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Proceedings of the
Compte rendu du

Forest Pest Management FORUM sur la répression des ravageurs forestiers

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The Forest Pest Management Forum would like to acknowledge
Gary Grant
from Natural Resources Canada, Canadian Forest Service, for the contribution he has made to the success of the Forest Pest Management Forum and the advancement of forest pest management research in Canada

1941-2011

Le Forum sur la répression des ravageurs forestiers aimerait souligner la contribution de
Gary Grant
de Ressources naturelles Canada, Service canadien des forêts, au succès du Forum et à l'avancement de la recherche sur la lutte contre les ravageurs forestiers au Canada

1941-2011

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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 2011 FORUM ORGANIZING COMMITTEE

Le Forum 2011 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 2011

DECEMBER 6-8, 2011
Ottawa Convention Centre
Ottawa, Ontario
Second Floor – Gatineau Room

TUESDAY, DECEMBER 6

08:00	**Registration**	Prefunction - 2nd floor
08:30	**Welcome to the 2011 Forest Pest Management Forum** *Anthony Hopkin, Natural Resources Canada, Canadian Forest Service*	Gatineau - 205 and 207

Chair: *Taylor Scarr, Ontario Ministry of Natural Resources*

Session I: Western Pest Management Issues

08:40	British Columbia Report *Lorraine Maclauchlan, British Columbia Ministry of Forests, Lands and Natural Resource Operations*	
09:00	Alberta Report *Dan Lux, Alberta Sustainable Resource Development, Forest Division*	
09:20	Saskatchewan Report *Rory McIntosh, Saskatchewan Ministry of Environment, Forest Service Branch*	
09:40	Manitoba Report *Irene Pines, Manitoba Conservation, Forestry Branch*	
10:00	**Break and Poster Session**	Gatineau - 206 and 208

Chair: *Taylor Scarr, Ontario Ministry of Natural Resources*

Session II: North of 60 Report

Gatineau - 205 and 207

10:40	Northwest Territories Report *Mike Gravel, Government of the Northwest Territories, Environment and Natural Resources*	
10:50	Yukon Report *Rory McIntosh, Saskatchewan Ministry of Environment, Forest Service Branch, on behalf of the Government of Yukon, Energy, Mines, and Resources*	

Chair: *Taylor Scarr, Ontario Ministry of Natural Resources*

Session III: United States Report

11:00 Overview of forest pest conditions in the U.S.A.
Rona Sturrock, Natural Resources Canada, Canadian Forest Service, on behalf of the United States Department of Agriculture, Forest Health Protection

11:30 **Lunch break (not provided)**

13:00 **Welcoming Remarks** — Gatineau - 205 and 207
Tom Rosser, Assistant Deputy Minister
Natural Resources Canada, Canadian Forest Service

Session IV: Genome Canada Presentation

13:10 Genome Canada funding announcement
Alan Winter, Genome Canada

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

Session V: National Forest Pest Strategy Update

13:40 An update of the National Forest Pest Strategy
Kami Ramcharan, Natural Resources Canada, Canadian Forest Service

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

Session VI: National Forest Pest Strategy Discussion

14:00 Why Canada needs a forest pest management strategy
Vince Nealis, Natural Resources Canada, Canadian Forest Service

14:20 Perspective from the newcomer in forest pest management
Mike Gravel, Government of the Northwest Territories, Environment and Natural Resources

14:30 Perspective from the newcomer in forest pest management
Rory McIntosh, Saskatchewan Ministry of Environment, Forest Service Branch, on behalf of the Government of Yukon, Energy, Mines, and Resources

14:45 Perspective from an established forest pest management program
Taylor Scarr, Ontario Ministry of Natural Resources

15:00 Panel Discussion

15:15 **Break** — Gatineau - 206 and 208

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

Session VII: Pesticide Regulations, Alternatives, Minor Use

Gatineau - 205 and 207

15:45	Introduction *Michael Irvine, Ontario Ministry of Natural Resources*	
15:55	PMRA update, including a proposal for forest working groups *Terry Caunter, Health Canada, Pest Management Regulatory Agency*	
16:25	Update on IAS approaches from the PMRA perspective *Imme Gerke, Health Canada, Pest Management Regulatory Agency*	
16:50	Adjourn	
17:00	Forest Pest Management Forum Steering Committee Annual Meeting (closed session)	Gatineau - 205 and 207

WEDNESDAY, DECEMBER 7

08:00	**Registration**	Prefunction - 2nd floor

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

Session VIII: Eastern Pest Management Issues

Gatineau - 205 and 207

08:20	Ontario Report *Taylor Scarr, Ontario Ministry of Natural Resources*	
08:40	Quebec Report *Pierre Therrien, Ministère des Ressources naturelles et de la Faune du Québec*	
09:00	New Brunswick Report *Nelson Carter, New Brunswick Department of Natural Resources*	
09:20	Nova Scotia Report *Peter Amirault, Forest Protection Limited, on behalf of the Nova Scotia Department of Natural Resources*	
9:40	Newfoundland and Labrador Report *Nelson Carter, New Brunswick Department of Natural Resources, on behalf of Newfoundland and Labrador Department of Natural Resources*	
10:00	**Break & Poster Session**	Gