited success, as the drought that spawned the infestation initially is long over and the trees' natural resistance to attacks has been restored.


Map 3:
Spruce beetle-caused mortality in southwest Yukon mapped by aerial survey in 2012
Canyon Lake
Hutshi Lakes
River
Aishihik
Moraine Lake
Taye Lake
Pine Lake
ALASKA
HIGHWAY
Dezadeash
River
Haines Junction
Champagne
HAINES
ROAD
Kathleen Lakes
Jo-Jo Lake
Dezadeash Lake
Kluane National Park
Frederick Lake
Lake
Kusawa
Mush Lake
Spruce Bark Beetle Damage 2012
South West Yukon
Spruce beetle damage, by severity
Light (263 ha)
Moderate (0 ha)
Severe (0 ha)
N
0 5 10 15 20 25 km
1:500,000

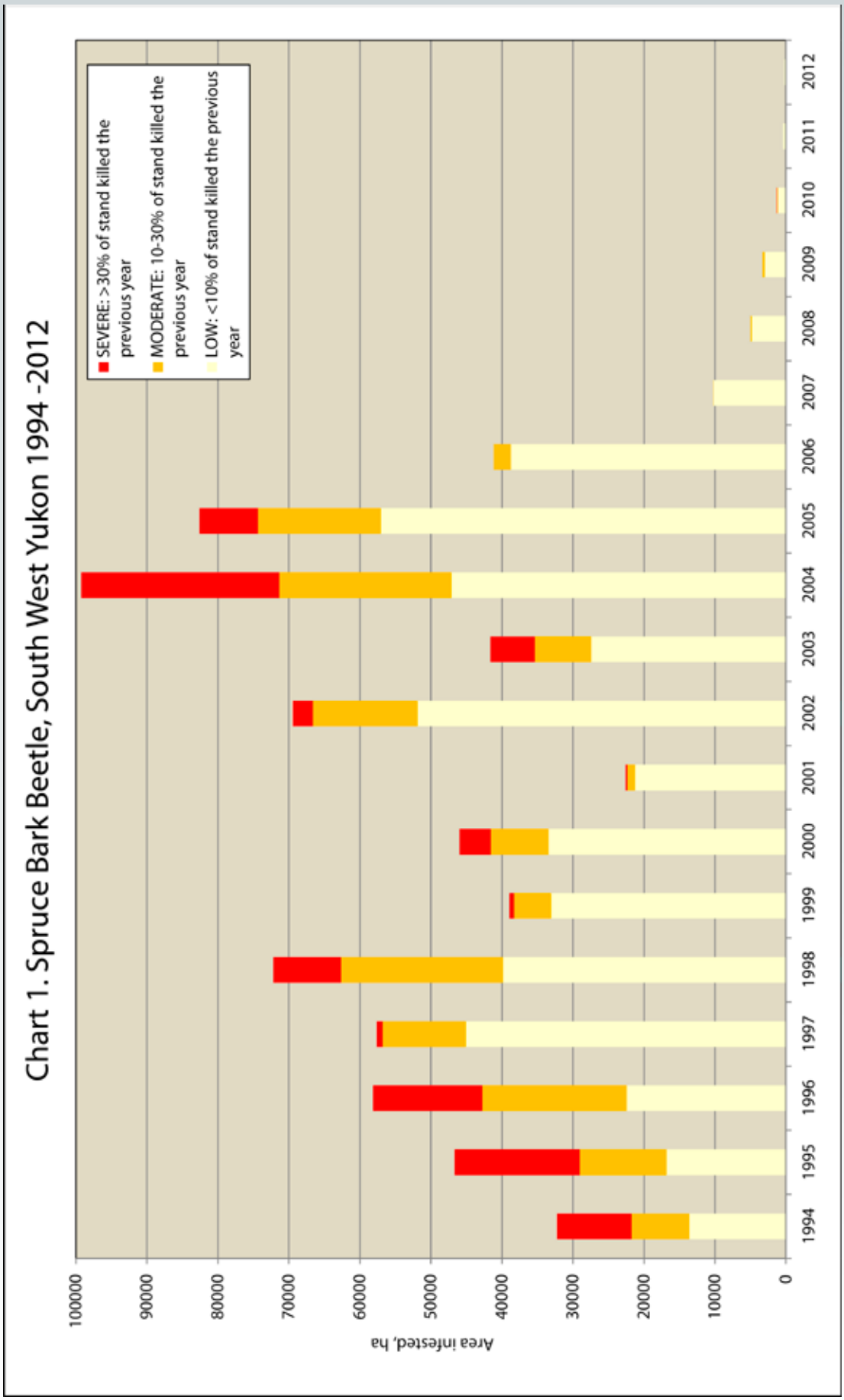


Chart 1. Spruce Bark Beetle, South West Yukon 1994 -2012
SEVERE: >30% of stand killed the previous year
MODERATE: 10-30% of stand killed the previous year
LOW: <10% of stand killed the previous year
Area infested, ha
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
100000
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012

The continuing legacy of the beetle: the next generation of forest

Although the infestation is essentially over, its legacy remains in the form of millions of dead white spruce trees across approximately 400,000 ha of southwest Yukon landscape, primarily within Kluane National Park and the Shakwak Trench. These dead trees will remain standing for many years before root decay reduces their attachment to the soil and they begin to fall over. The question that concerns foresters and residents of the infested area is: what will we be left with?

Between 2000 and 2003, CFS established 27 research plots within the spruce bark beetle infestation area. The purpose of the research plots was to determine what the short-and long-term effects of the spruce bark beetle infestation had on forest composition and structure and how the infestation affected regeneration. The regeneration was found to be fairly well-spaced with some clumping especially within the smaller tree class (Garbutt et al., 2006). The clumping was not surprising because in the boreal forest, a typically thick moss layer on the forest floor discourages the germination of tree seeds. Germination can occur only when mineral soil is exposed. Soil is exposed most often when trees fall over with their root balls still attached, leaving an exposed root pan in which numerous seedlings can germinate. This was seen in some of the plots and in many of the surrounding stands. The groups of trees are naturally thinned by competition with their close neighbours and become more regularly distributed as they mature.

Some of the trees, particularly those in the larger size class, have already been released by the increase in light penetrating through the thinned crowns of the dead over-story. The remainder will be released slowly as the branches of the dead over-story are shed and the trees begin to fall over. The risk of a wildfire is still significant because of an abundance of fine fuels on the forest floor and in the fine branchlets that remain on the dead trees (Hawkes, 2003 pers. comm.). As the loss of fine branchlets progresses, the possibility of an intense and rapidly spreading fire within the tree crowns will diminish. Instead we will see a progressive accumulation of ground fuels, with an increasing risk of a less damaging ground fire. The period of highest hazard has already passed. With continued moist summers and a low incidence of lightening, the forests will be replenished. In 50-60 years the new forest will be largely indistinguishable from the forest that existed before the onset of the beetle infestation.

Photo 1. Ongoing light spruce beetle-caused mortality near the West Aishihik River

Mountain pine beetle,
Dendroctonus ponderosae

The mountain pine beetle (MPB) is a native North American bark beetle that is distributed throughout most of the range of lodgepole pine in British Columbia. The MPB is currently the single biggest forest health concern in western Canada; the current MPB outbreak is responsible for killing over 18 million hectares of pine forest in B.C. alone.

The MPB is one of 10 forest health agents that pose the greatest risk to Yukon forests and can be effectively monitored as part of a risk-based forest health monitoring program. Although the MPB population has not expanded into Yukon, it has moved quickly northward in the last few years within the Rocky Mountain Trench in northern B.C. In the next few years, there is potential for further northward movement of a large population of MPB into Yukon.

Climate plays an important role in the population of MPB. The most important factor in controlling the northern movement of MPB is cold weather and an inner bark temperature of -40˚C for at least one week. Mild winter weather allows overwintering MPB populations to thrive and the outbreak to continue.

This beetle poses a potential threat to lodgepole pine forests of southern Yukon. It has historically been restricted to the pine forests of central and southern B.C.

- Beginning in 1994, in areas of central British Columbia, the beetle successfully invaded lodgepole pine forests to the north and east of its traditional range. These areas had formerly been denied to the beetle, being too harsh climatically. With recent climate moderation this has changed.
- As the beetles moved beyond their traditional range they invaded stands that had no historical relationship to the beetle and hence had little or no adaptive resistance.
- In the past few years populations of beetles have moved north within the Rocky Mountain Trench and into southern portions of the Muskwa-Kechika Conservation Area, killing most of the mature pine as they went. In 2010, infestations were mapped by B.C. Ministry of Forests' aerial surveys within 150 km of the Yukon border. In 2011, MPB had advanced to within 80 km.
- It is as yet unknown whether the beetle will be successful as it moves north into harsher climatic conditions.

Pest Risk Analysis

Identifying the risk

The first step in developing a pest risk assessment is the identification of risk posed by a specific disturbance agent. In the case of MPB, the potential risk to Yukon forests was recognized as early as 2003, when pheromone baits trapped beetles for the first time on the east side of the Rocky Mountains near Chetwynd, B.C. It was then that the Rocky Mountain Trench was recognized as the most direct and geographically the most suitable lowland route for the beetle to move northward toward Yukon. Forest inventory data also indicated an abundance of susceptible pine within the Trench.

The only question remaining was whether the beetle could survive the rigours of climate, particularly the increasingly harsh winters, as it moved northward. This question was answered by aerial survey data from B.C. which documented the northern movement. In 2010, large areas of continuous beetle-caused mortality were mapped within the Muskwa-Kechika Conservation Area, 150 km south of the Yukon border.

Monitoring the Mountain Pine Beetle in 2012

In 2011, after viewing the 2010 aerial survey maps from northern B.C., FMB decided to take a proactive approach to managing the threat posed by the MPB. Surveys were conducted to determine beetle movement between 2010 and 2011, as well as an assessment of the size and health of the current beetle population. Aerial surveys in 2011 determined that the beetle had advanced northward and killed small numbers of trees as close as 80 km south of the Yukon border. Ground surveys within 13 stands in August 2011 found that severe cold during the winter of 2010/11 had killed the vast majority of broods within the trees but significant recent attacks were seen in 3 of the 13 stands. Detailed results of these surveys were published in two reports available upon request from the FMB.

Assessments in 2012 were broken into two stages:

- Stage 1: June ground assessment
- Stage 2: July aerial survey

Stage 1

In early June a four-person crew accessed nine stands by helicopter to perform "R-value" assessments on trees that were attacked the previous year. The purpose was to determine survival of overwintering broods and estimate the risk for further attacks by emerging broods. The first three assessments were made at sites where current attacks were found and trees were flagged during the 2011 ground survey. The additional six sites were selected for assessment based upon the presence of "faders" (trees attacked and killed in 2011 and recognized from the air by the yellow-red colour of the crowns), and the availability of a helicopter landing site. The assessment consisted of removing 225cm^2 (15 cm X 15 cm) bark samples at breast height (1.3 m) from the north and south sides of each of 10 trees per site and counting the surviving broods. No living progeny were found in any of the 172 samples (Photo 2). Note only six trees were sampled at one site. Heavy woodpecker debarking was seen at all sites. Little or no larval development was seen in most samples.

Any development that was seen had been killed by winter cold (Photo 3). There were signs of woodpecker feeding at most sites, but instead of removing extensive bark in search of larvae, the woodpeckers had made small and evidently targeted feeding holes. We concluded that, in most cases, the woodpeckers had been feeding on the parent adults.

In most cases of severe winter mortality, it is possible to find a small surviving population at or near the root collars of the trees, where the broods were insulated from the severe cold by a layer of snow (Bleiker, 2012, pers. comm.). Examples of survival were found at some of the sites (Photo 4), but time constraints precluded a comprehensive examination to determine frequency and abundance. These progeny will have matured into adults later in the summer, and emerged from the trees to attack new hosts. In addition, examination of a few of the red trees (attacked in 2010) found small numbers of pre-flight adults that had failed to mature in 2011. These beetles will have emerged within the next few weeks, but the population was small and unlikely to overcome normal tree defenses.

Photo 2. Typical "R-value" sample showing no brood survival

Photo 3. "R-value" sample containing broods killed by winter cold

Photo 4. Surviving larvae at the base of a tree attacked in 2011

Stage 2

A two-day fixed-wing aerial survey was completed in July to map "faders." In 2011, south of the confluence of the Kechika and Frog rivers (approximately 150 km south of the Yukon border) MPB had killed almost all of the mature pine. North of there for another 10 km, many large patches of mortality were mapped, but there remained an abundance of available host. All areas mapped in 2011 within this zone contained faders, but in 2012 the attack intensities were generally lower (Photo 5). Farther north within the Trench, patches of attacked trees were small and widely scattered and there was no increase in mortality from that recorded in 2011 (Map 4). A small patch containing a few "faders" was mapped near Aeroplane Lake, approximately 80 km south of the Yukon border. There was, however a significant northern movement to the east of the Trench. Populations had apparently crossed the height of land between this creek and Matulka Creek to the south, where some mortality had been recorded the previous year.

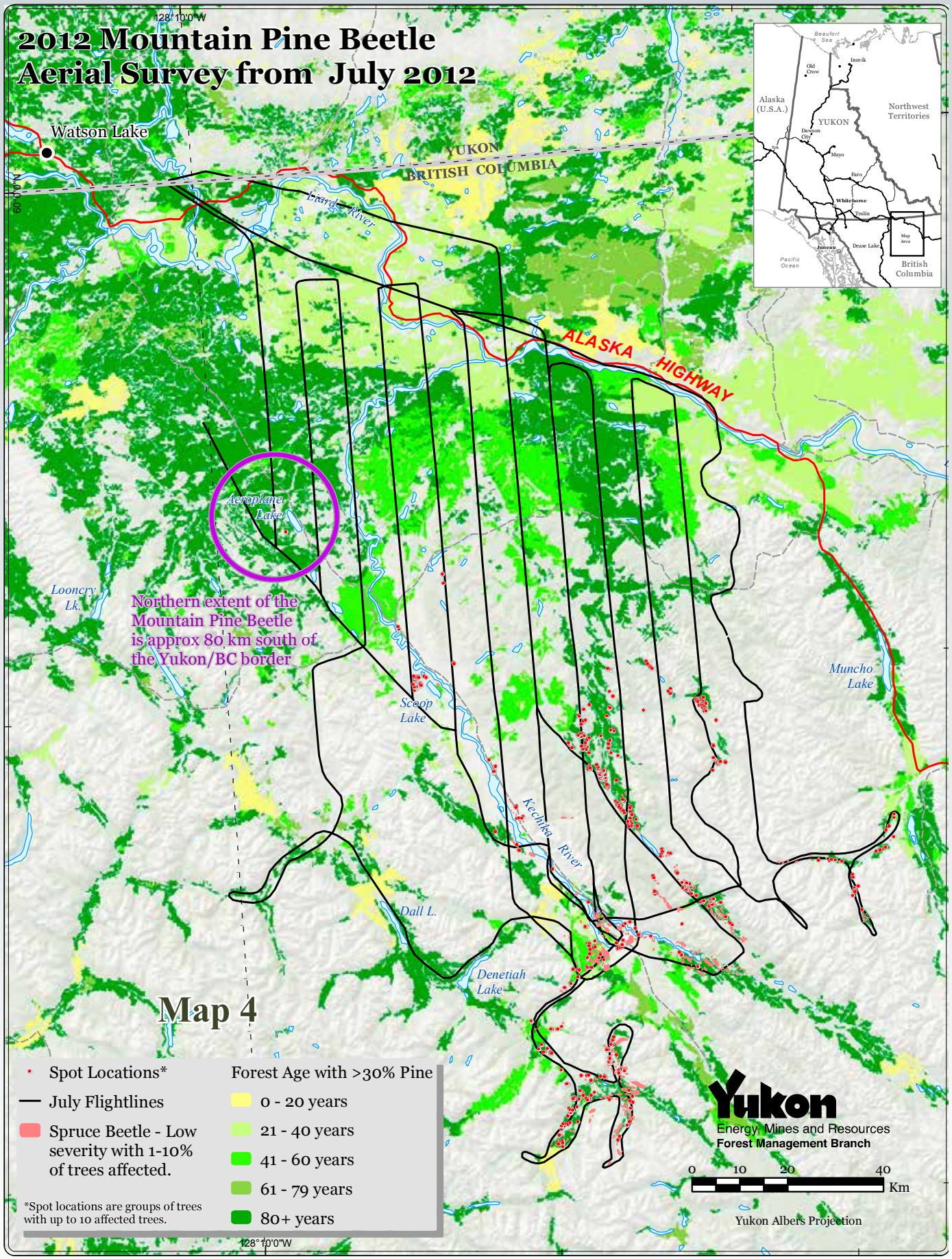
Using Bait Traps

Since 2009, FMB has been setting up and monitoring pheromone bait tree stations in southern Yukon to detect MPB. These pheromone baits do not attract MPB over long distances, but will draw them to the baits if they are already in the area. No presence of MPB was found in 2012.

In summary

It is not known at this time if there will be a sufficient MPB population to attack and overcome the defenses of a significant number of trees and continue the infestation into 2013. It is clear, however, that the northern movement of MPB faces significant challenges in the Rocky Mountain Trench. Two successive winters with prolonged periods of intense cold have killed all of the broods above the root collar. The number of "faders," though surprisingly high, was significantly less than was seen in 2011. This decline in tree mortality is expected to continue in 2013. If favorable weather occurs for a few years in a row (i.e., mild winters and seasonably warm spring and summers), populations could increase (Bleiker, 2012 pers. comm.). The MPB is well adapted to take advantage of opportunities, and there remains a large pool of susceptible host. A possible future scenario could result in small remnant populations surviving and crossing the border into southeast Yukon and killing scattered individual or small groups of trees. This could occur within the next five to eight years. Meanwhile, FMB will continue the pheromone trapping program targeting pine stands along the Alaska Highway southeast of Watson Lake, to monitor any beetle populations that stray across the border.

Photo 5. Pine in area of discontinuous attack showing red trees (2010 attacks) and faders (2011 attacks)


2012 Mountain Pine Beetle
Aerial Survey from July 2012
128°10'0"W
60°0'0"N
Watson Lake
YUKON
BRITISH COLUMBIA
Liard River
ALASKA HIGHWAY
Aeroplane Lake
Northern extent of the Mountain Pine Beetle is approx 80 km south of the Yukon/BC border
Looncry Lk.
Scoop Lake
Muncho Lake
Kechika River
Dall L.
Denetiah Lake
Map 4
Spot Locations*
July Flightlines
Spruce Beetle - Low severity with 1-10% of trees affected.
*Spot locations are groups of trees with up to 10 affected trees.
Forest Age with >30% Pine
0 - 20 years
21 - 40 years
41 - 60 years
61 - 79 years
80+ years
Yukon
Energy, Mines and Resources
Forest Management Branch
0 10 20 40
Km
Yukon Albers Projection
Beaufort Sea
Inuvik
Old Crow
Alaska (U.S.A.)
Northwest Territories
YUKON
Dawson City
Mayo
Faro
Whitehorse
Teslin
Juneau
Dease Lake
Pacific Ocean
British Columbia
Map Area

Aspen serpentine leafminer,

Phyllocnistis populiella

During the aerial survey of the northern portion of Forest Health Zone 2, aspen serpentine leafminer defoliation was mapped over an area of 68,244 ha (Table 1, Photo 6). On the whole, defoliation severities continued to decline. Though almost every aspen tree sustained damage to some degree, the severities were often recorded as light or moderate instead of severe, which had been the norm for many years. As was seen in 2011, defoliation was generally lighter in the west largely due to the dominance of white birch in many of the stands.

Whether the decline is related to adverse environmental conditions or some biological agent such as a parasite, disease or a chemically-based host defense is unknown. Studies in Alaska of an outbreak that lasted between 1997 and 2005 found all of these factors to be influential (Wagner, 2007). Parasitism, disease and predation by ants and mites all contributed in population reduction, but there was no evidence that any one or all were responsible for the collapse in 2005. The main causal factor(s) remain a mystery.

One conclusion from the Alaska study, however, was that population success has been linked to the moderating climate. The leafminer moth overwinters in the duff. They have a remarkable defense in their ability to supercool and survive temperatures of -35°C. Measurements of duff temperatures over many winters in the vicinity of Fairbanks, Alaska, found consistent temperatures well above that required to kill overwintering moths. The author pointed out, however, that one short period of extreme cold would be all that was required to cause a population collapse. The outbreak in Yukon began in the Mayo area about 20 years ago and quickly spread north to the Dawson area, where temperatures of -40°C and below occur regularly in the winter. This suggests that it would require an unusually severe cold event to kill the overwintering moths.

Photo 6. Typical aspen stand with moderate defoliation by aspen serpentine leafminer

Large aspen tortrix,
Choristoneura conflictana

For the first time since 2000, trembling aspen defoliation by large aspen tortrix was recorded within Yukon. Mostly severe defoliation was mapped from the air over a total of 2,765 ha (Table 2) at five separate locations between Mendenhall and Haines Junction in the southwest (Map 5, Photos 7 and 8). Smaller patches of light-to-moderate defoliation were mapped over 730 ha (Table 1) in-and-around the village of Pelly Crossing (Map 6, Photo 9).

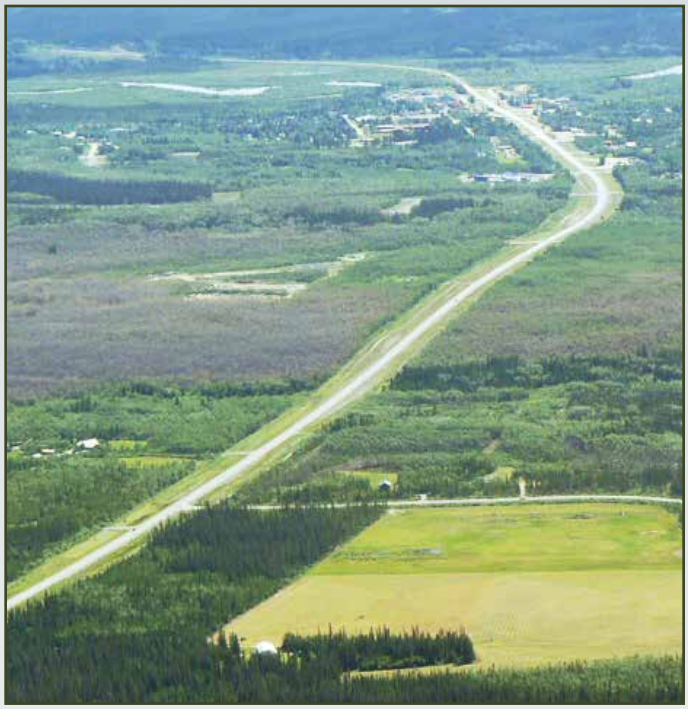


Photo 7. Severe defoliation of aspen at Haines Junction by large aspen tortrix

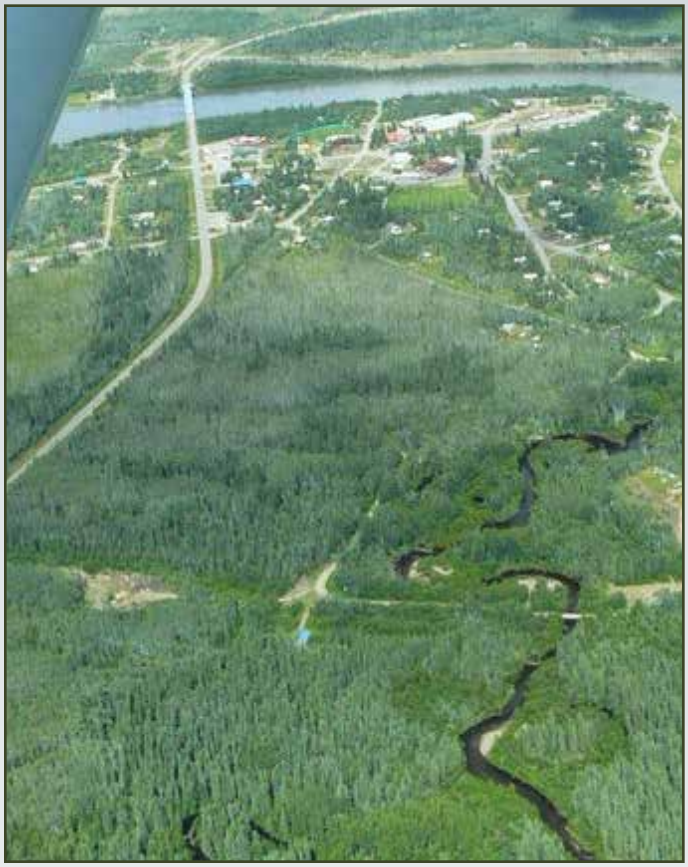
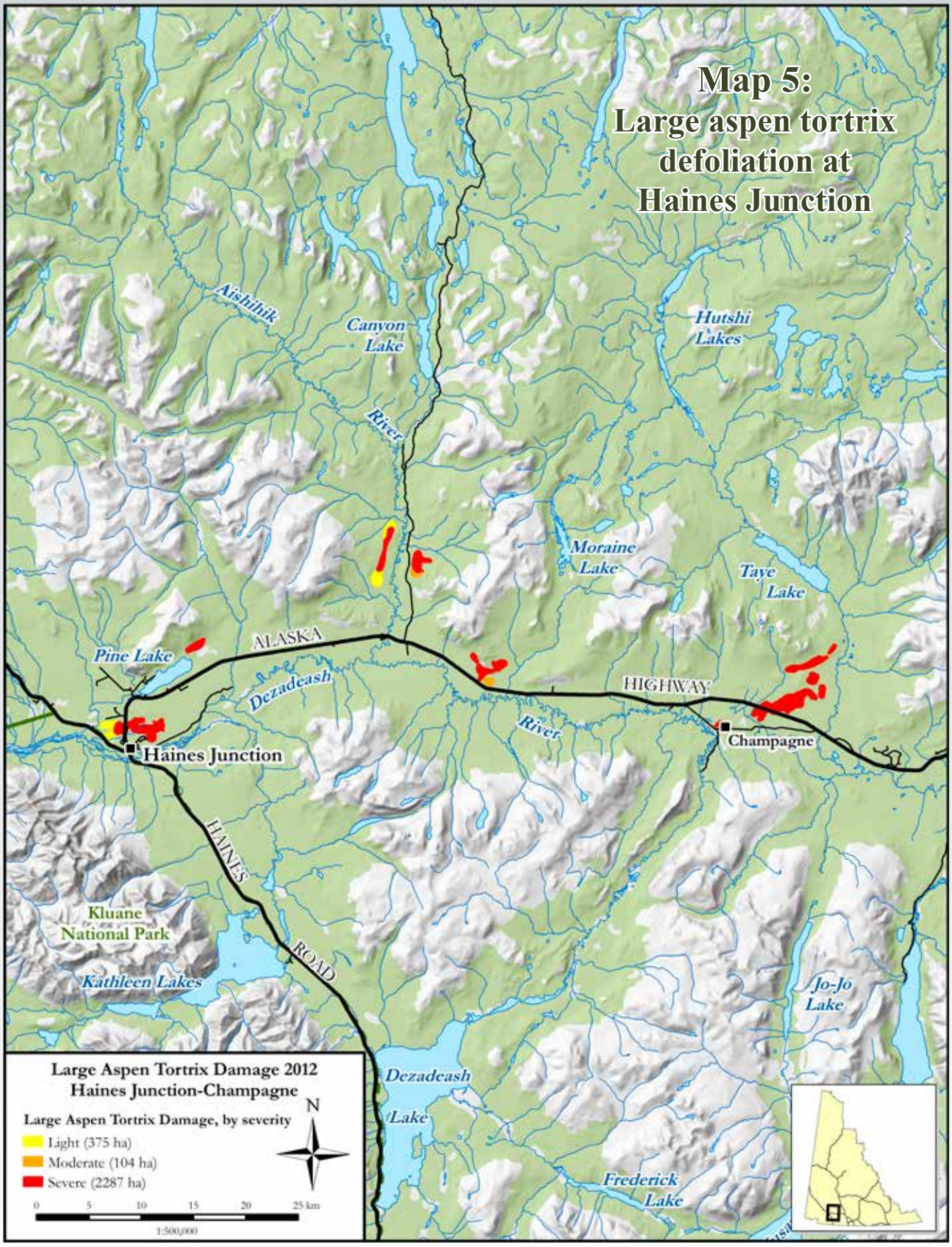
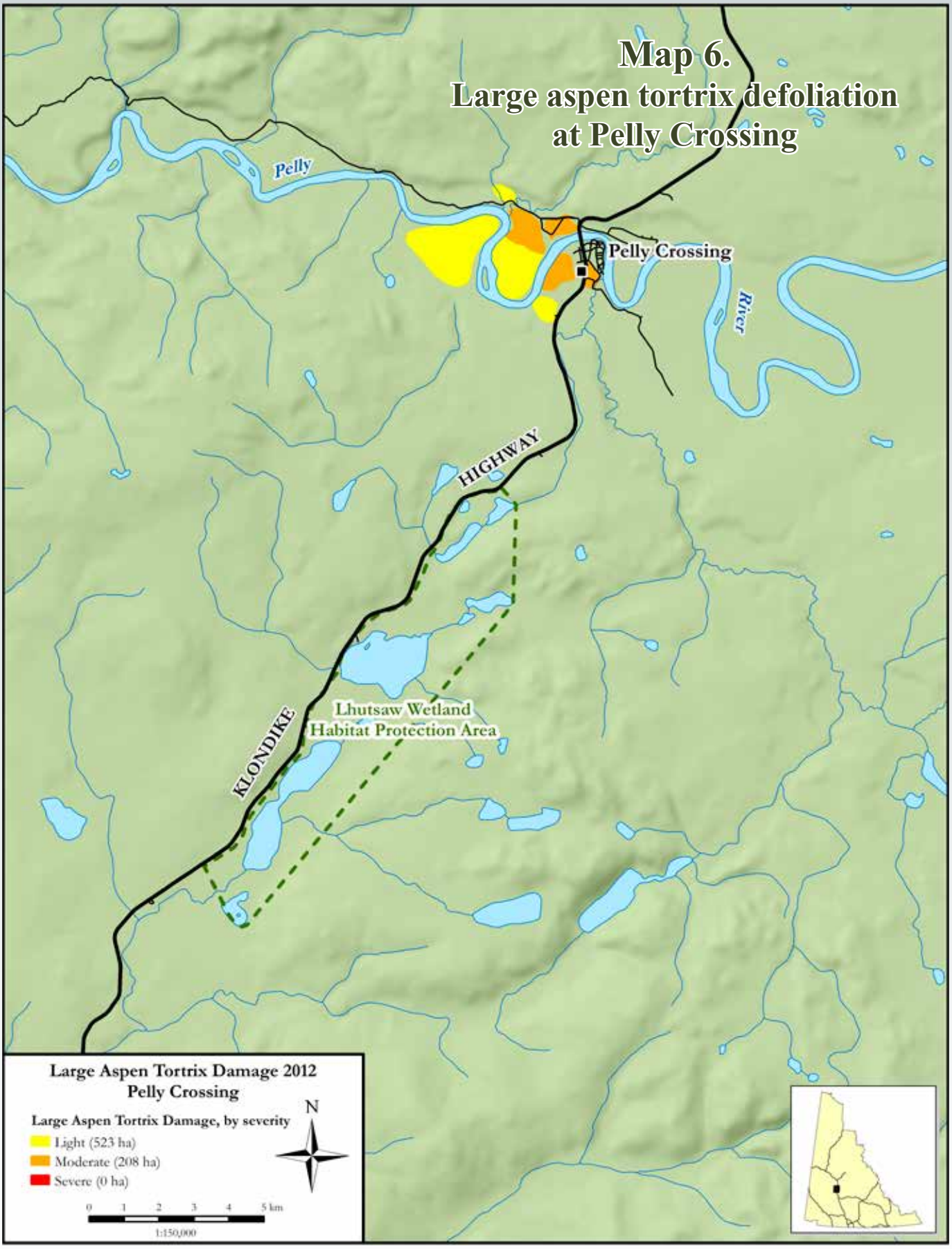


Photo 9. Light-to-moderate defoliation at Pelly Crossing by large aspen tortrix

Photo 8. Large aspen tortrix defoliation at Haines Junction


Map 5:
Large aspen tortrix defoliation at Haines Junction
Aishihik
Canyon Lake
River
Hutshi Lakes
Moraine Lake
Taye Lake
ALASKA
HIGHWAY
Pine Lake
Dezadeash
River
Haines Junction
Champagne
HAINES
ROAD
Kluane National Park
Kathleen Lakes
Jo-Jo Lake
Dezadeash Lake
Frederick Lake
Large Aspen Tortrix Damage 2012
Haines Junction-Champagne
Large Aspen Tortrix Damage, by severity
Light (375 ha)
Moderate (104 ha)
Severe (2287 ha)
N
0 5 10 15 20 25 km
1:500,000


Map 6.
Large aspen tortrix defoliation
at Pelly Crossing
Pelly
Pelly Crossing
River
HIGHWAY
KLONDIKE
Lhutsaw Wetland
Habitat Protection Area
Large Aspen Tortrix Damage 2012
Pelly Crossing
Large Aspen Tortrix Damage, by severity
Light (523 ha)
Moderate (208 ha)
Severe (0 ha)
N
0 1 2 3 4 5 km
1:150,000

The large aspen tortrix is native to North America and is found throughout the range of trembling aspen. Prior to 1990 and the onset of the spruce bark beetle infestation in the southwest, it was the single most common cause of insect-based disturbance in Yukon forests. The most recent infestation prior to this year also occurred near Haines Junction, but in stands just north of Haines Junction rather than in the town itself.

This insect completes its life cycle in a single year. Tortrix larvae overwinter in bark crevices near the base of the tree and emerge in the spring when the aspen buds begin to swell. They feed initially in the buds and continue feeding on the leaf surfaces following leaf flush. In some instances initial feeding damages the buds to the extent that they fail to flush. Larvae are a distinctive grey-green colour (Photo 10) and bear four black dots (characteristic of the genus to which they belong) on each body segment. Three other species of *Choristoneura* also cause defoliation in Yukon; two (*C. biennis* and *C. orae*) on spruce and one (*C. rosaceana*) on birch. In the third instar they commence to roll the aspen leaves, securing them with silken strands. They then feed within the rolled leaves until they pupate, usually in early July. Pupae characteristically can be found adhering to the outside of the rolled leaves (Photo 11). Adults emerge after about 10 days, mate, and then females lay green egg masses on the upper leaf surfaces.

The life history of this insect places it in direct competition with the aspen serpentine leafminer. This intra-specific competition is likely the main reason why the decline of recorded tortrix damage coincided with the explosion of leafminer populations. The past two years have seen a decline in leafminer damage throughout Yukon and, thus, a coincident opportunity for renewed success of the tortrix.

Though most of the defoliation mapped from the air was recorded as severe, with up to 90% of leaves destroyed, the trees re-foliated with a new flush of smaller leaves in July following the cessation of feeding. It is only following two or more years of severe defoliation that permanent damage in the form of top and branch dieback or complete tree mortality has been seen in past outbreaks. Significant mortality was recorded near Tagish following a two-year outbreak in the early 1990s and again at Braeburn in 1999.

Photo 10. (inset) Large aspen tortrix larva (Canadian Forest Service Photo)
Photo 11. Large aspen tortrix pupa attached to rolled leaf

Pine needle cast, *Lophodermella concolor*

During aerial surveys of the northern portion of Forest Health Zone 2, stands of discoloured young pine were mapped over a total area of 2,901 ha (Table 1, Photo 12). This was just north of the areas where 4,215 ha of discloured pine was mapped in 2011. Most of the discolored stands were situated just to the east and west of Pelly Crossing (Map 7). Depending upon the intensity of the red colour, a subjective assessment of infection severity was made from the air. Though the identification was not verified by ground checks, pine needle cast was considered the most likely cause as no other known damage (either insect or disease-caused) produces a similar aerial signature. Needle cast damage was seen and verified in central Yukon for the first time in 2009, in stands on the Minto Flats, not far to the south. All of the infested stands were young pine that had regenerated following wildfires.

This was the second consecutive year that extensive needle cast damage had been mapped in central Yukon. The area that was mapped in 2011 is contiguous with the areas mapped in 2012. Two consecutive years of disease of this intensity is unusual, but is consistent with the life history of this disease. The recent successive years of wet spring weather are responsible for the success of the disease. Pine needle cast proliferates when spring rainfall coincides with the maturation of fungal spores. The disease spores are transferred during periods of wet weather from the year-old needles to the newly flushed needles at the branch tips (Allen, 1996). The one-year-old needles are then shed. Successive years of severe infection results in a phenomenon known as "lions tailing," where the current needles are all that remain on the trees. This results in a significant loss of growth potential, especially in younger trees (Allen, 1996).

The more widespread distribution of this disease may be related to increased rainfall brought on by climate moderation. We may expect to see more of this disease and another needle disease of pine known as *Dothistroma* needle blight, *Mycosphaerella pini*, in the future. The latter has moved rapidly northward in the last 10 years and was identified three years ago by a B.C. forest pathologist (A. Wood, 2009 pers. comm.) infecting pine at the Dease River Crossing, approximately 100 km south of the Yukon border. It has, as yet, not been detected in the Watson Lake area, but in all likelihood, it is already there.

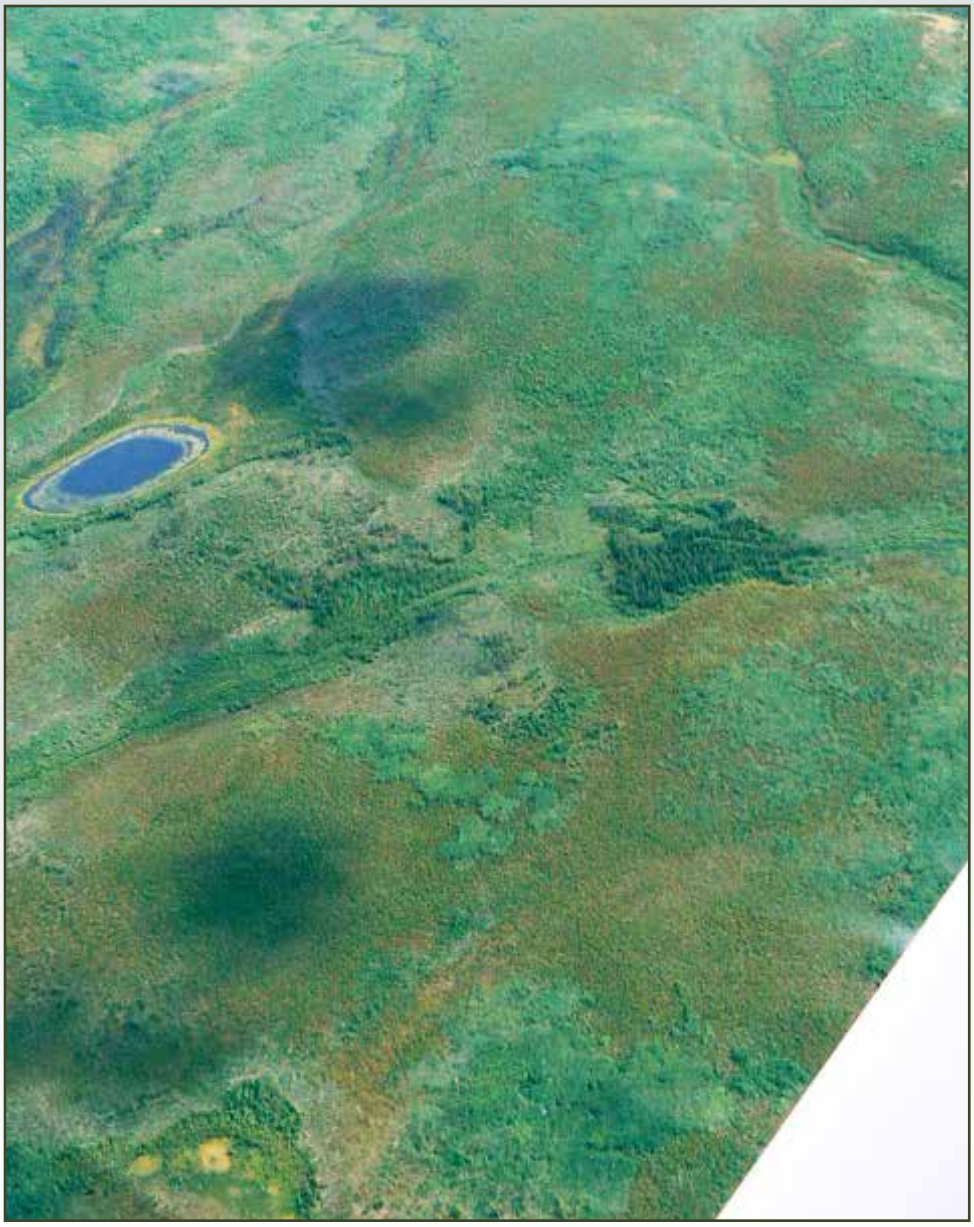
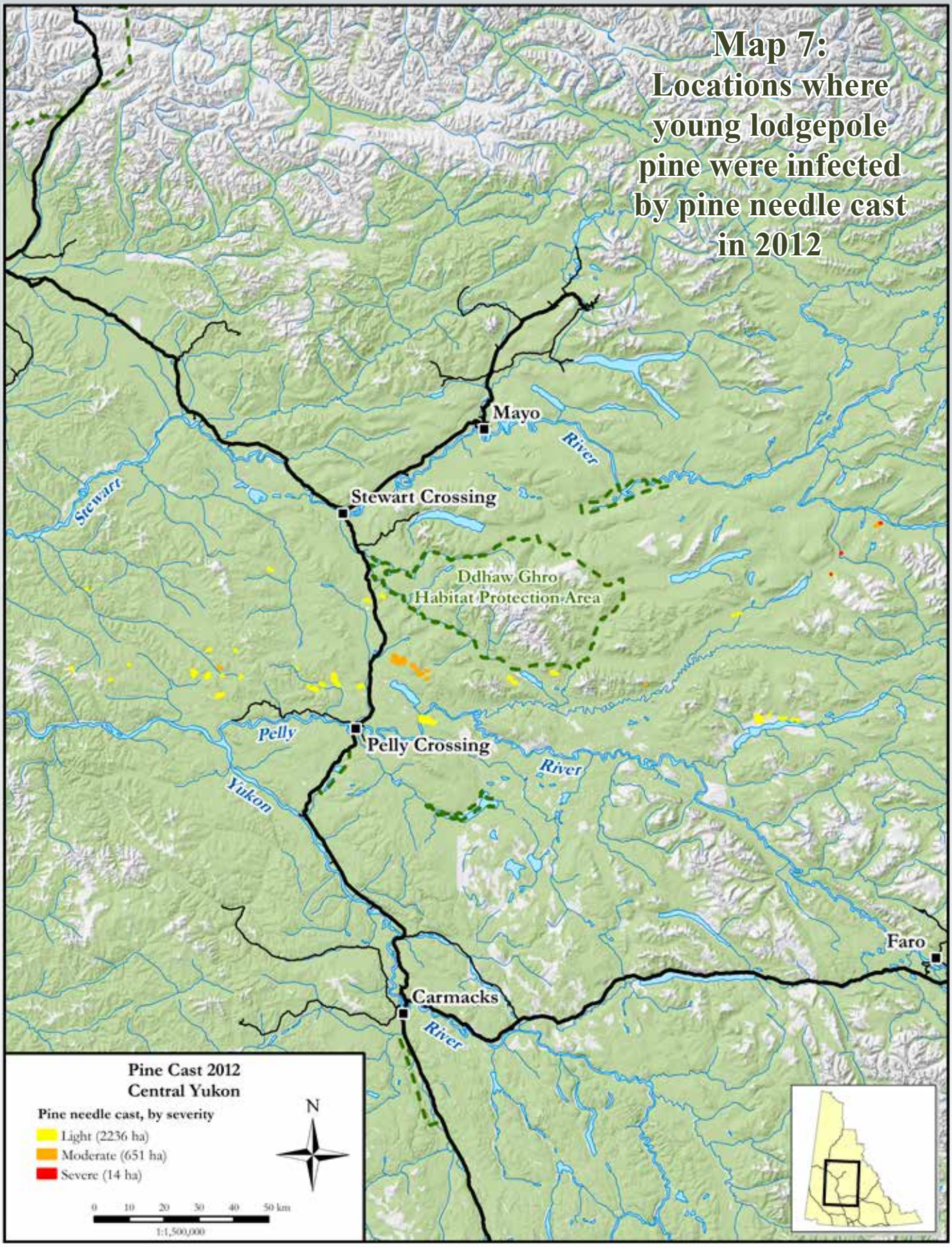


Photo 12. Aerial photo of needle cast-infected young lodgepole pine


Map 7:
Locations where young lodgepole pine were infected by pine needle cast in 2012
Mayo
River
Stewart
Stewart Crossing
Ddhaw Ghro
Habitat Protection Area
Pelly
Pelly Crossing
River
Yukon
Faro
Carmacks
River
Pine Cast 2012
Central Yukon
Pine needle cast, by severity
Light (2236 ha)
Moderate (651 ha)
Severe (14 ha)
N
0 10 20 30 40 50 km
1:1,500,000

Ambermarked birch leafminer,
Profenusa thomsoni

In 2012, for the first time, outbreak levels of this leafmining sawfly (Photo 13) were seen on native and ornamental birch throughout Dawson City, with up to 100% of leaves mined on some trees (Photo 14). This insect was first found infesting the leaves of native white birch in Dawson City in 2003 and ornamental birch in Whitehorse and Watson Lake in the same year. Since then it has been repeatedly found lightly infesting birch at all three locations.

This leafminer was introduced into the eastern United States and was first identified in 1923. Since then populations have spread throughout North America. Most of the recorded outbreaks have occurred on ornamental plantings in urban settings, with only light attacks on native birch. Fortunately effective biological control has been achieved by a variety of parasitic wasps that are either native to North America or were introduced with the leafminer. The most important of these is the parasitic wasp *Lathrolestes luteolator* which is a native species that has apparently adapted to parasitize a new host (Digweed et al., 2003). Infestation levels in Edmonton dropped from epidemic to low levels between 1992 and 1995 due to a subsequent increase in populations of the parasite. Population levels have remained low since.

Collections of *L. luteolator* adults and pupae were made in northern Alberta and released in Anchorage, Alaska, between 2004 and 2007 (MacQuarrie, 2008). Introduction was successful and *P. thomsoni* populations have declined slowly since the introductions. Populations of both species are being closely monitored.

Photo 13. (inset) Ambermarked birch leafminer leaf blotch and larva
Photo 14. Severe defoliation by ambermarked birch leafminer in Dawson City

Willow blotch miner,
Micrurapteryx salicifoliella

After almost disappearing in 2011, there was a resurgence of this pest in 2012 to levels close to those seen in 2010. High levels of infestation, however, were limited this year to the area between Mayo and Dawson City (Photos 15 and 16).

This insect was first identified in Yukon near Stewart Crossing in 2007. It appeared to have followed the Yukon River corridor from Alaska where damage has been widespread since 1991. It had likely been present in Yukon for some years prior to 2007 as populations built and discolouration increased to visible levels. Populations have spread southward, and in 2010 light defoliation was seen along the Robert Campbell Highway, just north of Watson Lake. Since the insect has now become well established in Yukon, infestation levels can be expected to cycle like other insect populations, appearing to disappear one year and then resurge the next.

Photo 15. Infested willow leaves in Dawson City

Photo 16. Aerial shot of infested willows near Mayo

Birch defoliation

Severe defoliation of white birch was mapped over an area of 468 ha (Table 1) during the aerial survey of Forest Health Zone 2 (Photo 17). The damage was mapped in a remote area well to the west of Pelly Crossing so it was not ground checked. The most likely cause of the damage was one of a group of leafrolling insects that have been found in birch stands from Whitehorse to Dawson City.

Photo 17. An unknown insect defoliated white birch west of Pelly Crossing

Yellow-headed spruce sawfly,

Pikonema alaskensis

For the fourth consecutive year, larvae of the yellow-headed spruce sawfly defoliated young ornamental white spruce at Shipyards Park in Whitehorse (Photo 18). After three consecutive years of damage to trees lining the parking area, the insects moved to previously uninfested trees just to the north. No damage was seen elsewhere in Whitehorse.

This insect selects open-grown trees and for this reason most damage recorded in North America occurs on young planted urban trees rather than in dense forest (Kusch and Cerezke, 1991). Eggs are laid singly in early June, in slits at the base of needles. Usually all eggs of a single adult are laid on a single shoot. When eggs hatch young larvae commence feeding on newly flushed needles. Like most sawflies the yellow-headed spruce sawfly is a colonial feeder. When the new growth has been consumed larvae will continue feeding on the older needles until they are ready to pupate in mid-July. Pre-pupal larvae drop to the ground and dig into the duff layer under the tree where they spin their cocoons. They remain there until the adult emerges the following season to coincide with the swelling of buds in the spring.

Control

In the current situation, because the trees are small, the simplest method of population control is to locate clusters of feeding larvae while they are still small. Larvae can be removed from branches by shaking the branches and catching the falling larvae in a bucket of soapy water (Hansen and Walker, n.d.). Control can also be achieved by the application of insecticidal soap when larvae have just begun to feed (Alberta Department of Agriculture and Rural Development, 2006). A third method involves laying a sheet covered with spruce needles under the tree while larvae are still feeding. Mature larvae drop to the ground (in this case, on to the sheet) just prior to pupation. The sheet can than be removed and the pupae destroyed.

Photo 18. Defoliated ornamental white spruce at Shipyards Park in Whitehorse

Abiotic Pests

Environmental damage

Examples of environmental damage caused by extreme winter freezing and cold desiccating winds can be found in conifers and deciduous trees during the growing season the following year. Some of the more extreme examples have been reported in previous Forest Health reports. The damage seen this year was less dramatic than previous years. One of the most common examples is the death of spruce buds and/or newly flushed foliage (Photo 19) by late spring frosts. These usually occur in open-growing trees that are exposed to drying wind.

Many of the ornamental birch planted by the City of Whitehorse at Shipyards Park were showing signs of severe dieback (Photo 20). A close examination of the trees found no signs of insect or disease involvement. The most likely cause was desiccation of living tissues in branches and stem by cold winter winds. Whatever the cause, the effect of the damage was delayed until after the leaves had flushed and some catkins had been produced. If the damage was caused by a single event such a cold desiccating wind then the trees may show signs of recovery in the spring of 2013. If however, the damage is progressive, some mortality can be expected.

Photo 19. New growth on white spruce seedling killed by frost

Photo 20. Dieback of ornamental birch at Shipyards Park in Whitehorse

It is often difficult to determine the exact cause of such damage because tree physiology and its interaction with the environment is complex. One of the enduring mysteries has involved the slow dieback and mortality of trees of all species along the side of portions of the Alaska Highway, the Klondike Highway (North and South) and the Atlin and Mayo roads. This form of damage has been reported in Yukon since the 1970s. More recently, similar damage has been seen in the Cowley Creek sub-division (Photo 21). The damage progresses over many years, usually resulting in tree death. It affects white spruce, lodgepole pine, aspen, balsam poplar and even willow species, often affecting multiple species at a single site. Because it is limited to roadsides and there is no insect or disease involvement, the environment is assumed to be the cause. Winter desiccation does not explain the slow progressive nature of the dieback. One suggestion has been chemical residue in the soil from the days when all roads were gravel and chemicals were used for dust abatement. This however does not explain Cowley Creek. It likely comes back to physiology and interactions between tree and environment that tree physiologists are just beginning to understand.

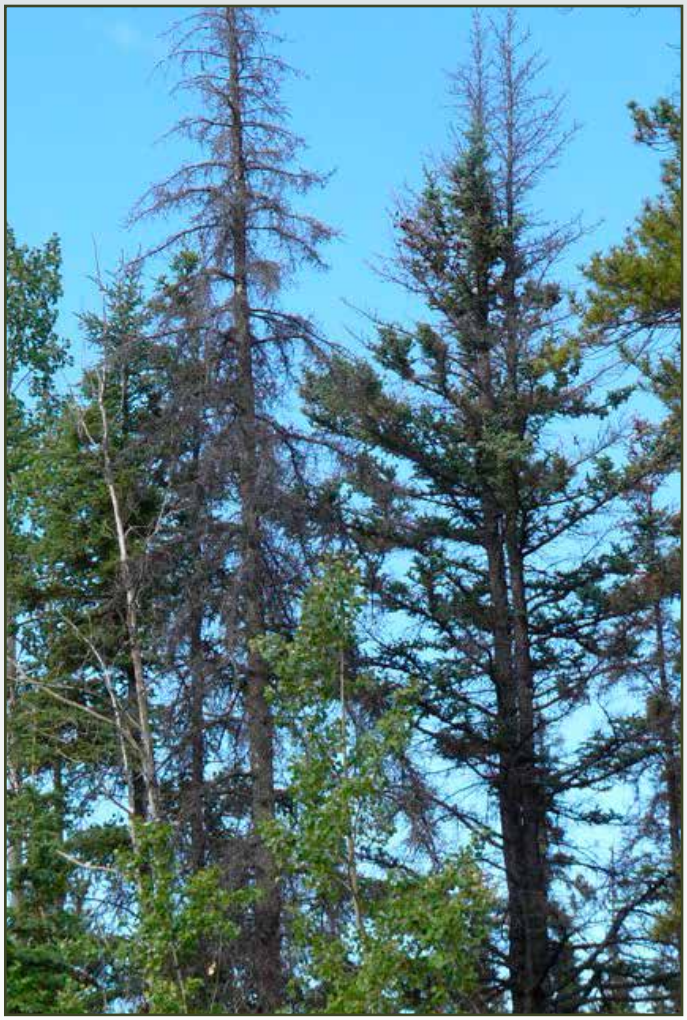


Photo 21. Dieback of mature spruce at Cowley Creek sub-division

Another common environment effect is branch "flagging," seen commonly throughout Yukon affecting white spruce and lodgepole pine (Photo 22). It refers to the reddening and subsequent shedding of older needles in the interior of tree crowns. The term "effect" is used in place of "damage" because this is a normal and natural tree response to prolonged periods of drought. Trees lose moisture by the process of transpiration through the needles. This process is the means by which trees draw water from the soil by capillary action to feed the living tissues. When moisture becomes limited, the tree sheds older needles first, in favour of the newer ones, which gather and process the most light energy from the sun.

Photo 22. "Flagging" in lodgepole pine

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Appendix 1

Summary of the Executive Summary of the "Mountain Pine Beetle Pest Risk Analysis for Yukon Lodgepole Pine Forests"

In 2012, a Pest Risk Analysis "Mountain Pine Beetle Pest Risk Analysis for Yukon Lodgepole Pine Forests" was completed by JCH Forest Pest Management. Field assessments were led by the Forest Management Branch, and direction for the risk analysis was provided by the Yukon Government MPB Inter-Departmental Committee. The purpose of the risk assessment was to assess the likelihood and consequences of mountain pine beetle introduction to Yukon forests. A plain language summary of the Executive Summary is provided here in Appendix 1. Copies of the entire "Mountain Pine Beetle Pest Risk Analysis for Yukon Lodgepole Pine Forests" can be obtained from the Forest Management Branch.

Mountain Pine Beetle Pest Risk Analysis For Yukon Lodgepole Pine Forests
Executive Summary (Plain Language)

Mountain pine beetle (*Dendroctonus ponderosae* Hopkins) (MPB) is a native bark beetle that attacks pines in western North American forests. It is now the single most destructive insect for mature pine trees in western Canada. In the past, outbreaks have been held in check by cold temperatures (below -40°C) and the Rocky Mountains (a topographic barrier). However, an unprecedented outbreak in British Columbia (B.C.) began in the late 1990s and covered 18.1 million hectares in 2011. The beetle is now firmly established in Alberta and is moving northward in B.C. Its presence has been confirmed approximately 75 km south of the Yukon border in the Rocky Mountain Trench, and there are suspected spot infestations about 3 km south of the Yukon border in the Liard Basin. These spot infestations have been mapped by experienced aerial surveyors by the B.C. Ministry of Forests, Lands and Natural Resource Operations and Yukon government's Forest Management Branch and will require ground-truthing to confirm presence or absence of MPB. Climate change and a vast supply of pine (host material to MPB) has been responsible for the expansion into new habitat – these are commonly referred to as novel habitats containing naïve pine.

This pest risk analysis (RA) was completed to assess the potential threat by the MPB to novel lodgepole pine forests and the values of the people of Yukon.

The RA is science-based and transparent approach that characterizes the risks of MPB by examining evidence and identifies uncertainties or information gaps. Uncertainties are a result of missing, inconsistent or insufficient information.

The objectives of the RA are to answer the following questions, using scientific evidence and input from land managers (including First Nations and municipalities) and Yukon government.

1. What is the likelihood of the MPB invading Yukon and what are the potential social, economic, and environmental effects, both short-term (before 2020) and long-term (2070)?
2. What steps should the Yukon government consider to limit both short- and long-term consequences?
3. What information is needed to help better understand the risk to Yukon forests?

Yukon differs from other jurisdictions currently managing MPB in that non-timber values are significant. In Yukon, forest fiber (merchantable wood for forest timber products) is not the main value of concern. The potential impacts of MPB on social and cultural values, including those of First Nations, and other economic and environmental values, are integral components of a Yukon-specific MPB pest risk analysis. To gain a sense of non-traditional values (e.g., non-fiber), a MPB workshop was held in Whitehorse in June 2012 to familiarize land managers and government stakeholders with MPB and to gather information regarding their values. Value forms, which assessed tolerance to risk or impacts to values caused by incipient (building phase) or outbreak populations, were completed by land managers and users and government stakeholders after the workshop. In total, five responses were received, with possibly more to come. These value responses are an integral component of the pest risk analysis for Yukon.

What is the level of risk?

Risk is defined as a combination of the likelihood of introduction and consequences of the introduction of MPB. Risk identifies response options and promotes risk communication.

The overall risk is rated as low in the short term (before 2020) and moderate-to-high in the long term (2070). The following evidence was considered when evaluating and determining the level of risk. Levels of uncertainty for the information are noted in brackets:

- MPB has been moving steadily northward. There are suspected infestations within 3 km of the Yukon border, and confirmed ones 75 km from the Yukon border *(very low uncertainty).*
- There is ample supply of mature pine (host material) in Yukon forests, which will support a MPB outbreak under favourable climatic conditions *(very low uncertainty).*
- MPB populations are reproducing and surviving at low levels in the Rocky Mountain Trench of northern B.C. *(very low uncertainty).*
- The likelihood of MPB long distance wind dispersal events influencing continued population growth in the Rocky Mountain Trench is low due to declining populations in northern B.C. *(very low uncertainty).*

- Climate models predominately show that conditions in Yukon will become more favourable for MPB survival by 2070. However, the climate suitability will remain low and very low throughout most of Yukon, with some higher suitability in SE Yukon *(very low uncertainty).*
- Very low climate suitability may be limiting the northward spread of MPB in the Rocky Mountain Trench, even with plenty of available mature pine trees. In 2011, MPB expanded in a NE direction toward a fragmented pine landscape with better climatic suitability, rather than up the Rocky Mountain Trench *(moderate to high uncertainty).*
- MPB have twice as many offspring in naïve pine trees (pine habitats that have not had a history of experiencing MPB in past, e.g., Yukon pine forests) as experienced pine (pine habitats that have a history experiencing MPB, e.g., pine in Southern B.C.). The naïve pine trees may have lower resistance to the MPB, which may lead to more outbreaks in suitable weather conditions *(moderate uncertainty).*

Concerns from land managers included the following:

- Sociocultural values of the highest concern are the possibility of wildfires, the impact on forests in general, community well-being, healthy watersheds, recreational trapping and northern woodland caribou.
- Environmental values of highest concern are the possible impacts on northern mountain caribou, water and trapping.
- Economic values that would be moderately impacted are: tourism, forestry and water.

What should the response be?

Currently the MPB is not in Yukon. A long-term prevention strategy is therefore recommended, with a potential to shift to a suppression strategy once MPB expands into Yukon. Detection and monitoring by annual air surveys and ground checks are essential for preventing and controlling outbreaks. It is very important to examine the way populations of MPB behave in previously untouched forests. Uncertainties should be addressed to determine the need and timing of any suppression activities and ultimately reduce the risk and associated consequences.

What have we learned?

It is highly likely that MPB will expand into Yukon by 2020. Populations will likely remain low until several successive years of suitable weather conditions allow for the beetle to become established.

1. A cycle involving a low number of permanently present beetles (erupting and briefly experiencing population outbreaks followed by a collapse of populations down to a low number of permanently present beetles) will happen through to 2070, unless new models show a different pattern.
2. Impacts will be low in the short term and moderate to high in the long term. Social and cultural values will be most affected in the short term, and environmental and economic values will be most affected in the long term.
3. Annual aerial surveys along the border where the beetle might enter and where the highest susceptible forests occur (e.g. mature pine), are very important for monitoring the risk. These surveys are the highest priority, followed by ground checks.

What steps can we take?

The following are key considerations that will help to determine how Yukon might minimize the MPB risk to lodgepole pine forests and to identify appropriate and effective management responses.

1. Research the biology and the causes, distribution and control of the MPB in novel forests (pine habitats that have not had a history experiencing MPB).
2. Identify the peak tree-fading time period in northern forests so that aerial surveys can better pinpoint where beetle outbreaks occur and how they are moving.
3. Update the pest risk analysis with any new information as it becomes available.
4. Develop a five-year plan and strategy for monitoring and dealing with MPB.
5. Develop an agreement with neighbouring jurisdictions that have MPB infestations, such as B.C., to allow Yukon to manage areas not currently being managed that pose a risk to Yukon lodgepole pine forests.
6. Address uncertainties as time and/or funding permits.

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Energy, Mines and Resources
Forest Management Branch

SESSION VI: PESTICIDE REGULATIONS, ALTERNATIVES, MINOR USES

Chair: *Michael Irvine*
Ontario Ministry of Natural Resources

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

Président : *Michael Irvine*
Ministère des Richesses naturelles de l'Ontario

PMRA UPDATE

Terry Caunter

Health Canada, Pest Management Regulatory Agency

NOT AVAILABLE

RISKS OF PESTICIDES USES ON POLLINATORS

Wayne Hou

Health Canada, Pest Management Regulatory Agency

ABSTRACT

The past few years have seen increased scientific and public concerns on declines in pollinator populations. Interactions of a number of factors, including pesticides, are being investigated as potential contributors to the pollinator declines. The Pest Management Regulatory Agency (PMRA), Health Canada has been actively working with international partners on updating the risk assessment scheme for pollinators. This risk assessment scheme and relevant information required to conduct the assessment will be discussed. Aspects relevant to forestry pesticide uses will be included, for example tree injections with systemic pesticides.

RÉSUMÉ

Il y a eu, depuis quelques années, une augmentation des préoccupations du public et du monde scientifique au sujet du déclin des populations de pollinisateurs. Les interactions entre plusieurs éléments, y compris les pesticides, sont en cours d'étude comme contributeurs possibles aux déclins des pollinisateurs. L'Agence de réglementation de la lutte antiparasitaire (ARLA) et Santé Canada travaillent activement avec des partenaires internationaux en vue de mettre à jour le programme d'évaluation des risques liés aux pollinisateurs. Nous discuterons de ce programme et des renseignements pertinents nécessaires pour réaliser l'évaluation. Les aspects relatifs aux utilisations de pesticides en zone forestière seront pris en compte, comme par exemple, les injections d'insecticides systémiques dans les arbres.

TREEAZIN® - A NATURAL BOTANICAL INSECTICIDE FOR MANAGEMENT OF EAB AND OTHER WOOD BORING INVASIVE ALIEN INSECT PESTS

Dean Thompson

Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre

ABSTRACT

TreeAzin® is a systemic insecticide recently registered for use against the invasive alien insect pest Emerald Ash Borer (EAB). The active ingredients in this product are azadirachtins, natural compounds derived from the neem tree *Azdirachta indica*, which impair both larval growth and fecundity of adult EAB following feeding exposure on critical transport and leaf tissues in treated ash trees. A brief summary of the scientific knowledge base supporting this new registration as well as results from ongoing studies which suggest probable equivalent potential for use against ALB will be provided in this presentation.

RÉSUMÉ

TreeAzin® est un insecticide systémique enregistré récemment aux fins de lutte contre l'agrile du frêne, un insecte nuisible exotique envahissant. Les ingrédients actifs de ce produit sont les azadirachtines, des composés naturels issus du margousier *Azdirachta indica,* qui portent atteinte à la métamorphose larvaire et à la fécondité de l'agrile du frêne adulte par suite d'une exposition par alimentation sur les tissus importants de transport et foliaires des frênes traités. Un résumé de la base de connaissances scientifique à l'appui de ce nouvel enregistrement, de même que les résultats d'études en cours proposant un potentiel équivalent pour la lutte contre le longicorne étoilé seront fournis dans le cadre du présent exposé.

SESSION VII: WESTERN PEST MANAGEMENT ISSUES

SÉANCE VII : LA RÉPRESSION DES RAVAGEURS DANS L'OUEST

MANITOBA REPORT

Fiona Ross

Manitoba Conservation, Forestry Branch

Climatic Extremes

Major storm event are a common appearance in Manitoba. In June 2012 a major storm occurred in western Manitoba within the Duck Mountain Provincial Forest. This event impacted approximately 7500 hectares and will have an implication in more than 1 million cubic meter of volume within that area. Manitoba Conservation and Water Stewardship (MCWS) was able to map this event with the use of mobile PC Tablets.

Spruce Budworm

In 2012 very few pockets of defoliation by spruce budworm, *Choristoneura fumiferana*, were observed throughout Manitoba. An aerial survey was conducted in the western region to map spruce budworm defoliation using mobile PC Tablets. Verylight to no defoliation was observed.

Based on the 2011 defoliation predictions derived from fall egg mass surveys and hazard rating for tree condition, no operational spruce budworm suppression program was implemented in 2012.

In August and September, spruce and fir branch samples were collected at plots throughout the province and processed to assess current defoliation levels and determine egg mass densities to predict 2013 defoliation (Table 1).

Table 1. 2011 Spruce Budworm Defoliation and Predictions for 2013

Location	2012 Defoliation*	2012 Egg Mass/10m^2	2013 Defoliation Prediction
Northeast	Light	18.6	Light
Northwest	Light	60	Light
Western	Light	0	Light
Riding Mt. Nat. Park	Light	0	Light
Southwest	Moderate	89	Moderate
Interlake	Light	0	Light
Eastern	Light	0	Light

* Defoliation classes are as follows:

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

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

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

SASKATCHEWAN REPORT

Rory McIntosh

Saskatchewan Ministry of Environment, Forest Service Branch

Defoliators – Softwood

Spruce budworm, *Choristoneura fumiferana*

Following a general decline 2002-2008 damage levels of the eastern spruce budworm *Choristoneura fumiferana* are fluctuating in Saskatchewan. Aerial surveys conducted in 2010 revealed 85,466 hectares of moderate to severe defoliation increasing to 90,548 ha in 2011. In 2012 the net defoliated area of moderate and severe defoliation dropped significantly to 28,272 hectares (Figure 1). Although the outbreak persists in the Dillon area, in the north-western part of the province south of Clearwater River and in the Pine house Lake area in north central Saskatchewan, the outbreak throughout the rest of the province appears to be collapsing (Figure 2).

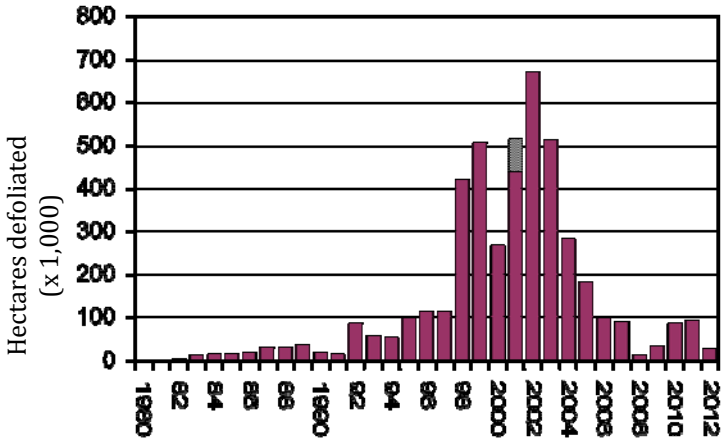

Figure 1. Area of moderate to severe defoliation caused by the spruce budworm *Choristoneura fumiferana* in Saskatchewan 1982-2012.

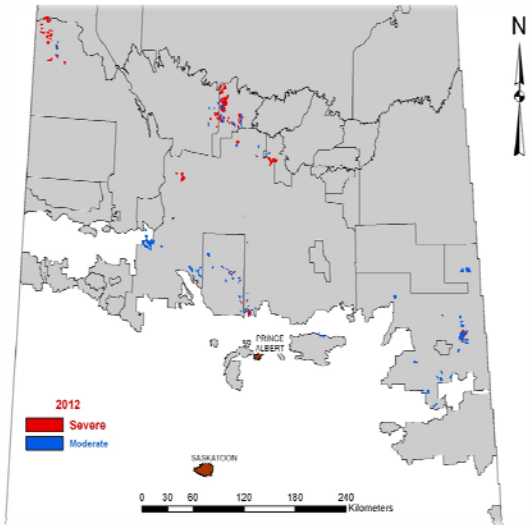

Figure 2. Area of moderate to severe defoliation caused by the spruce budworm *Choristoneura fumiferana* in Saskatchewan 2012.

Conclusions for 2012, Predictions for 2013

In 2012 15,800 hectares of forest was sprayed using a double application of Foray 76B, at a rate of 30 BIU/1.5L/ha. In 2012 operations were run out or two spray bases: Big River, and Hudson Bay. In Big River, conditions for spray treatment were perfect however, in the Hudson Bay area, spray conditions were more challenging. Operations in both areas started on June 5 and were completed by June 12. Results were very positive. Significant reduction in numbers of larvae was noted in pre-spray as compared to post-spray blocks; however, this trend was also detected in control blocks. There was a significant reduction in defoliation in post-spray blocks as compared to control blocks. Overall, the spray program was successful and the 40% defoliation target was achieved in all sample spray blocks as compared to control.

SBW populations continue to persist in the Dillon area in the northwest and in the Besnard and Pinehouse Lake areas west of La Ronge. The outbreak in Prince Albert National Park appears to have collapsed.

Overwintering L2 surveys reveal a significant decline in population growth. The Ministry will not be implementing a spray program for 2013.

Pine needle sheath miner, *Zellaria haimbachi*

In 2012, aerial surveys detected 3,888 hectares of pine defoliation caused by pine needle sheath miner *Zellaria haimbachi*. The affected areas were located to the east of Cumberland Lake near Cumberland House in east central SK (Figure 3). Although identified as a periodic defoliator in the Prairie region, we believe, this may be the first report of this pest in Saskatchewan.

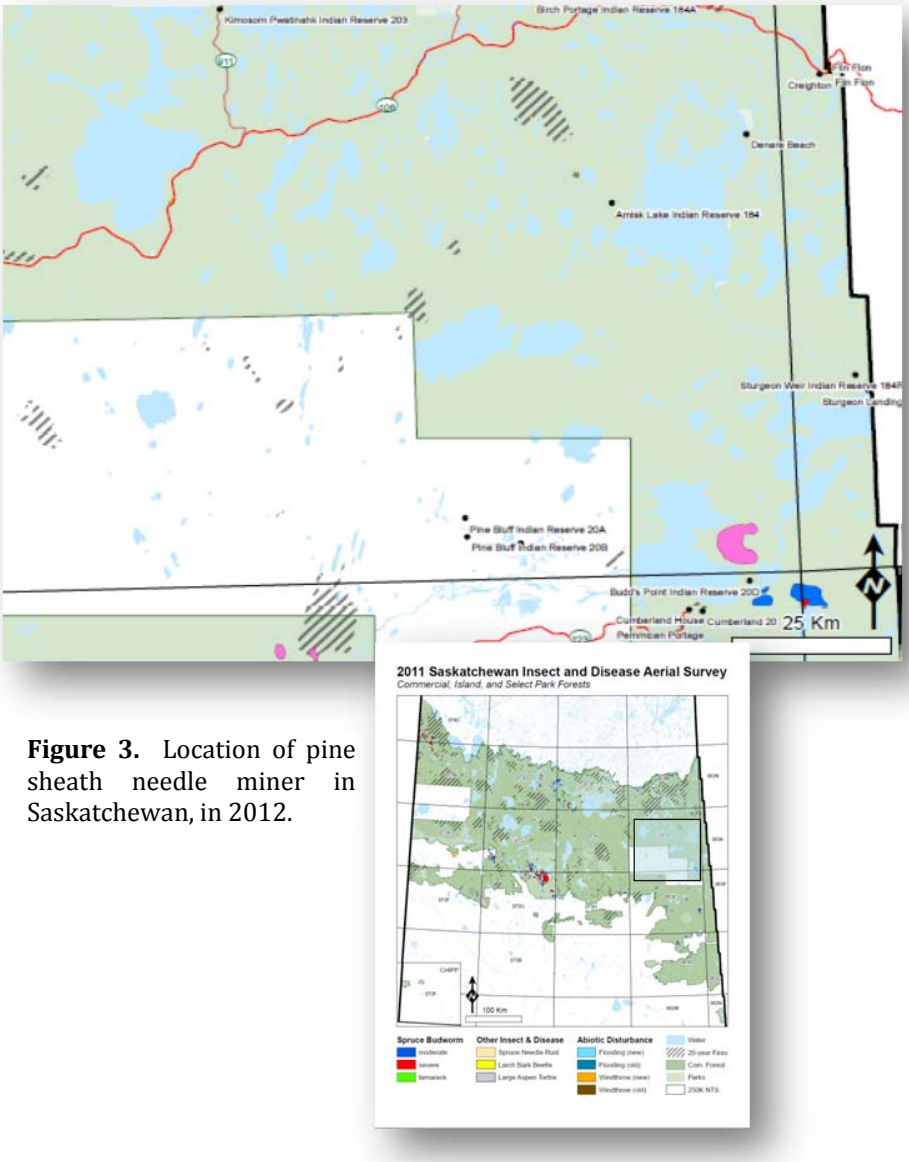

Figure 3. Location of pine sheath needle miner in Saskatchewan, in 2012.

Jack pine budworm, *Choristoneura pinus pinus*

In 2012, there was again no detectable Jack pine budworm defoliation in Saskatchewan. Jack pine budworm – a periodic defoliator of jack pine, has not been detected since the early 1980s. In 2012 the provincial pheromone trapping network was maintained showing very low trap counts throughout the province.

Defoliators – Hardwood

Large aspen tortrix, *Choristoneura conflictana*, and Forest tent caterpillar, *Malacosoma disstria*

The area of hardwoods defoliated increased significantly from 24,577 ha in 2011. In 2012 a net area of 42 454 ha of aspen forest was defoliated in the forest fringe area near Glaslyn. While in 2011 the damage reported was predominantly due to large aspen tortrix, ground surveys revealed most of the 2012 damage was attributed to forest tent caterpillar (Figure 4).

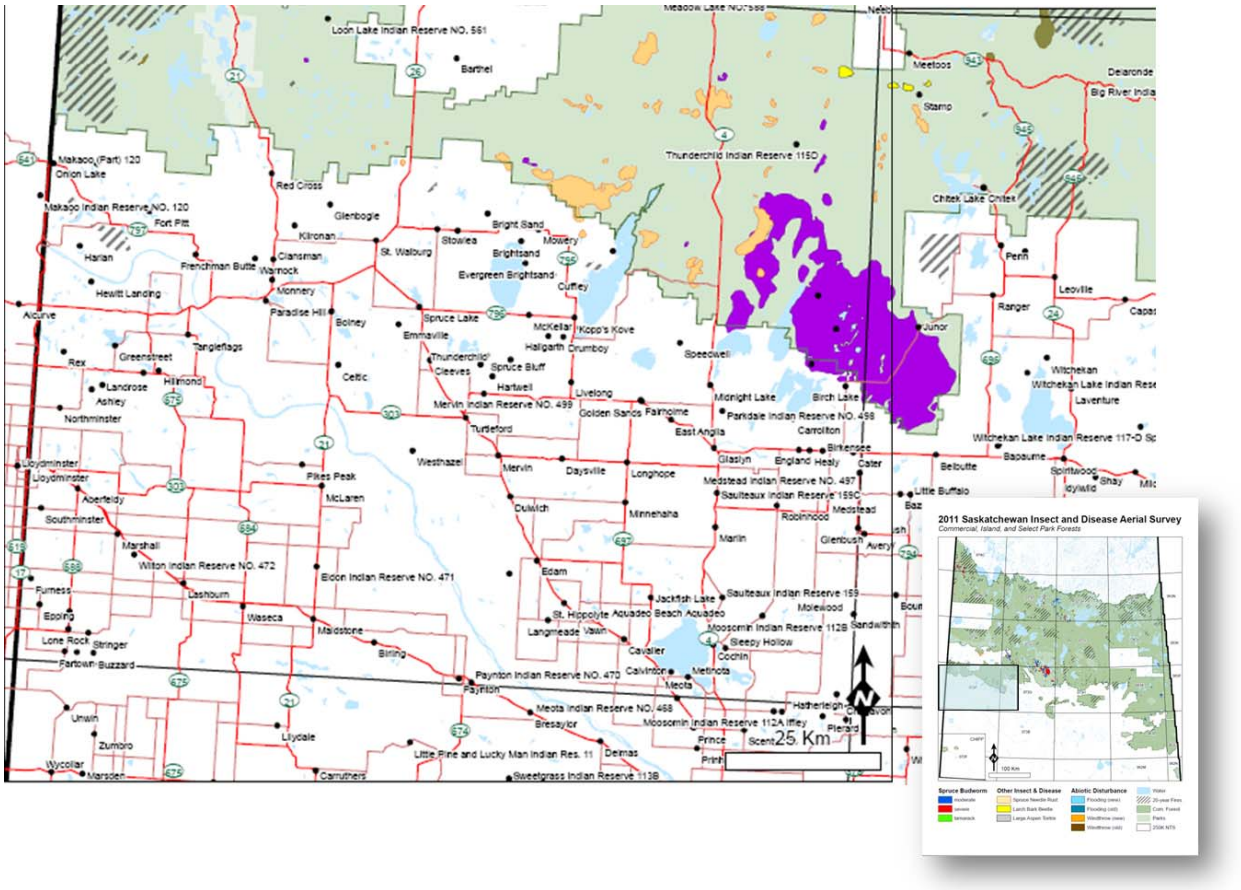

Figure 4. Area of moderate to severe defoliation caused by the Forest tent caterpillar, *Malacosoma disstria*, in Saskatchewan, in 2012.

Foliar Diseases

Spruce needle rust, *Chrysomyxa ledicola*

Spruce needle rust, *Chrysomyxa ledicola* (Figure 5), was detected again in 2012, for the third year in a row. Aerial and ground surveys revealed 19,500 hectares of spruce forest affected by this pathogen – a significant increase from the 1,433 ha reported in 2011. Areas affected by spruce needle rust were located in and around Dillon Lake, north of the Cold Lake Air Weapons Range northwest of Prince Albert National Park and South of Meadow Lake (Figure 6).

Figure 5. Spruce needle rust, *Chrysomyxa ledicola*.

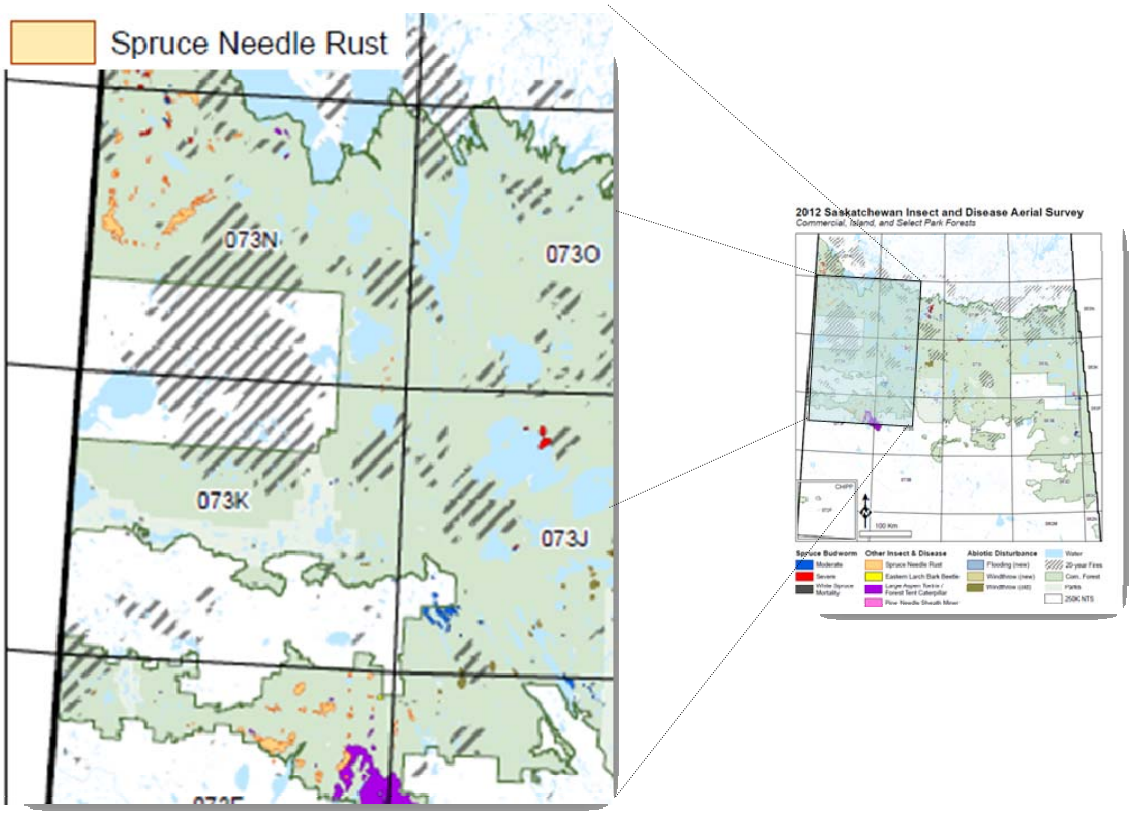

Figure 6. Area of spruce needle rust defoliation (light yellow), North of the Cold Lake Air Weapons Range in western Saskatchewan.

Invasive and Non-Native Pests

Dutch Elm Disease, *Ophiostoma novo ulmi*

In 1980 Dutch elm disease (DED) was first discovered in Saskatchewan (Regina). Since then, DED has slowly spread along the Souris and Qu'Appelle river valleys in southeast and eastern Saskatchewan and is now found throughout most of the range of native elms in Saskatchewan (Figure 7).

With the exception of the larger urban centers, currently 13 communities (shown in Figure 7 as stars) have secured a contractor to conduct surveillance in their jurisdictions. These communities are:

- Balcarres
- Carlyle
- Estevan
- Foam Lake
- Indian Head
- Kipling
- Langham
- Moosomin
- Preeceville
- Wadena
- Watrous
- Wolseley
- Wynyard

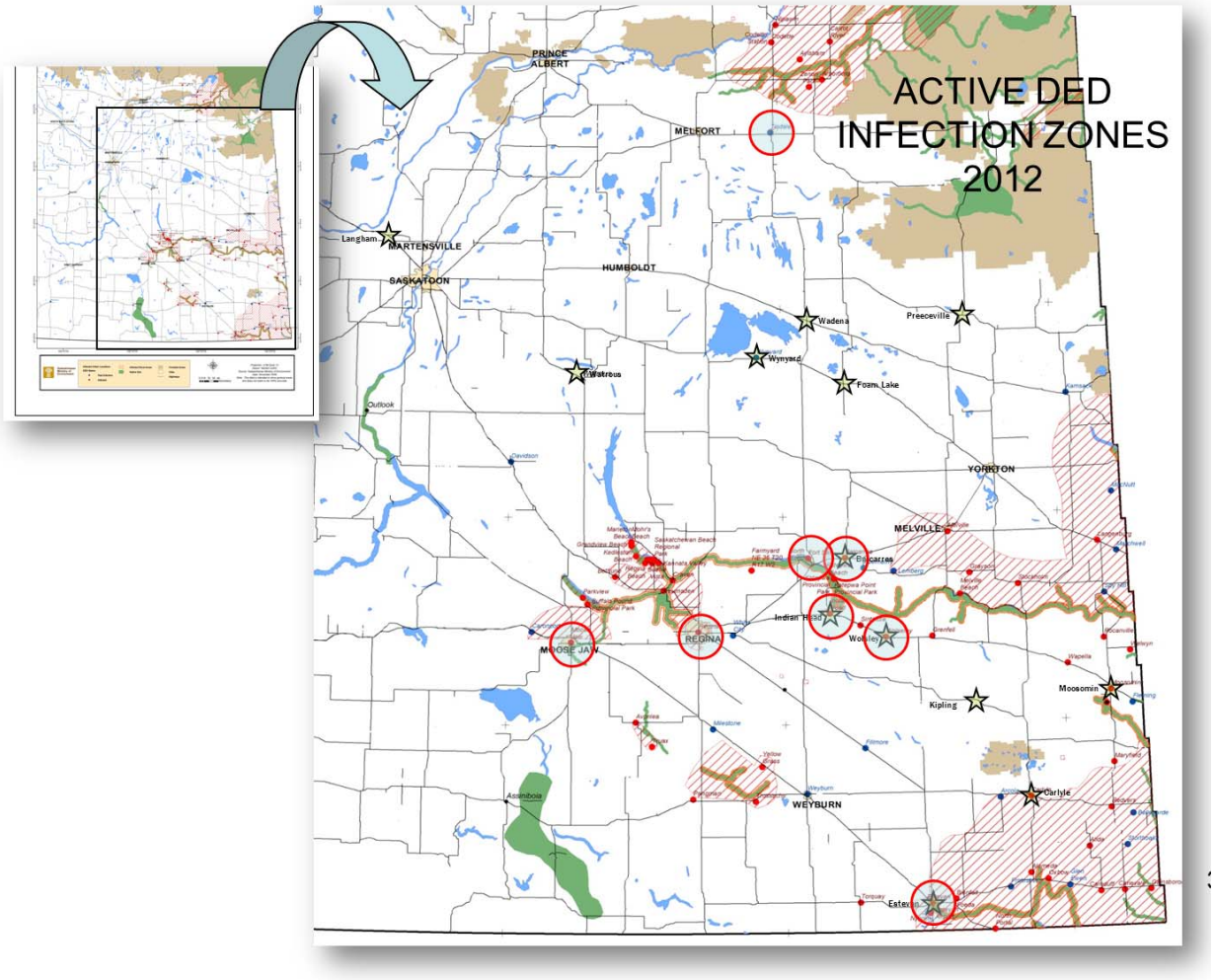

Figure 7. Distribution of Dutch elm disease active zones (red cross hatch) throughout Saskatchewan in 2012. Saskatchewan Ministry of Environment continues to survey in wild stands in seven buffer areas outside major communities and in two Provincial Parks (Circles). In addition to the major urban centers, 13 communities (stars) conduct DED management action in their own communities.

Since changes to the provincial program were implemented in April 1, 2010, the municipalities are responsible for DED management in their communities. The ministry of environment conducts surveillance and removal activities in seven buffer areas outside major communities (as well as two provincial parks) threatened by DED. The Ministry of Environment also ensures regulatory compliance, diagnostic services and provides scientific and technical support to communities.

2012 Highlights:

- The only new community with DED is Maple Creek; this is the furthest west the disease has spread in SK.
- DED has reappeared in Wynyard, SK after several years of DED absence.
- DED still present in traditional south east region of the province.

In 2012, the number of infected trees removed in management (buffer) zones has increased when compared to 2011 The number of trees removed from Echo Valley provincial park is significantly lower than in 2011 (Table 1).

Table 1. Number of DED infected trees marked for removal in the six buffers and two parks in Saskatchewan in 2011 and 2012.

Buffers	Removed		Parks	Removed	
	2011	2012		2011	2012
Estevan	0	2	**Katepwa**	0	0
Regina	24	37	**Echo Valley**	72	32
Moose Jaw	13	22		0	0
Indian Head	12	23		0	0
Wolsley	-	0			
Tisdale	1	5		0	0
Balcarres	-	73			
Total	**92**	**162**		**72**	**32**

European gypsy moth, *Lymantria dispar*

In 2012, the Canadian Food Inspection Agency (CFIA) continued ongoing monitoring in Saskatchewan deploying 511 Tréce delta II green traps baited with gypsy moth string lure (Table 2). All traps were targeted at the European gypsy moth *Lymantria dispar.* One Gypsy moth male was collected from a trap in Regina and one was collected from a trap in Yorkton. In 2013 CFIA will conduct delimitation surveys (16 traps/mile) around both positive finds.

Table 2. Number and distribution of gypsy moth traps in Saskatchewan, in 2012.

LOCATION	NUMBER Traps	NUMBER Positive
REGINA	175	1
SASKATOON	150	0
YORKTON	51	1
N. BATTLEFORD	55	0
NIPAWIN	40	0
MELFORT	40	0

In 2012, the CFIA continued with the Emerald ash borer survey both trapping and visual surveillance. In total, 17 green panel traps were deployed in 2011. None were positive.

- **1 MALE GYPSY MOTH WAS FOUND IN YORKTON, AND 1 IN REGINA.**
- **IN 2012, NO EMERALD ASH BORERS WERE TRAPPED IN SASKATCHEWAN.**

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. The monitoring program was continued until the 2006 discovery of banded elm bark beetles (BEBB), *Scolytus schevyrewi*, in Medicine Hat, AB. There was a need to modify and expand the program.

In 2007, and in collaboration with CFIA, Saskatchewan Ministry of Environment extended the monitoring to include 10 major communities across the southern part of the province. Sticky panel traps baited with 90-day elm bark beetle lures[1]. BEBB were detected in traps located in **five** of these communities: Maple Creek, Assiniboia, Moose Jaw, Weyburn and Estevan. In 2008, the trapping effort was expanded in each of these positive locations to determine the extent of the infestation and confirm if populations are establishing. Current distribution of BEBB is shown in Figure 8.

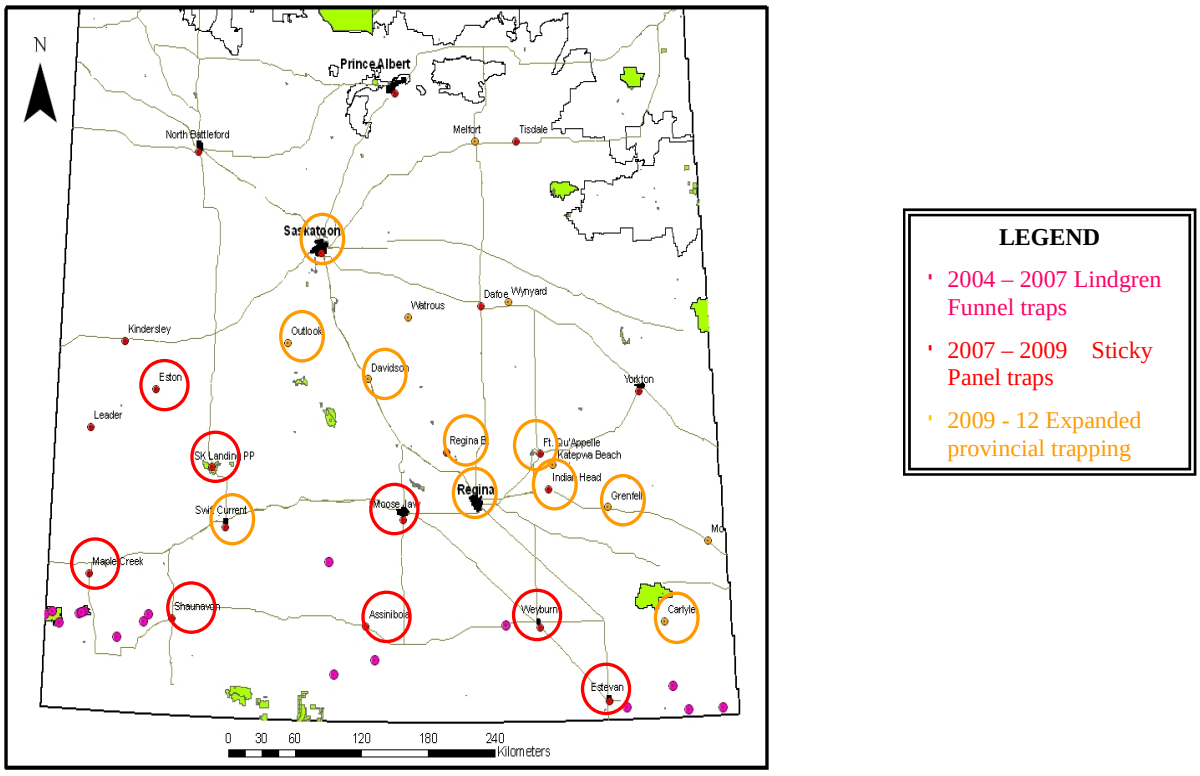

Figure 8. Map showing focus of monitoring program and the spatial distribution and spread of banded elm bark beetles in Saskatchewan, 2004-2012.

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

By 2012, BEBB has spread to most of the major urban centres including Saskatoon, Regina, Moose Jaw, and Swift Current throughout the southern half of the province. The beetle has been collected just outside the city of Saskatoon, which is currently this most northerly extent of the known range in Saskatchewan. It is now clear the beetle is established in Saskatchewan. Monitoring for this insect is ongoing.

Mountain pine beetle, *Dendroctonus ponderosae*

The risk of mountain pine beetle (MPB) spreading eastwards and establishing in Saskatchewan's boreal jack pine forests continues to be the primary concern. In 2012 the government of Alberta reported that MPB had been found in a baited tree east of Fort McMurray, within 50 km of the AB–SK border. Currently, there is an active MPB outbreak in the Cypress Hills Inter-provincial Park in southwestern Saskatchewan (Figure 9).

In SK there still remains the opportunity to focus on proactive, **Preventive** approaches instead of active beetle-focused **Suppressive** action.

Figure 9. Building Mountain pine beetle infestation in and around the Cypress hills Interprovincial Park, southwestern Saskatchewan**.**

Since 2002, Saskatchewan Ministry of Environment (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.

SK & AB Interprovincial agreement to slow the spread of MPB in Alberta

Central to Saskatchewan's strategic approach is to focus on aggressive fall and burn operations in the leading edge **in Alberta** to prevent or slow the spread of mountain pine beetle into the boreal forest and across Canada. As the MPB invades novel ecosystems (and colonizes naïve hosts) there is an unique opportunity to reduce MPB spread into the boreal Jack pine in the boreal bridge zone east of Slave Lake Alberta. The forests in this region are fragmented, beetle survival is currently poor, and the extent of damage is low. In 2011, the province of Saskatchewan entered into a multi-year agreement to partner with the province of Alberta to develop a coordinated, strategic approach to control the spread of the mountain pine beetle into Saskatchewan's boreal forest. This agreement was continued in 2012.

Under this agreement annual work plans are developed by the Spread Management Action committee (SMAC) integrating current aerial and ground survey data to prioritize and coordinate control activities. Work in 2012 focused on the leading edge through maintaining a tree-baiting network to delineate the leading edge; conducting air photography as a technique to monitor spread through "change detection"; and Level 1 (single tree) removal of MPB infested trees in the Slave Lake and Marten Hills areas.

Saskatchewan continues to be vigilant in early detection surveillance and preparations for rapid response. In 2011 a tree-baiting grid was implemented in Saskatchewan to provide an extension of the Alberta detection baiting program, to help detect and delineate the "leading edge" of MPB and detect presence/spread into Saskatchewan.

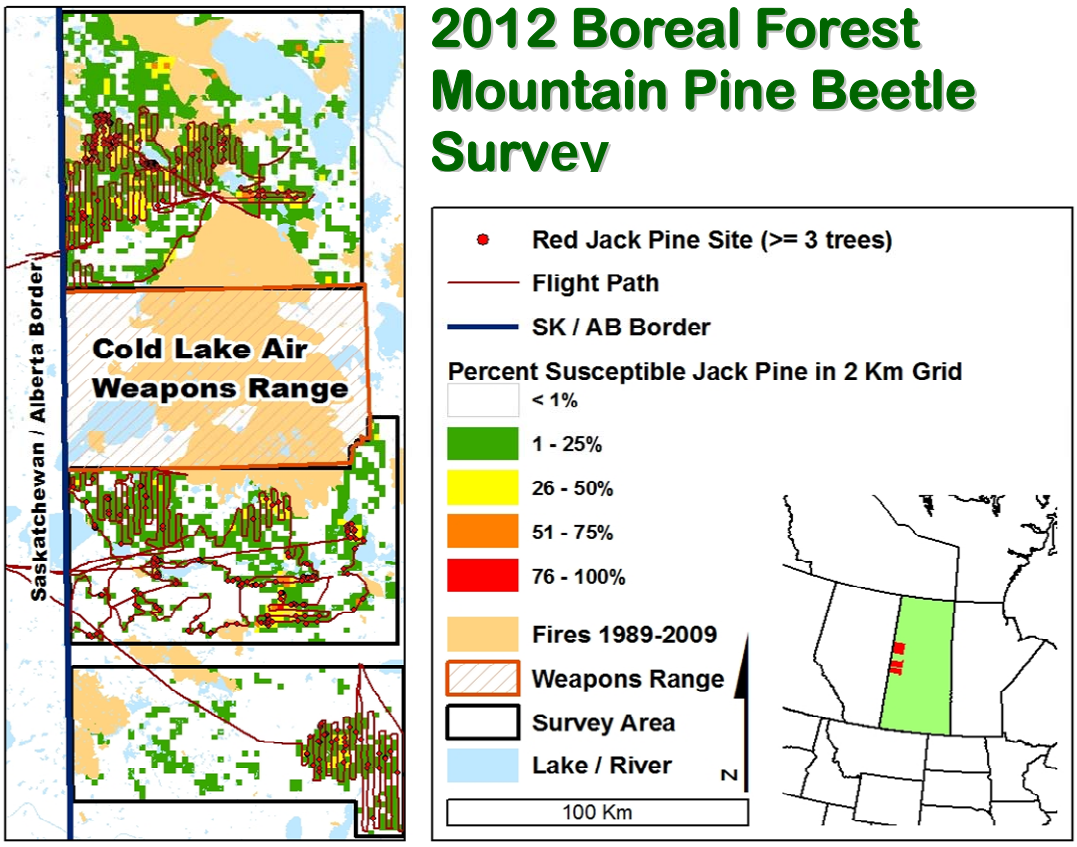

Figure 10. Map of western Saskatchewan showing areas North and South of the Cold Lake Air Weapons range where Saskatchewan Ministry of Environment conducts extended aerial monitoring prioritized on the distribution of susceptible pine stands.

Mountain pine beetle surveys

The surveillance program is divided into two components: the Cypress Hills Inter-provincial Park (CHIPP); and the Northern Boreal forest. Saskatchewan's strategic approach to the MPB threat is very similar to that of fire-fighting – early detection leading to immediate, rapid and aggressive response. To help focus surveillance and detection of MPB, Saskatchewan 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 fire disturbance data are used to help focus efficient aerial and ground surveillance activities (Figure 10).

Cypress Hills Inter-provincial Park (CHIPP)

Saskatchewan Ministry of Environment has been monitoring MPB in the CHIPP since the last outbreak declined in 1985/86. Aerial overview surveys are used to locate all red trees, shown as the red dots on the

map (Figure 11). These observations are then verified with detailed ground surveys. All locations shown on the map (Figure 12) show the locations of red trees across the landscape. The blue flags represent trees that have been killed by other agents and are not related to MPB; however, the red flags show the sites where trees were heavily attacked by killed by MPB and have been marked for removal in fall and burn operations. The outbreak remains in the south western corner (West Benson drainage) of the park along the SK–AB border.

In 2010 there were 167 trees treated; in 2011 this number was 195. In 2012, 443 trees were marked for fall and burn.

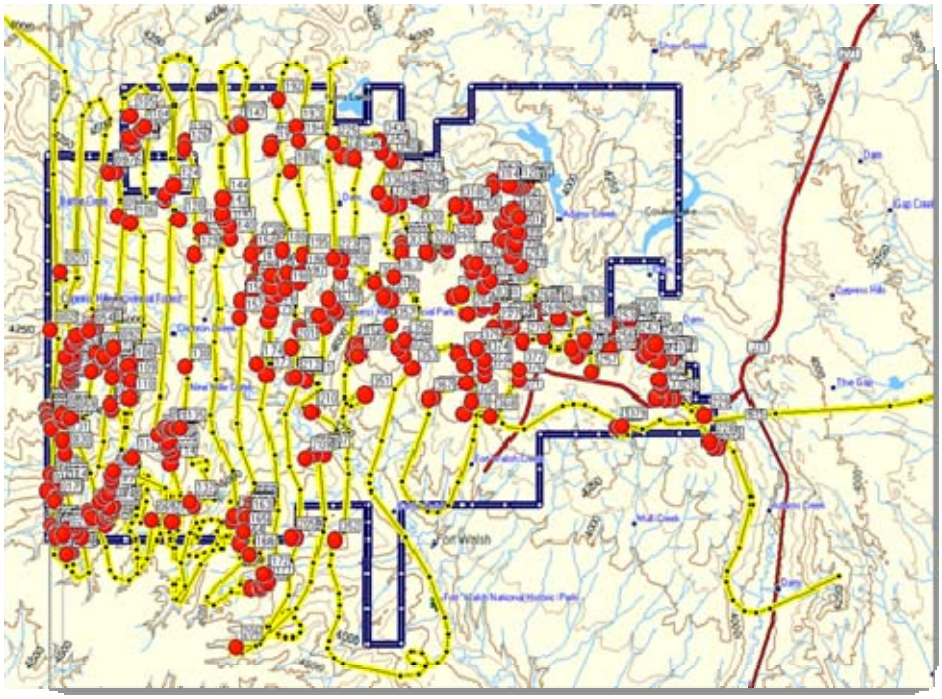

Figure 11. Track log of aerial surveys conducted in West Block of the Cypress Hills Inter-provincial Park in southwestern Saskatchewan.

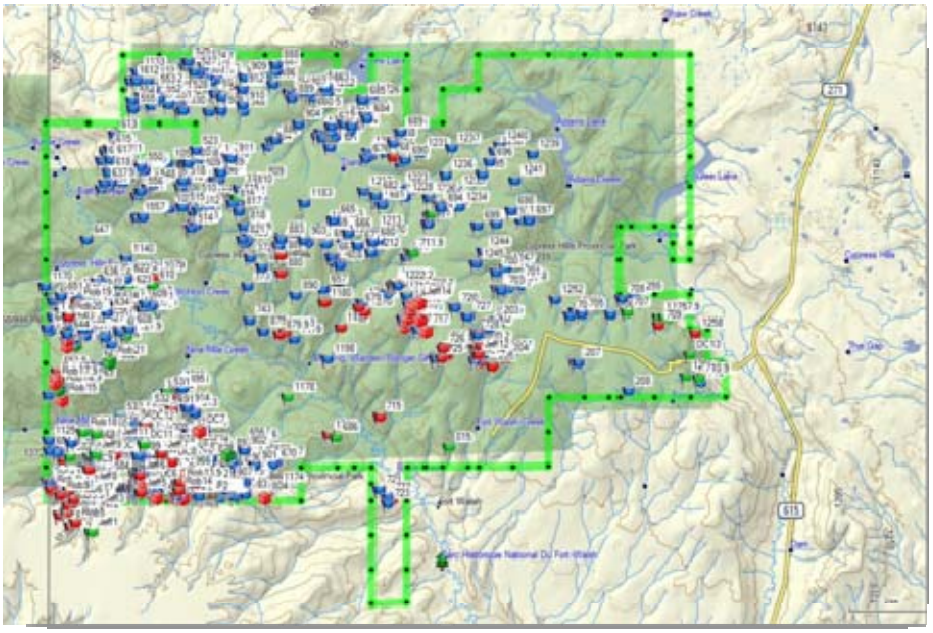

Figure 12. Location and distribution of mountain pine beetle infested trees (red flags) detected through aerial surveys and confirmed by ground checks in the West Block of the Cypress Hills Inter-provincial Park in southwestern Saskatchewan, 2012.

Each year, all trees verified during the ground surveys and marked for removal are removed. In 2006 only two trees were removed however, this number has increased gradually each year until the number of trees has almost doubled 2011-12 (Figure 13).

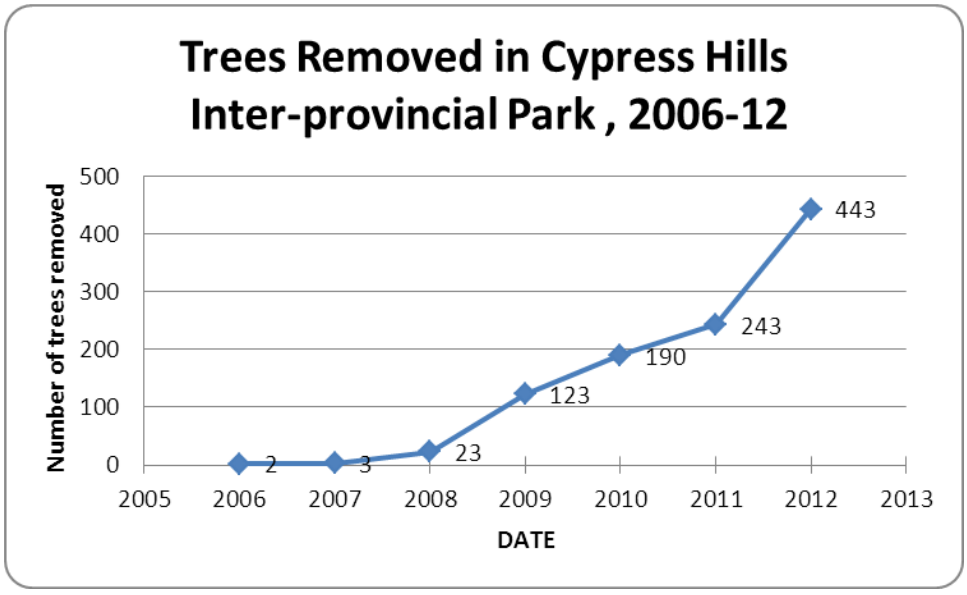

Figure 13. Total number of trees removed in Cypress Hills Interprovincial Park from 2006 to 2012.

Since this outbreak is located across multiple jurisdictions, including private land to the south of the CHIPP, SK is working with CFS and First Nations to coordinate work and assist in the control of infested trees on first Nations lands outside of the park boundaries. The ministry is also working with the Province of Alberta, Ranchers and municipal leaders to develop a collaborative, regional approach to managing Mountain pine beetle in the area.

In 2012 the Ministry of Environment added a pine forest inventory component to the annual aerial survey. Air surveys were extended beyond park boundaries and all pine forests adjacent to the park and on private land were mapped. All red trees were marked and maps with GPS locations of these trees were provided to each stakeholder. The Ministry of Environment provided training and assistance for stakeholders to help them identify and assess MPB attacked trees and advise as to control techniques.

Northern Boreal Forest Surveys

The Ministry of Environment conducts systematic monitoring along the Alberta-Saskatchewan border, with a focus on areas of highly susceptible jack pine. The ministry surveys approximately 1.6 million hectares of pine forests, extending 100 km east from the Alberta border and from the southern forest fringe north to the Churchill River. The 2012 systematic rotary wing aerial surveys were conducted in September/October to detect red trees. Of the boreal forest identified 324 sites with over 1,500 suspect “red” or recently dead jack pine (Figure 14). Approximately 20% of these locations were ground-truthed (where access permitted). Ground surveys verify MPB attack or confirm mortality resulted from other biotic and abiotic agents. The most common damage agents found in the “red” trees were: engraver beetles *Ips* spp., sawyer beetles *Monochamus* spp. and root rot *Armillaria* spp.

In 2012, in alignment with the leading edge monitoring network in Alberta, the Ministry decided to expand the existing early detection network. To serve this purpose, 40 heli-landing areas were cut in pine and pine-leading stands – one per township (Figure 15). The purpose of this initiative was two-fold: first to provide a contiguous grid within which to deploy tree baiting stations to delineate the leading edge as it transitions across AB and SK; and second to provide a network of access points from which Level 1 single tree response action might be deployed if necessary.

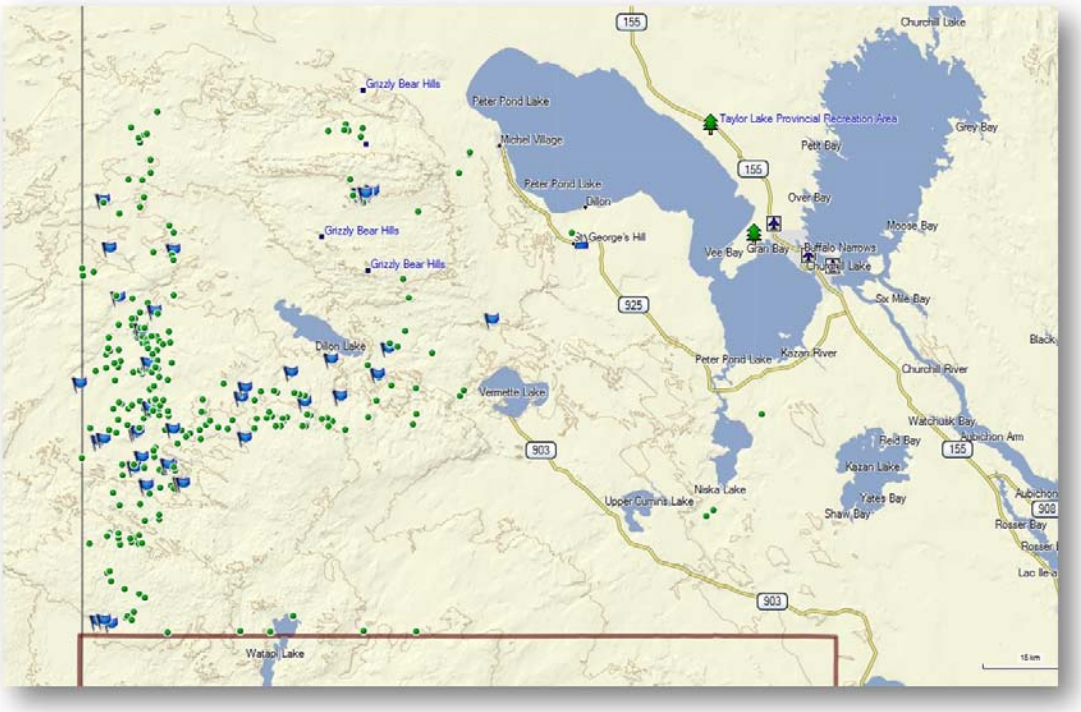

Figure 14. Distribution of fader trees (green dots) and initial ground survey sites (blue flags) in northern boreal survey.

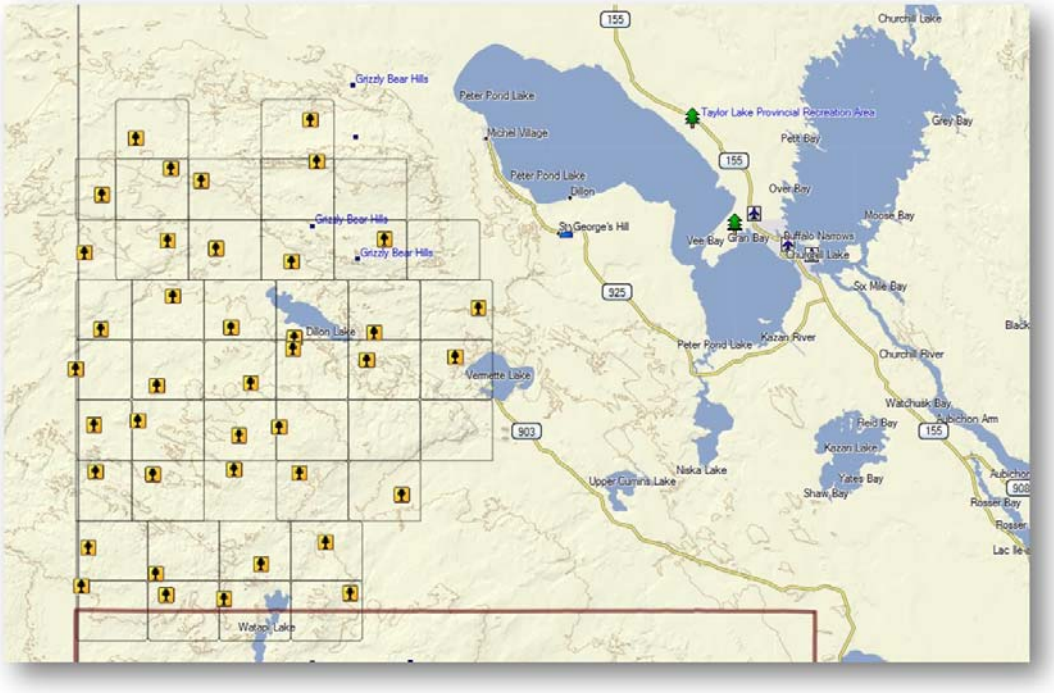

Figure 15. Distribution of heli-landing areas to expand the leading edge monitoring network across the region.

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

Abiotic Disturbances

Plough winds/blow down

Severe wind damage is a common phenomenon in the prairie region. On the July long weekend, 2010, a massive plow wind touched down in the City of Prince Albert causing extensive damage to parks and property.

On August 1, 2011 plough winds touched down damaging an area approximately 100,000 hectares of forests north of Chitek Lake and slicing a path heading north east north of Delaronde Lake past the northern tip of Prince Albert National Park southwest of Dore and Smoothstone lakes. In 2012, another major wind event damaged extensive areas of the Fort a La Corne island forest. On June 25, approximately 70,000 hectares of forest was affected (Figure 16).

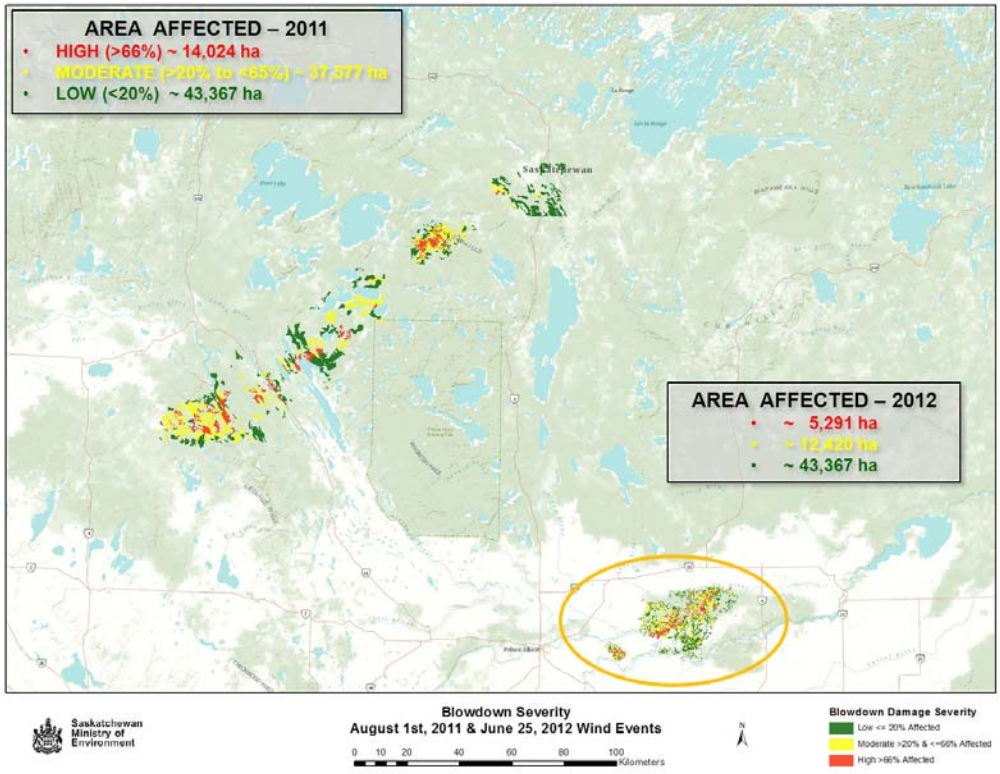

Figure 16. Areas affected in two major wind events occurring August 1, 2011 and June 25, 2012 in central Saskatchewan.

Figure 17. Spruce blown damage caused by plough winds near Chitek Lake, Saskatchewan.

Large scale wind events appear to be occurring more frequently and with devastating effects. These landscape disturbance events (Figure 17), although very difficult to predict, will have an effect on long term sustainability of the forest.

ALBERTA REPORT

Dan Lux

Alberta Sustainable Resource Development, Forest Division

Vision for the Forest Health Program in Alberta

To lead Canada in science-based, proactive, adaptive and innovative management of damaging forest health agents in a forest environment with a multitude of values and challenges posed by a changing climate.

Eastern Spruce Budworm

Defoliation Severity	2011 (ha) net	2012 (ha) net
Moderate (35 – 70%)	32,195	83,515
Severe (Over 70%)	3,208	33,825
Total	35,403	117,340

Aspen Defoliators

Causative Agent	2011 (ha) gross	2012 (ha) Gross
Bruce Spanworm	309	0
Forest Tent Cat	68,117	628,531
Large Aspen Tortrix	0	577
TOTAL	68,426	629,108

Other interesting forest health projects

Drought - In 2012, there was 42,238 hectares of drought related damage mapped in the Northeast part of the Province.

Hail/wind damage – Hail and/or damage impacted 7,100 ha of forest stands in 2012. Most of this damage was moderate in intensity. We have established long-term monitoring plots to follow the impact and to determine if rehabilitation is required.

Climate change impacts on the productivity and health of aspen (CIPHA) – We continued to monitor the plots initially established by Dr. Ted Hogg at the Northern Forestry Centre. We will continue to provide collected data to Dr. Hogg.

Mountain Pine Beetle

Mountain pine beetle threatens six million hectares of Alberta forests containing pure or mixed pine stands. The value of the standing timber in Alberta alone – just to industry – is estimated at more than $8 billion in present-day dollars. Nearly 26,000 Albertans and 50 Alberta communities depend on the forest industry for their livelihood (direct and indirect jobs). Right now, there are 25 major forest companies (Annual Allowable Cut of 10,000 m^3 or greater) operating in Alberta. More than half of them (14) rely on pine to

continue operations. In Alberta, MPB outbreaks threaten 90,000 hectares of watersheds in southern Alberta. Of this area, 8,000 hectares are the primary source of drinking water for southern Alberta communities and further east, and another 5,000 hectares are secondary drinking water sources.

We started our spring surveys to look at overwintering survival and evaluate the risk of beetle spread on May 15, 2012. The r-value relates directly to how a beetle population is expected to spread during the beetle flights in July and August. Overall, beetle populations either remained static or showed signs of increase except those in southern Alberta and along the eastern fringe of the infestation around Slave Lake which continued to decline.

Initial ground surveys this fall indicated that there was no large in-flight of beetles from British Columbia in 2012. However, the MPB that attacked trees in 2011 successfully reproduced and flew in July this year to infest more trees. Beetle populations showed signs of increase in northwest and west central Alberta but declined along the eastern slopes and along the eastern fringe of the infestation. We detected beetles within 50 km of the Saskatchewan border in dispersal baits and also detected beetle movement into the Northwest Territiries.

The beetle control program is essential to contain the risk of spread in the leading edge as much as possible. In the 2011-12 beetle year approximately 135,000 infested pines were removed under the beetle control program.

The risk of future in-flights from B.C. still exists and is projected to continue until 2014, when current population models in British Columbia are expected to peak along the Alberta border and begin to recede. As a result, our Department invested over 200 million dollars over the last 4 years to manage the impacts of the mountain pine beetle. You can find the Alberta Beetle Management Strategy at www.mpb.alberta.ca.

All of our maps and all pest conditions can be found at: http://www.srd.ab.ca

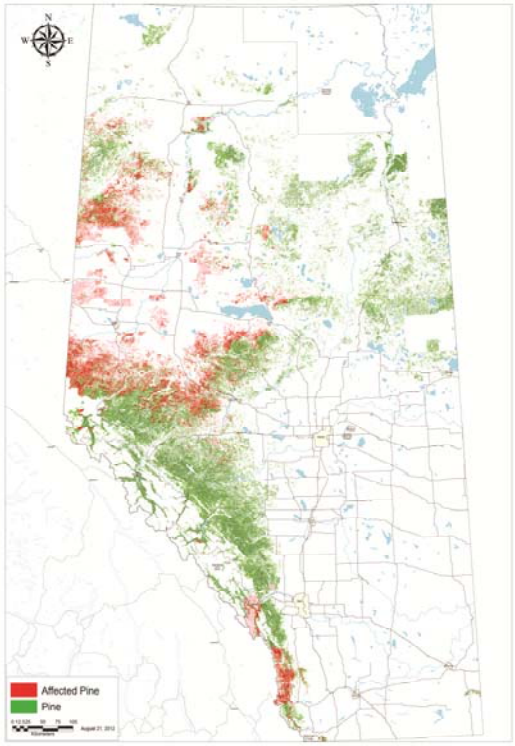

Figure 1. Distribution of the mountain pine beetle impacted stands in 2012 in Alberta.

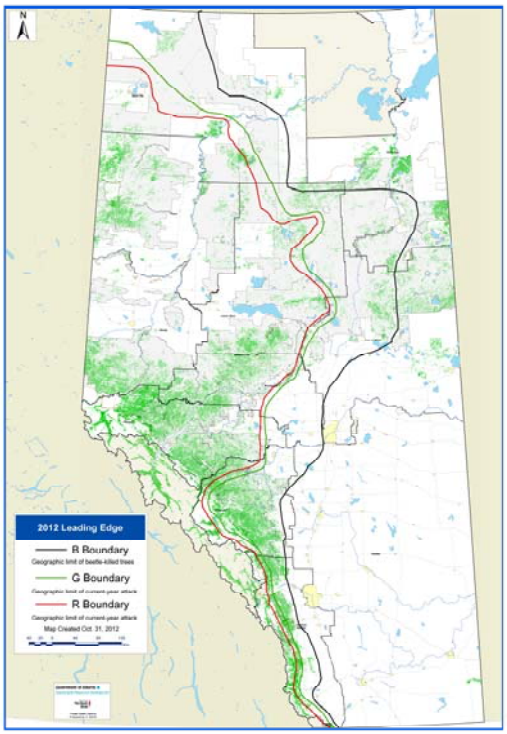

Figure 2. Distribution of the mountain pine beetle in 2012 in Alberta.

BRITISH COLUMBIA REPORT

Jennifer Burleigh

British Columbia Ministry of Forests, Lands and Natural Resource Operations

The province conducts an annual aerial overview survey (AOS) over all forested land (including private and federally managed lands, including parks). The entire province is not targeted for surveying each year and areas where there is low likelihood of disturbances are scheduled to be surveyed in alternate years. Other factors limiting complete coverage are weather and funding but typically over 80% of the province is surveyed. In the summer of 2012, after a slow start due to very poor weather that ended in mid-July, but turned ideal until late September, the survey was completed over 91% of the province – a new record (Figure 1)!

The mountain pine beetle (MPB) outbreak continued to wane as most of the susceptible pine in the province's central interior has been killed since the outbreak began around 1999. The MPB still managed to affect about 3.1 million ha of mainly lodgepole pine forests (down from 5.2 million ha in 2011) (Figures 2 and 3). Most of the new damage has occurred in the northern edge of the outbreak and for the first time, attacks are being found as far north as the Yukon and Northwest Territory borders.

Each year, the province uses the new MPB damage data to update its estimate of the cumulative volume of pine affected by the beetle to date and projected to the end of the outbreak to 2021. The latest estimates based on the 2011 AOS data was a total of 710 million m3 were killed to date while the overall impact by 2021 will be 790 M m^3. Each year, the overall impact of the MPB appears to be less than the previous year's estimate as the current AOS data indicates the MPB populations are declining faster than had been originally predicted (Walton 2012).

A timber supply crises has now hit much of the province's central interior districts where pine was once the dominant commercial species but the MPB killed timber has now reached the end of its merchantability limit for sawlogs. Dependency on other non-pine species for many forest based communities make losses due to other bark beetles more important than they were before the MPB outbreak. Douglas-fir beetle is a common killer of mature Douglas-fir found throughout the host's range. Mature Douglas-fir is vital habitat for wildlife species and protection of stands from Douglas-fir beetle mortality is often the primary rationale for treatment rather than to protect commercial timber. Over 23,000 ha of Douglas-fir beetle attack was mapped in 2012 which is nearly twice as much area recorded in 2011. Increases may be due to post-wildfire stress and perhaps from improved detection resulting from the end of the MPB outbreak.

Spruce beetle is B.C.'s third most important bark beetle species and past outbreaks have killed very large areas of spruce forest, mainly in the central interior. In 2012, the area attacked (48,154 ha) doubled since 2011 with most of the new attack occurring in the Cariboo region.

B.C. is blessed (or cursed) by a wide variety of forest defoliators – attacking both conifers and deciduous trees. Table 1 lists just some of the more significant insects, the area they damaged in 2012, and the affected area that was treated.

Table 1. Major defoliating insect species in B.C. observed in 2012 and the area treated.

Defoliator Species	Ha Infested	Treatment
Western Spruce Budworm	456,780	117,162 ha
Western Hemlock Looper	8,121	11,981 ha
Blackheaded budworm	34,849	0
2 Yr cycle budworm	74,891	890 ha (trial)
Gypsy Moth	0	0
Aspen Leaf Miner	1,172,191	0

Western spruce budworm (WSBW) continues to be the dominant conifer defoliator in the interior Douglas-fir forests of the province's southern interior. Although the area damaged declined from 2011 and 2010's totals, a portion of the 456,279 ha of defoliation expanded into the Kootenay/ Boundary region. A new record was set for WSBW treatment area in 2012 when 117,162 ha were sprayed with Foray 48B.

Western hemlock looper populations rose considerably in wet belt areas of southern B.C. with 8,121 ha of defoliation being mapped in 2012. Egg and larval counts indicated certain areas of vital habitat for endangered woodland Caribou would be severely defoliated. A treatment program of 11,981 ha was conducted primarily to protect this habitat in the Revelstoke area.

The 2-year cycle budworm, *Choristoneura biennis*, was recently added to the label of Foray 48B but operational treatment of this pest has not been done. To determine optimum spray timing, a trial spray of 890 ha was conducted near Quesnel to protect a long-term research installation. Preliminary results show excellent efficacy.

On the coast, blackheaded budworm, *Acleris gloverana*, damage increased significantly on Northern Vancouver Island but the population appears to be subsiding on Haida Gwaii as mapping of the second year of this outbreak revealed. A total of 74,981 ha of mainly western hemlock forest was defoliated.

For the second year, monitoring trapping for the North American strain of European gypsy moth conducted by CFIA and by the province, revealed a new record low by catching only 3 moths in three locations – Delta, Sooke, and Kaslo (in the southern interior). No treatments are planned for 2013 and more intensive trapping will be conducted at the locations where moths were caught in 2012 while the rest of the province's high priority areas will undergo monitoring trapping. The threat of Asian gypsy moth is being dealt with by CFIA's increased monitoring efforts around ports.

Aspen leaf miner continued to be the most significant deciduous defoliator recorded in 2012. The area defoliated doubled since 2011 with 1.17 million ha of defoliated aspen being mapped in 2012.

As reported last year, the most significant damage caused by a pathogen noted in 2012 continued to occur in the Kootenay / Boundary Region where over 31,690 ha of larch needle blight, *Hypodermella larcis*, was mapped mostly near Nelson, B.C. (Figure 4.).

As in 2011, the early summer of 2012 was again plagued by long periods of wet weather that ended suddenly in mid-July. Heavy rain along with a high snowpack caused several major devastating landslides in south eastern B.C. Other climate-related damage appears to be visible in the form of deciduous decline syndromes for both aspen and birch. Some limited research has been undertaken in to attempt to describe the various pathogens and insects associated with birch decline. Recorded for the first time, primarily in the Cariboo region this summer, was the common occurrence of post-burn mortality of young trees of all species following large wildfires in 2010 (Figure 5).

Another interesting damage report occurred on northern Vancouver Island where seedlings were being girdled in alarming numbers by the conifer seedling weevil, *Steremnius caranatus*. Although this pest was new to the foresters managing these plantations, a quick search of FIDS records revealed that the last major outbreak occurring in the nearly the same areas was in the mid-1980s. This shows the value of these historical records for many pests whose outbreak cycles span many decades.

The retirement of Cariboo Regional Entomologist, Leo Rankin, was celebrated this spring and his replacement has been chosen. Jodi Axelson begins her post in Williams Lake in January 2013. The Thompson/Okanagan and Cariboo Regions are sharing the talents of the new Regional Pathologist, David Rusch, following the vacancy created when Dr. Michelle Cleary, resigned for a new life in Sweden. David will be busy covering a large area with a multitude of pathological issues ranging from pine stem rusts to armillaria root disease.

A more detailed report is available on-line at:
http://www.for.gov.bc.ca/hfp/health/overview/overview.htm.

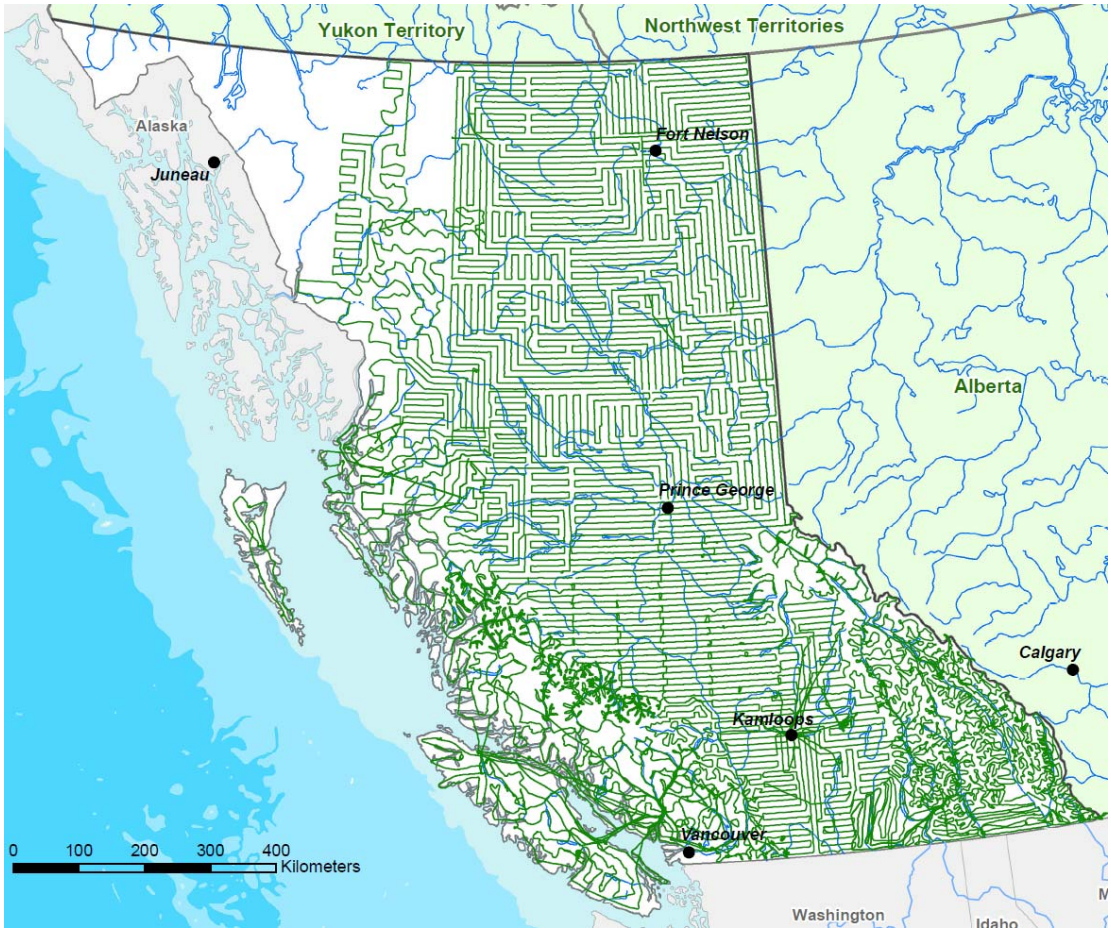

Figure 1. 2012 aerial overview survey flight lines in British Columbia. A record 91% of the province's forested land base was surveyed.

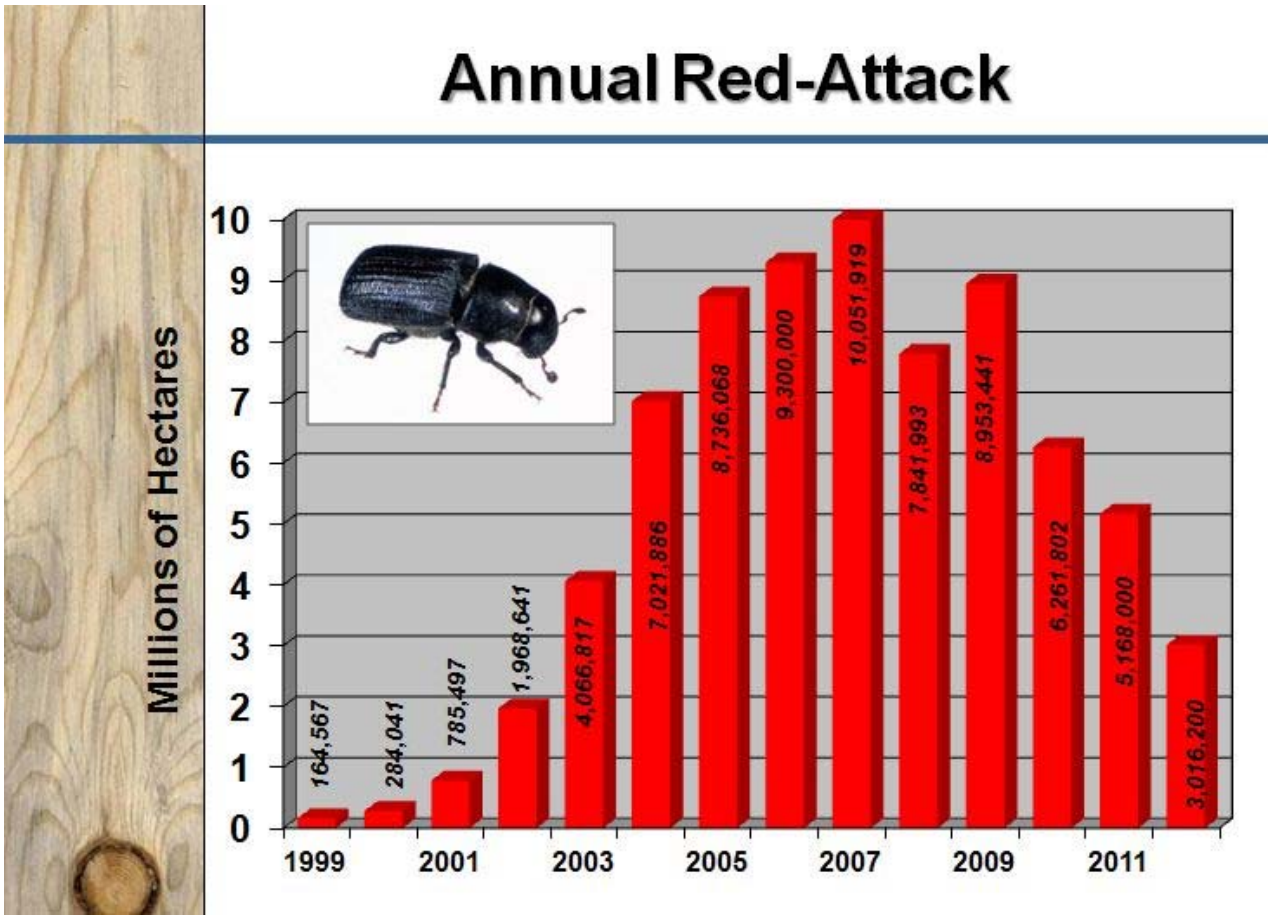

Figure 2. Annual area of attack by mountain pine beetle in British Columbia from 1999 to 2011.

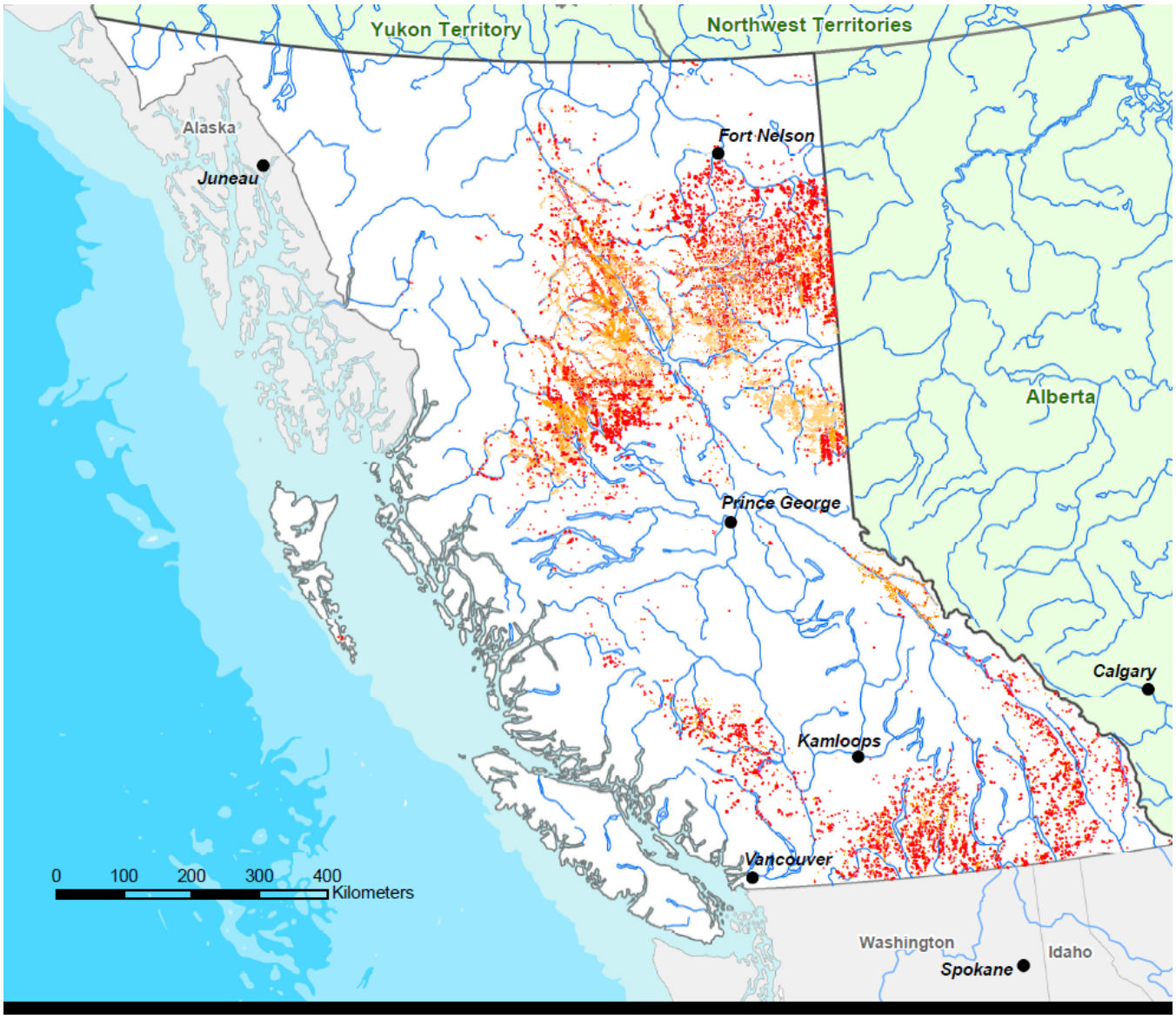

Figure 3. Distribution of mountain pine beetle damage recorded by the provincial aerial overview survey in 2012.

Figure 4. The most damage caused by a pathogen recorded during the aerial overview survey was attributed to larch needle blight. This picture shows typical damage symptoms observed near Nelson, B.C.

Figure 5. Post-wildfire damage recorded in the Cariboo Region following major wildfires in 2010.

References

Walton, A. 2012. Provincial-Level Projection of the Current Mountain Pine Beetle Outbreak: Update of the infestation projection based on the Provincial Aerial Overview Surveys of Forest Health conducted from 1999 through 2011 and the BCMPB model (year 9). http://www.for.gov.bc.ca/ftp/hre/external/!publish/web/bcmpb/year9/BCMPB.v9.BeetleProjection.Update.pdf

SESSION VIII: UNITED STATES REPORT

SÉANCE VIII : RAPPORT DES ÉTATS-UNIS

OVERVIEW OF FOREST PEST CONDITIONS IN THE U.S.A.

Robert Rabaglia

United States Department of Agriculture, Forest Health Protection

NOT AVAILABLE

SESSION IX: PEST MANAGEMENT CHALLENGES IN A CHANGING WORLD

Chair: *Tod Ramsfield*
Natural Resources Canada, Canadian Forest Service

SÉANCE IX : LES DÉFIS DE LA LUTTE CONTRE LES RAVAGEURS DANS UN MONDE EN CHANGEMENT

Président : *Tod Ramsfield*
Ressources naturelles Canada, Service canadien des forêts

DEVELOPMENT OF AN INTEGRATED APPROACH TO FORECAST MIGRATION BY EASTERN SPRUCE BUDWORM

Marc Rhainds

Natural Resources Canada, Canadian Forest Service

ABSTRACT

The eastern spruce budworm is the most severe pest in boreal forest in eastern Canada. Despite millions of dollars spent in research over the last decades, no tool is available to predict when and where outbreak populations will rise, hence hampering pest management efforts. The major factor limiting our ability to forecast regional population dynamics is a profound lack of understanding of migration by females. We are currently developing a field-based approach to predict the timing of migrations as well as the trajectories of migrants (source, destination). This holistic approach integrates several analytical tools including (among others) weather patterns, predicted vs. observed daily variation in abundance of adults, wing wear and residual fecundity of females, and landscape variation in morphometric attributes. The ultimate (20 year) goals of the research are to forecast incoming migrations/outbreaks and to develop an effective monitoring system to capture migrant females.

RÉSUMÉ

La tordeuse des bourgeons de l'épinette est le ravageur le plus important de la forêt boréale dans l'est du Canada. Malgré les millions de dollars consacrés à la recherche au cours des dernières décennies, on ne dispose d'aucun outil pour prédire quand et où on assistera à une explosion de la population, ce qui ralentit les efforts de lutte contre ce ravageur. Le principal facteur qui limite notre capacité de prévoir la dynamique des populations régionales est un manque profond de compréhension de la migration des femelles. Nous sommes en train d'élaborer une approche de terrain pour prévoir le moment des migrations ainsi que les trajectoires des migrateurs (source, destination). Cette approche holistique intègre plusieurs outils d'analyse, notamment les régimes climatiques, les variations quotidiennes prévues par opposition à celles observées dans l'abondance des adultes, l'usure des ailes et la fécondité résiduelle des femelles, et la variation du paysage dans les attributs morphométriques. Les objectifs finals (20 ans) de la recherche sont de prévoir les immigrations / pullulations et de mettre au point un système de surveillance efficace pour capturer les femelles migratrices. La tordeuse des bourgeons de l'épinette est le ravageur le plus important de la forêt boréale dans l'est du Canada. Malgré les millions de dollars consacrés à la recherche au cours des dernières décennies, on ne dispose d'aucun outil pour prédire quand et où on assistera à une explosion de la population, ce qui ralentit les efforts de lutte contre ce ravageur. Le principal facteur qui limite notre capacité de prévoir la dynamique des populations régionales est un manque profond de compréhension de la migration des femelles. Nous sommes en train d'élaborer une approche de terrain pour prévoir le moment des migrations ainsi que les trajectoires des migrateurs (source, destination). Cette approche holistique intègre plusieurs outils d'analyse, notamment les régimes climatiques, les variations quotidiennes prévues par opposition à celles observées dans l'abondance des adultes, l'usure des ailes et la fécondité résiduelle des femelles, et la variation du paysage dans les attributs morphométriques. Les objectifs finals (20 ans) de la recherche sont de prévoir les immigrations/pullulations et de mettre au point un système de surveillance efficace pour capturer les femelles migratrices

SPRUCE BUDWORM PARASITISM BY *TRANOSEMA ROSTRALE*: WHAT INFLUENCES ITS EFFICACY?

Lukas Seehausen[1], ***Jacques Régnière***[2] ***and Sandy M. Smith***[1]

[1]*University of Toronto, Faculty of Forestry*
[2]*Natural Resources Canada, Canadian Forest Service, Laurentian Foresty Centre*

ABSTRACT

The larval parasitoid *Tranosema rostrale* (Brishke) (Hymenoptera: Ichneumonidae) is an important natural enemy of the spruce budworm in low density populations. A long term study of spruce budworm's natural enemies by the Canadian Forest Service in Québec underlined the importance of parasitism by this species as a natural mortality factor. Furthermore, a project investigating the influence of partial cutting on its parasitism rate has revealed a significant reduction in parasitism by this silvicultural treatment. However, the seasonality and other important life history traits of *T. rostrale* are largely unknown. A better understanding of its biology could help determine the conditions necessary for its success and its role in maintaining low spruce budworm populations. This presentation presents findings and an outlook on a project to investigate the detailed biology and seasonality of *T. rostrale* aimed at answering key questions about its role in spruce budworm population dynamics.

RÉSUMÉ

Le parasitoïde larvaire *Tranosema rostrale* (Brishke) (Hymenoptera: Ichneumonidae) est un ennemi naturel important des populations endémiques de la tordeuse des bourgeons de l'épinette. Une étude à long terme sur les ennemis naturels de la tordeuse des bourgeons de l'épinette par le Service canadiens des forêts au Québec a souligné l'importance du parasitisme par cette espèce comme facteur de mortalité naturelle. En plus, un projet examinant l'influence de la coupe partielle sur les parasitoïdes a relevé une réduction significative du taux de parasitisme de *T. rostrale* par ce traitement sylvicole. Cependant, la saisonnalité et d'autres caractéristiques importantes du cycle de vie de ce parasitoïde sont largement inconnues. Une meilleure compréhension de sa biologie aiderait à déterminer les conditions nécessaires à son succès et à évaluer son efficacité de garder des populations de la tordeuse des bourgeons de l'épinette à un niveau endémique. Le présent exposé présente des résultats et un aperçu d'un projet qui vise à examiner en détail la biologie et saisonnalité de *T. rostrale* pour déterminer son influence sur la dynamique des populations de la tordeuse des bourgeons de l'épinette.

SOME ECOLOGICAL IMPLICATIONS OF EMERALD ASH BORER-INDUCED LOSS OF ASH IN RIPARIAN FORESTS

David Kreutzweiser[1]***, Scott Capell***[1]***, David Nisbet***[2]***, Paul Sibley***[2] ***and Taylor Scarr***[3]

[1]*Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre*
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[3]*Ontario Ministry of Natural Resources, Forest Health and Silviculture*

Canada's National Forest Pest Strategy includes a Risk Analysis Framework that requires science-based risk assessments for mitigation of emerging forest pest threats, including assessments of the ecological impacts of pest infestations. The exotic invasive insect, emerald ash borer (EAB), is rapidly spreading through southern Ontario and causing extensive mortality of ash trees. Many of these trees are in riparian (shoreline) areas that provide critical refuge habitats, movement corridors, and ecological services including the support of a rich biodiversity and the protection of water quality and aquatic ecosystem health. We describe a field study in south-western Ontario that is assessing the ecological consequences of ash mortality from EAB in riparian forests of agricultural landscapes. Early results show how the loss of ash influences stream canopy cover and leaf litter deposition, and how these affect organic matter dynamics in adjacent streams. Across our riparian forest study plots, ash trees contributed 10-90% tree basal area, with an average of 35%. EAB infestations caused 100% ash mortality. When ash trees compose about 30% or more of riparian forests, this mortality causes large and sudden canopy openings. Light penetration to forest floors is measurably increased, riparian vegetation proliferates, incursions by invasive plants are about doubled, and nitrogen cycling in riparian soils is increased by about four times above baseline rates. In our riparian plots, ash is always among the top four tree species contributing leaf litter to adjacent water bodies, with an average contribution of 20% and ranging to 45%. Ash litter inputs to streams have a distinct seasonal trend; always among the earliest inputs. Among litter from the six most common riparian trees, ash is preferred (decomposed) by aquatic invertebrates as first or second choice in selection microcosms. Further endpoints, including invertebrate communities on in-situ leaf packs with or without ash, are being assessed. We discuss how the loss of important tree species in riparian forests can affect riparian and aquatic ecosystems and their services, and how these effects could be mitigated or managed. This will identify susceptibilities, quantify threats, and inform the development of environmentally-sound management strategies for dealing with invasive insect pests in riparian forests.

ALL ARE NOT EQUAL: DIFFERENTIAL RESPONSES TO ENVIRONMENTAL CHALLENGES BY BARK BEETLES

Mary Reid[1,2]***, Leanna Lachowsky***[1] ***and Clayton Manning***[2]

[1] *University of Calgary ,Department of Biological Sciences*
[2] *University of Calgary, Environmental Science Program*

Population models typically treat all individuals as equivalent in their contributions to population growth. However, individuals are likely to differ in their responses to environmental challenges and opportunities in ways that are predictable according to the individuals' traits. Here we consider traits of mountain pine beetles, *Dendroctonus ponderosae*, that influence their survival and reproductive success under suboptimal conditions. Overwintering is a key period of beetle mortality, and we find that males are more likely to die than females, resulting in a female-biased sex ratio with implications for subsequent attack dynamics. Body size had little effect on overwintering mortality, but body size and energetic condition positively predicted survival to high concentrations of tree defensive chemicals (monoterpenes) analogous to induced tree defences. For beetles that survived exposure to monoterpenes, reproductive investment in eggs decreased as monoterpene concentration increased, consistent with either toxicity or a strategic avoidance of well-defended trees. Strategic allocation to egg size and number dependent on both female body size and tree growth rate was evident in another study. These results provide the basis for refining population models to incorporate the effects of environmental conditions on the number, sex ratio, and reproductive potential of mountain pine beetles, and so on the potential for population growth according to climate, landscape and the population size of mountain pine beetles.

EARLY DETECTION OF EMERGING DISEASES ON URBAN TREES USING NEXT GENERATION DNA SEQUENCING

Jean Bérubé

Natural Resources Canada, Canadian Forest Service, Laurentian Forestry Centre

ABSTRACT

Urban trees are the frontline against alien pests. Increasing international trade leads to increasing number of introductions and alien invasive fungi with potential to become emerging diseases usually establish themselves first on urban trees located near ports and transport nexus. An early warning system based on Next Generation DNA Sequencing (NGS) is used to identify newly introduced or already established alien invasive fungi. More than 800 urban trees from Vancouver, Victoria, Montreal and Quebec City were sampled in 2011 and preliminary results indicate this method yields 50 times more data than conventional methods. Alien pests can be molecularly monitored using NGS, leading to development of new management options.

RÉSUMÉ

Les arbres urbains sont sur la ligne de front de la lutte contre les ravageurs exotiques. Le commerce international croissant se traduit par un nombre croissant d'introductions et les champignons exotiques envahissants ayant le potentiel de devenir des maladies émergentes s'établissent habituellement en premier lieu sur les arbres urbains situés près des ports et des carrefours de transport. Un réseau d'alerte rapide fondé sur le séquençage de l'ADN de la prochaine génération est utilisé pour détecter les champignons exotiques envahissants nouvellement établis ou déjà établis. Plus de 800 arbres urbains de Vancouver, de Victoria, de Montréal et de Québec ont été échantillonnés en 2011 et les résultats préliminaires indiquent que cette méthode donne 50 fois plus de données que les méthodes classiques. Les ravageurs exotiques peuvent être surveillés sur le plan moléculaire à l'aide du séquençage de la prochaine génération, ce qui aboutira à la création de nouvelles options de gestion.

LONGEVITY OF *HETEROBASIDION OCCIDENTALE* IN UNTREATED WESTERN HEMLOCK LUMBER

Brenda Callan

Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre

ABSTRACT

The ability of the root disease pathogen *Heterobasidion occidentale* to produce infective conidia on the surfaces of colonized wood under damp conditions makes it a target of phytosanitary regulators. To better understand its longevity in products made from untreated wood, dimensional lumber was sawn from Vancouver Island-sourced infected windthrown western hemlock trees that were still green at the time of harvest. The lumber, which appeared sound but was confirmed via culturing to be fully colonized, was stored in two 25-board stacks outdoors in an unheated, open-sided shade house. Monthly sampling and culturing of the stacks continued over one year, after which two boards were still yielding the fungus. Molecular data confirm that all of the cultural isolates taken from the green lumber were genetically very close and likely to have originated from a common source, but distinct from nearby aerial isolates collected during the course of the study.

RÉSUMÉ

En raison de sa capacité de produire des conidies infectieuses sur les surfaces du bois colonisé dans des conditions humides, l'agent pathogène de la maladie des racines *Heterobasidion occidentale* est une cible des chargés de la réglementation phytosanitaire. Pour mieux comprendre sa longévité dans les produits fabriqués à partir de bois non traité, on a scié du bois de construction de dimensions courantes provenant de pruches de l'Ouest déracinées par le vent sur l'île de Vancouver, qui était encore vert au moment de la récolte. Le bois, qui semblait sain, mais dont la mise en culture a confirmé qu'il était entièrement colonisé, a été entreposé à l'extérieur en deux piles de 25 planches, dans une ombrière ouverte non chauffée. L'échantillonnage et la mise en culture mensuelle des piles se sont poursuivis pendant un an; après cette période, deux planches produisaient encore le champignon. Les données moléculaires confirment que tous les isolats de culture prélevés dans le bois vert étaient génétiquement très proches et provenaient probablement d'une source commune, mais qu'ils se distinguaient des isolats aériens tout près recueillis durant l'étude.

SESSION X: MOUNTAIN PINE BEETLE

Chair: *Bill Wilson*
Natural Resources Canada, Canadian Forest Service

SÉANCE X : LE DENDROCTONE DU PIN PONDEROSA

Président : *Bill Wilson*
Ressources naturelles Canada, Service canadien des forêts

MPB INVASIVE SPREAD INTO THE NORTHERN AND BOREAL PLAINS REGIONS – ARE WE DOING ENOUGH?

Barry Cooke

Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre

NOT AVAILABLE

HOST DEFENSE AND SUSCEPTIBILITY IN THE EXPANDING RANGE OF MOUNTAIN PINE BEETLE

Allan Carroll

University of British Columbia

NOT AVAILABLE

ADVANCES IN MODELING MOUNTAIN PINE BEETLE CLIMATIC SUITABILITY ACROSS ITS EXPANDING RANGE

Jacques Régnière

Natural Resources Canada, Canadian Forest Service, Laurentian Forestry Centre

NOT AVAILABLE

MANAGING INVASIVE SPREAD THROUGH ALBERTA AND BEYOND USING A COLLABORATIVE APPROACH

Dan Lux

Alberta Sustainable Resource Development

The Alberta Government has been actively managing the most recent mountain pine beetle infestation on Provincial land since 2002. Initially, the infestation was contained to the Bow Valley in Southern Alberta within the Bow Valley Provincial Park, adjacent to the Town of Canmore and Banff National Park. In 2003, a Strategic Directions Committee was created to manage the beetles across all jurisdictions. Management included operational survey and control, stakeholder communications, and research. The work undertaken by this committee successfully reduced beetle populations and earned a Premiers Award for exceptional cooperation and teamwork. As the beetle population continued to spread to other area of Alberta, several other cooperative ventures and committees were created. To be successful, collaboration need to occur at several levels with all stakeholders and clients. In Alberta, collaboration occurs both formally and informally with British Columbia, researchers and research organizations, forest industry, municipalities, First Nations communities, contractors, and parks. As we look to the future, the Spread Control Action Committee that coordinates the operational delivery of the 3 year Memorandum of Understanding between Alberta and Saskatchewan will pave the way for collaboration in the future.

MOUNTAIN PINE BEETLE INVASIVE DETECTION AND CONTROL OPTIMIZATION MODELING IN SPARSE MIXEDWOOD LANDSCAPES

Barry J. Cooke

Natural Resources Canada, Canadian Forest Service, Northern Forestry Centre

MPB aerial monitoring surveys are scheduled to optimize for the detection of fading trees, however because of the slow fade rate of current-year attack, this optimization leaves little or no time for control of the current-year generation. Typically, control is scheduled for the fall and winter, well after the current generation has dispersed in late summer. Ground surveys are thus required to detect those freshly attacked green trees that are the target of direct control. However these surveys are fallible and the detection rate of green-attack declines with increasing distance from the source tree. In the endemic context, the failure to detect long-range dispersers from red and fading source trees does not matter greatly, as these are dispersing into a matrix of endemic-level populations. In the invasive context, however, these long-range dispersers are directly responsible for range expansion. To maximize the reduction in the rate of invasive spread thus requires earlier monitoring, and hence a greater tolerance for detection error, in order to maximize the product of the rate of detection and the rate of control given detection. The economic dimension to this problem is especially important to consider using formal reasoning because the rates of detection are substantially lower in sparse jack pine than in thick lodgepole pine, and the cost of control is significantly higher in the inaccessible, non-merchantable forest stands of the Alberta-Saskatchewan border region. This illustrates how operational practices that were developed in the native range of the invader may need to be re-thought when the pest becomes invasive to a new environment.

CFIA'S ASIAN GYPSY MOTH SUMMIT

SOMMET DE L'ACIA SUR LA SPONGIEUSE ASIATIQUE

ASIAN GYPSY MOTH: A PEST OF CONCERN TO NORTH AMERICA

***Lesley Cree* and Louis Dumonchel**

Canadian Food Inspection Agency

In Canada and the US, the European gypsy moth *Lymantria dispar dispar* (EGM) is one of the most destructive pests of hardwood forests and shade trees; it is known to defoliate millions of acres of trees in a single season. Its close relative, the Asian gypsy moth (AGM), a complex of two subspecies of *L. dispar* and three species of *Lymantria*, is attracted to lights in ports located near forested areas in Asia and is known to lay egg masses on diverse surfaces, including vessels and cargo destined for North America. With the durability of the moth's egg masses, its ability in the larval stage to survive and develop on marginal hosts, its greater dispersal potential due to the flight capability of females, and the plasticity and variation in biological characters in diverse populations, AGM may invade a broader geographic range and more varied habitat types than EGM in North America, if introduced.

This presentation provides an overview of the taxonomy, morphology and life cycle of AGM, with an emphasis on the factors contributing to its potential introduction into North America and the traits influencing its possible impacts. Other *Lymantria* species of concern are mentioned and the authors conclude by identifying some of the knowledge gaps that could be addressed through research initiatives.

UPDATE ON THE CURRENT ASIAN GYPSY MOTH SITUATION

Leland Humble[1] ***and Jamie Richardson***[2]

[1]*Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre*
[2]*Canadian Food Inspection Agency*

The presentation was introduced with a short YouTube® video documenting a mass flight of Asian gypsy moth (*Lymantria dispar*) in the fishing port of Kuji, Iwate Prefecture in northwestern Honshu, Japan during 2008.

Introductions of Asian Gypsy Moth (AGM) populations into the ports of Vancouver, BC, Seattle-Tacoma, WA and Portland, OR in the early 1990's from egg masses transported on the hulls and superstructures of ocean-going vessels resulted in costly and extensive eradication programs to prevent establishment of this forest pest. In order to reduce the risk of future introductions of AGM, offshore mitigation measures are now required for ocean-going vessels that visit China, Japan, Korea or Far Eastern Russia during the female flight and oviposition period.. When port visits occur during the AGM egg laying period, vessels are now required to be inspected and certified free from AGM at their last Asian port of call before departing for North America.

Over 1600 vessels regulated for AGM arrived in Canada from March to September 2012. About 40% were inspected, and of these, 4.9% were found to have AGM egg masses. The egg masses were discovered on both uncertified and certified vessels.

The increase in vessels infested with AGM egg masses arriving in Canada and the United States and the high numbers of egg masses detected on individual vessels in 2012 suggest that populations are increasing in regulated areas of Asia. An example of this is the presence of AGM egg masses observed in forested and urban areas adjacent to Japanese ports bordering the inland sea region between the islands of Honshu and Shikoku during a visit in September 2012. However, accurate data on where the AGM egg masses were laid is not always available because vessels often visit multiple ports and countries where AGM occurs.

During 2013, the National Plant Protection Organizations (NPPOs) of Canada and the United States will continue to inspect non-certified vessels for AGM egg masses, audit certified vessels to evaluate the off-shore mitigation measures undertaken by each regulated country in Asia, and work with the respective NPPOs of each regulated country to enhance off-shore mitigation measures.

ASIAN GYPSY MOTH PROGRAM – PROPOSED CHANGES FOR THE 2013 SEASON

Diana Mooij

Canadian Food Inspection Agency

This presentation provided an overview of the Canadian Food Inspection Agency's (CFIA) current Asian gypsy moth (AGM) policy, a summary of the challenges and key issued faced in 2012 and proposed changes to the AGM program for 2013.

Examples of proposed changes to the AGM policy for the 2013 season included: shortening the time period that AGM certification would be required for entry to Canada, requiring notification of vessel arrival and two year port of call data year round from vessels having called on areas regulated for AGM and expanding the list of regulated pests to include all species commonly referred to as AGM. In addition to proposed changes to the policy, ongoing emphasis on mitigation at origin and increased communication and outreach to vessels were proposed for the 2013 season.

SHIPPING PERSPECTIVE ON THE ASIAN GYPSY MOTH PROGRAM

Bonnie Gee

Chamber of Shipping of British Columbia

The international shipping industry faced some immense challenges with the expanded Asian Gypsy Moth policy in 2012. The added regulated ports in Japan, Korea and China affected an estimated 1500 vessels calling Canada's West Coast between the high risk season between March 1st and October 15th. While there was a relatively high level of compliance, 101 (7%) vessels arrived without the approved phytosanitary certificates and were subject to delays offshore while waiting for inspection and an automatic penalty of $10,000 for non-compliance. No life stages of Asian Gypsy Moth were found on the non-compliant vessels when inspected by the Canadian Food Inspection Agency. However, by the end of the 2012 high risk period on the West Coast 27 vessels that were inspected and certified in the regulated foreign ports were found with life stages of Asian Gypsy Moth.

The current policy poses many challenges for the international shipping industry as CFIA's policy only recognizes certificates approved by the national plant protection organization in the regulated areas. In 2012, many vessel operators were unaware or confused by the certification requirements that would capture vessel calls in the regulated ports over the past two year. Vessel operators often change during the life of the vessel and tramp operators are often unaware of their future ports of call and their unique certification requirements. The current Asian Gypsy Moth policy provides very little opportunity for vessels to obtain certificates outside of the regulated ports and as result vessels are subject to the mandatory inspection and $10,000 penalty prior to entering Canada.

The Asian Gypsy Moth policy is a joint US-Canada initiative, but there is a significant discrepancy in how each country administers and enforces the policy requirements. Vessels calling the Canadian ports are disadvantaged as the consequences of non-compliance are far greater in Canada. US Customs and Border Protection (CBP) enforces the policy in the US and will allow non-compliant vessels to be inspected alongside. There are no penalties issued by the US for non-compliance and vessels are only ordered out for cleaning if Asian Gypsy Moth is detected upon inspection.

The Chamber of Shipping strongly advocates for an improved policy that offers the following:

- CFIA and/or NPPOs to recognize or approve other inspection companies outside of the regulated areas to allow vessel greater opportunity to achieve compliance;
- Establishing better training and auditing tools, and programs to allow for the certification of more inspection companies and consistency in application; and
- Require vessels to self-inspect – extensive checklists to be developed and provided to the vessels. All vessels that complete the checklist should be allowed alongside for inspection. This would be an improvement to what currently occurs in the US.

FOREST INDUSTRY PERSPECTIVE

Brian Zak

Canada Wood Group

ABSTRACT

Brian Zak will present a forest industry overview as to what the implications of an Asian Gypsy Moth (AGM) outbreak in Canada would mean to this Sector. Offshore exports of Canadian forest products have increased over the last six years in order to reduce the industry reliance on the U.S. marketplace.

The Canadian industry is now marketing to 129 countries, all of which have become increasingly aware of Canada's newly visible exports, which are already under close scrutiny for the safe phytosanitary entry into their countries.

An outbreak of the "destroyer AGM" will impose implications and costs to this $28 billion sector which is working towards returning to its former standing of being a $35 to $40 million contributor to the Canadian economy (subject to no more pest outbreaks!)

RÉSUMÉ

Brian Zak va dresser un portrait des implications que pourrait avoir une infestation de spongieuses asiatiques sur le secteur forestier canadien. Les exportations de produits forestiers canadiens vers l'étranger ont augmenté au cours des six dernières années pour réduire notre dépendance au marché américain.

L'industrie forestière canadienne est maintenant présente dans 129 pays. Les nouveaux produits d'exportation du Canada sont donc à l'avant-scène et font l'objet d'une surveillance attentive de la part des autorités phytosanitaires de ces pays.

Une infestation de spongieuses asiatiques, un ravageur destructeur, aurait des répercussions importantes et des coûts au niveau des exportations, une activité économique de près de 28 milliards de dollars. Cet impact se ferait sentir également sur le secteur forestier qui cherche à retrouver son ancien niveau de contribution à l'économie du Canada qui était de l'ordre de 35 à 40 millions de dollars. (À la condition de ne pas avoir d'infestations de ravageurs!)

POSTER SESSION

SÉANCE D'AFFICHES

Soil drainage class, host tree species and thinning influence host tree resistance to the spruce budworm

Alvaro, Fuentealba ***and Éric Bauce***
Université Laval, Département des sciences du bois et de la forêt, Faculté de foresterie, de géographie et de géomatique, Pavillon Abitibi-Price, 2405 de la Terrasse, Québec, QC G1V 0A6

Spruce budworm (*Choristoneura fumiferana* (Clem.)) is the most destructive insect pest in the maritime and boreal forests of North America. Thinning has been recommended to reduce damage caused by this insect. However, various studies have yielded equivocal results. The main objective of this project is to determine the real effect of thinning on host tree resistance to spruce budworm attacks. Field rearing experiments of spruce budworm were conducted along with foliar chemical analyses through a gradient of stand thinning density and site drainage quality in the Montmorency experimental forest to evaluate the impact of these factors on host tree resistance. Our results show that thinning reduced balsam fir (Abies *balsamea* (L.) Mill)) resistance one year after treatment, except on hydric drainage. Three years after treatment we observed the opposite response. This increased resistance last for at least 6 years, suggesting that thinning may be used as preventive control measure

Le drainage naturel, les espèces arborescentes hôtes et l'éclaircie influent sur la résistance des arbres-hôtes face à la tordeuse des bourgeons de l'épinette

Alvaro Fuentealba ***et Éric Bauce***
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La tordeuse des bourgeons de l'épinette (*Choristoneura fumiferana* [Clem.]) est l'insecte ravageur le plus destructif dans les forêts des Maritimes et la forêt boréale de l'Amérique du Nord. On a recommandé l'éclaircie pour réduire les dommages causés par cet insecte. Cependant, les résultats de diverses études sont équivoques. Le principal objectif de ce projet est de déterminer les effets réels de l'éclaircie sur la résistance des arbres-hôtes aux attaques de la tordeuse des bourgeons de l'épinette. Des élevages sur le terrain de la tordeuse des bourgeons de l'épinette et des analyses chimiques foliaires ont été effectués selon un gradient de densité de l'éclaircie du peuplement et de la qualité de drainage du site dans la forêt expérimentale de Montmorency afin d'évaluer l'effet de ces facteurs sur la résistance des arbres-hôtes. Nos résultats indiquent que l'éclaircie a réduit la résistance du sapin baumier (*Abies balsamea* [L.] Mill) un an après le traitement, sauf sur drainage hydrique. Trois ans après le traitement, nous avons observé la réaction opposée. Cette résistance accrue a duré pendant au moins six ans, ce qui autorise à penser que l'éclaircie pourrait être utilisée à titre de mesure préventive.

Potential high risk pathways for forest pests based on wood imports into Canada

***Jennifer Gagné*[1, 2] *and Klaus Koehler*[2]**

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[2] Canadian Food Inspection Agency, Plant Biosecurity & Forestry, 59 Camelot Drive, Ottawa, ON K1A 0Y9

The movement of firewood and logs creates opportunity for forest insects and pathogens to spread beyond national borders and to new geographic areas within Canada. While firewood is deemed a high-risk commodity for spread of forest pests, domestic movement has not been well documented and commercial firewood imports are too few to map significant pathways. Commercial log import records; on the other hand, are readily available and can provide complementary information regarding potential Forest Invasive Alien Species (FIAS) introductions and spread. The transportation pathways, comprising of origin, Canadian port of entry, and destination have been mapped and the most significant locations based on total weight of imports have been located. The results can provide guidance on optimal locations for FIAS detection surveys, as well as locate possible origins of spread, should a new infestation be detected. Additionally the resulting pathway maps present a good tool to increase public awareness of the freight transportation industry and the risk of transportation-related spread of FIAS.

Voies d'entrée à haut risque potentielles des parasites des forêts d'après les importations de bois au Canada

***Jennifer Gagné*[1, 2] *et Klaus Koehler*[2]**

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Le mouvement du bois de chauffage et des billes de bois crée des possibilités de propagation des insectes et des agents pathogènes des forêts au-delà des frontières nationales et vers de nouvelles zones géographiques au sein du Canada. Bien que le bois de chauffage soit jugé être une marchandise à risque élevé de propagation des parasites des forêts, le mouvement domestique n'est pas bien documenté et les importations de bois de chauffage commercial sont trop peu nombreuses pour permettre la cartographie d'importantes voies d'entrée. Par contre, les registres des importations des billes de bois commerciales sont aisément accessibles et peuvent fournir des renseignements complémentaires au sujet de l'introduction et de la propagation potentielles des espèces exotiques envahissantes forestières (EEEF). Les voies de transport, y compris l'origine, le point d'entrée canadien et la destination, ont été cartographiées et les emplacements les plus importants, d'après le poids total des importations, ont été repérés. Les résultats peuvent aider à orienter le choix des emplacements optimaux pour les enquêtes de dépistage des EEEF, ainsi qu'à trouver les origines possibles de la propagation, en cas de détection d'une nouvelle infestation. En outre, les cartes des voies d'entrée constituent un bon outil pour sensibiliser davantage le public à l'industrie du transport des marchandises et au risque de propagation des EEEF lié au transport.

Live insects found in wood packaging materials after implementation of ISPM 15

***Helen Gerson*[1], Becky Illson-Skinner[1], Ryan Guthrie[1] and Jean J. Turgeon[2]**
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Wood packaging material (WPM) is a pathway that allows many insects to move and establish outside their native range. The International Standard for Phytosanitary Measures (ISPM) No. 15 was adopted in 2002 and revised in 2006 and 2009 "to reduce the risk of introduction and/or spread of quarantine pests associated with WPM". Canada implemented this measure in 2006 and assesses compliance by inspecting WPM at ports of entry. Inspectors detected the presence of live insects, many of them regulated pests, in WPM from 79 of the 3887 marine containers examined for WPM in 2011-2012. In 60 of 78 containers for which treatment data were available, the infested WPM was stamped with an International Plant Protection Convention (IPPC) mark indicating either heat or methyl bromide treatment. Whether these observations indicate that the treatment is inadequate or ineffective, or is the result of fraudulent use of IPPC marks remains to be investigated because some species are able to re-infest already treated wood. Of the 79 containers with live pests, 90% were infested with beetles (Coleoptera); the remainder were found with either Hymenoptera or unknown insects. A list of the species found in these shipments and their countries of origin are presented.

Insectes vivants trouvés dans les matériaux d'emballage en bois suivant la mise en œuvre de la norme NIMP nº 15

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Les matériaux d'emballage en bois (MEB) constituent une voie d'entrée permettant à de nombreux insectes de se déplacer et de s'établir à l'extérieur de leur aire de répartition naturelle. La Norme internationale pour les mesures phytosanitaires (NIMP) numéro 15 a été adoptée en 2002 et révisée en 2006 et 2009 afin de « réduire le risque d'introduction ou de dissémination d'organismes de quarantaine associés aux MEB ». Le Canada a mis cette mesure en œuvre en 2006 et évalue la conformité en inspectant les MEB aux points d'entrée. Les inspecteurs ont relevé la présence d'insectes vivants, dont la plupart constituent des organismes nuisibles réglementés, dans les MEB de 79 des 3 887 conteneurs maritimes examinés en 2011-2012. Dans 59 des 76 conteneurs pour lesquels les données relatives au traitement étaient disponibles, les MEB infestés portaient la marque de la Convention internationale pour la protection des végétaux (CIPV) indiquant un traitement thermique ou un traitement au bromure de méthyle. Il reste encore à déterminer si ces observations indiquent un traitement inadéquat ou inefficace, ou une utilisation frauduleuse des marques CIPV, puisque certaines espèces peuvent infester à nouveau le bois déjà traité. Des 79 conteneurs infestés par des insectes, 90 % se composait de coléoptères, alors que les hyménoptères et des espèces inconnues constituaient l'autre 5 %. Une liste des espèces trouvées dans ces conteneurs ainsi que leurs pays d'origine est présentée.

Does emerald ash borer infestation facilitate exotic plant species invasion?

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"Invasional meltdown hypothesis" has been suggested as a mechanism to explain facilitative interactions among exotic species. We study the potential for invasion by exotic plant species following emerald ash borer (EAB) (*Agrilus plannipenis*) outbreaks. In Southwestern Ontario, this exotic wood-boring beetle has already killed several hundred thousand ash trees (*Fraxinus* spp.). A long-term monitoring study has been set up to evaluate a critical issue for forest management: the impact of understory vegetation response to the massive mortality of ash trees on forest ecosystem functions and services. One key aspect of this project is how landscape (urban and agricultural with different level of forest retention) and forest patch configuration (woodlot or riparian) affect the invasion potential of exotic plant species following EAB outbreak. EAB modify the habitat in a way that favours exotic plants. The use of a trait-based approach shows that exotic plant species possess different characteristics (i.e., trait values) according to the landscape and configuration of the forest. This variability, especially in traits related to competitiveness of the exotic species, may lead to different plant community responses following EAB outbreak. Because urban and riparian forests are more disturbed and more prone to exotic propagule pressure, they are expected to be more vulnerable to exotic plant species invasion. Understanding facilitative interactions between EAB outbreak and exotic plant responses are crucial information for managing and mitigating the loss of these foundation tree species.

Les infestations d'agriles du frêne facilitent-elles les envahissements par des espèces végétales exotiques?

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« L'hypothèse de fusion invasive » a été suggérée comme mécanisme expliquant la facilitation des interactions entre les espèces exotiques. Nous étudions les risques d'envahissement par des d'espèces végétales exotiques à la suite d'infestations d'agriles du frêne (*Agrilus plannipenis*). Dans le sud-ouest de l'Ontario, ces coléoptères exotiques perceurs du bois ont déjà entraîné la mort de centaines de milliers de frênes (*Fraxinus* spp.). Une étude de surveillance à long terme a été mise sur pied afin d'évaluer un des enjeux critiques pour la gestion forestière : l'incidence de la réaction de la végétation du sous-bois face à la mortalité massive des frênes sur les fonctions et les services de l'écosystème forestier. Un aspect clé du projet repose sur la façon dont le paysage urbain et agricole, présentant divers niveaux de préservation de forêts, et la configuration des parcelles forestières boisées ou riveraines affectent la possibilité d'envahissement par des espèces végétales exotiques suivant une infestation d'agriles du frêne, lesquels modifient l'habitat de façon à faciliter l'apparition de plantes exotiques. L'utilisation d'une approche axée sur les attributs démontre que les espèces végétales exotiques possèdent des caractéristiques différentes

(valeurs d'attributs) en fonction du paysage et de la configuration de la forêt. Cette variabilité, surtout lorsqu'il s'agit d'attributs liés à la compétitivité des espèces exotiques, peut entraîner différentes réactions de la part des communautés végétales, et ce, à la suite d'infestations d'agriles du frêne. Puisque les forêts urbaines et riveraines sont plus susceptibles aux perturbations et à la pression des propagules exotiques, on s'attend à ce qu'elles soient plus vulnérables à l'envahissement par des espèces végétales exotiques. Il est essentiel de comprendre la facilitation des interactions entre les infestations d'agriles du frêne et les réactions des plantes exotiques afin de mieux gérer et de limiter les pertes de ces espèces d'arbres fondatrices.

A basis for prioritizing removals of American elm trees with Dutch elm disease symptoms

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In Manitoba, a major component of Dutch elm disease management programs is removal of infected American elm trees, the potential source of spore-bearing native elm bark beetles (NEBB). In summer, symptomatic trees are tagged and, as NEBB can emerge in fall, rapid removal of tagged trees is desirable. Often the number of tagged trees exceeds the capacity for rapid removal, and removals must be prioritized. In dissected newly symptomatic trees, the total numbers of NEBB ranged from 0 to >40,000, 92% of branch sections had the blue staining characteristic of the disease, and NEBB were more likely to be in stained sections. The relationship: Number of NEBB/tree = 14.134 x $10^{0.029x}$, where x = % of stained sections with NEBB was significant. Scoring of NEBB presence in a small number of stained branch sections could allow identification of the trees with the most NEBB, the trees that should be removed first.

Fondement sur lequel prioriser l'enlèvement des ormes d'Amérique présentant des symptômes de la maladie hollandaise de l'orme

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Au Manitoba, un élément majeur du programme de gestion de la maladie hollandaise de l'orme consiste à enlever les ormes d'Amérique infectés, la source potentielle de scolytes de l'orme sporulés. Les arbres symptomatiques sont marqués durant l'été, et comme les scolytes de l'orme peuvent émerger à l'automne, l'enlèvement rapide des arbres marqués est souhaitable. Souvent, le nombre d'arbres marqués dépasse la capacité d'enlèvement rapide, et il faut prioriser les enlèvements.Dans les arbres nouvellement symptomatiques coupés, le nombre total de scolytes de l'orme a varié entre 0 et >40 000, 92 % des sections de branches présentaient le bleuissement caractérisant la maladie et les scolytes étaient plus susceptibles de se trouver dans les sections bleuies. La relation : Nombre de scolytes de l'orme/arbre = 14,134 x $10^{0,029x}$, où x = % des sections bleuies comportant des scolytes de l'orme, était importante. La notation de la présence de scolytes de l'orme dans un petit nombre de sections de branches bleuies permettait de reconnaître les arbres comportant le plus de scolytes, qui devaient être enlevés en premier.

Biology of the banded elm bark beetle on the Prairies

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From 2009 to 2011, we studied the alien invasive banded elm bark beetle (BEBB), *Scolytus schevyrewi*, in Saskatchewan and Manitoba. Catches on baited sticky traps showed that adult flight activity started in early summer, peaked in late summer, then decreased until ceasing in October. Unbaited sticky traps on a variety of potential host trees showed that adult beetles preferred water-stressed Siberian elms. Trap logs of American elm, Russian olive, white willow and caragana were never colonized by BEBB. Siberian elm trap logs were colonized, with the larval stage dominating from August until winter. From these logs in summer, 90% of brood emerged successfully, but only 14% emerged from logs held outside throughout winter. Our results suggest that the arrival of BEBB will not require changes in the ongoing Dutch elm disease management programs in Manitoba and Saskatchewan, but that BEBB populations could build in dying and dead Siberian elms.

Biologie du scolyte asiatique de l'orme dans les Prairies

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De 2009 à 2011, nous avons étudié le scolyte asiatique de l'orme envahissant, *Scolytus schevyrewi*, en Saskatchewan et au Manitoba. Les spécimens capturés à l'aide de pièges collants appâtés ont révélé que l'activité de vol des adultes commençait au début de l'été, atteignait son sommet à la fin de l'été, puis diminuait jusqu'au moment de cesser en octobre. Les pièges collants non appâtés placés sur divers arbres-hôtes potentiels ont révélé que les scolytes adultes préféraient l'orme de Sibérie soumis à des stress hydriques. Les tronçons pièges d'orme d'Amérique, d'olivier de Bohême, de saule blanc et de caragana n'ont jamais été colonisés par le scolyte asiatique de l'orme. Les tronçons pièges d'orme de Sibérie ont été colonisés, le stade larvaire dominant du mois d'août jusqu'à l'hiver. Quatre-vingt-dix pour cent des couvains ont émergé avec succès de ces tronçons au cours de l'été, mais seulement 14 % ont émergé des tronçons gardés à l'extérieur durant tout l'hiver. Nos résultats autorisent à penser que l'arrivée du scolyte asiatique de l'orme ne nécessitera pas de changements dans les programmes de gestion de la maladie hollandaise de l'orme en cours au Manitoba et en Saskatchewan, mais que des populations de scolytes asiatiques de l'orme pourraient se développer dans les ormes de Sibérie dépérissants ou morts.

Silvicultural control of Armillaria root disease in Manitoba

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In 1992, a replicated trial was established in the Sandilands region of Manitoba to investigate the efficacy of stump removal for the control of Armillaria root disease, caused by *Armillaria ostoyae*. Jack pine (*Pinus banksiana*) and red pine (*Pinus resinosa*) were planted into plots that either included the residual stumps from the previous stand or from which the stumps were removed. The trial was assessed yearly for the first 10 years and then again in 2012. Mortality caused by Armillaria root disease was found to be higher in the plots which were not treated by stump removal. Preliminary volume calculations indicate that the standing volume is higher for both red pine and jack pine in the plots from which the stumps were removed. Thus, stump removal appears to improve productivity in the regenerating stand, which benefits both carbon sequestration and traditional forestry objectives.

Contrôle sylvicole du pourridié-agaric au Manitoba

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En 1992, un essai répété a été établi dans la région de Sandilands du Manitoba afin d'étudier l'efficacité du dessouchage pour contrôler le pourridié-agaric, une maladie causée par l'*Armillaria ostoyae*. On a planté des pins gris (*Pinus banksiana*) et des pins rouges (*Pinus resinosa*) dans des parcelles qui comprenaient les souches résiduelles du peuplement antérieur ou dans des parcelles dessouchées. L'essai a été évalué chaque année pendant les 10 premières années, puis à nouveau en 2012. On a constaté que la mortalité provoquée par le pourridié-agaric était plus élevée dans les parcelles qui n'ont pas été traitées par le dessouchage. Les calculs de volume préliminaires indiquent que le volume sur pied est plus élevé pour le pin rouge et le pin gris dans les parcelles qui ont été dessouchées. Par conséquent, le dessouchage semble améliorer la productivité dans le peuplement de retour, ce qui profite tant à la séquestration de carbone qu'aux objectifs forestiers traditionnels.

Auto-dissemination of *Beauveria bassiana* for control of brown spruce longhorn beetle, *Tetropium fuscum* (F.), (Coleoptera: Cerambycidae)

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The exotic brown spruce longhorn beetle, *Tetropium fuscum* (F.), infests and kills mature spruce trees, especially those undergoing periods of stress, and could spread across Canada's boreal forest. Lavallée et al. developed an auto-contamination/dissemination device (ACD) which consists of a pheromone-baited trap on which the collecting cup is replaced with a substrate covered in conidia of the insect fungal pathogen, *Beauveria bassiana.* We performed a series of tests to evaluate the feasibility of suppressing *T. fuscum* via auto-contamination. Adult longevity, female fecundity, and percent egg hatch were significantly reduced by exposure to *B. bassiana,* through both direct contact on the ACD and indirect contact with beetles of the opposite sex that had exited an ACD 1–3 days previously. In a pilot-level ACD field test, 28% of *T. fuscum* were contaminated with *B. bassiana* and of those, 67% became infected, compared with 0% infection in the untreated stand.

Autodissémination du *Beauveria bassiana* pour la lutte contre le longicorne brun de l'épinette, *Tetropium fuscum* (F.), (coléoptère : cérambycidés)

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Le longicorne brun de l'épinette, *Tetropium fuscum* (F.), une espèce exotique, infeste et tue les épinettes mûres, plus particulièrement celles qui subissent des périodes de stress, et pourrait se propager dans l'ensemble de la forêt boréale du Canada. Lavallée et collab. ont mis au point un dispositif d'autocontamination/dissémination (ACD) consistant en un piège appâté avec des phéromones sur lequel le récipient collecteur est remplacé par un substrat recouvert des conidies de l'agent pathogène fongique de l'insecte, *Beauveria bassiana.* Nous avons effectué une série de tests pour évaluer la faisabilité de supprimer le *T. fuscum* par l'autocontamination. La longévité des adultes, la fécondité des femelles et le pourcentage d'éclosion des œufs ont été considérablement réduits par une exposition au *B. bassiana* assurée par un contact direct sur l'ACD et un contact indirect avec des longicornes de sexe opposé qui étaient sortis d'un ACD entre 1 et 3 jours auparavant. Lors d'un essai sur le terrain de l'ACD, effectué dans le cadre d'une étude pilote, 28 % des *T. fuscum* ont été contaminés par le *B. bassiana* et parmi ceux-ci, 67 % sont devenus infectés, comparativement à 0 % d'infection dans le peuplement non traité.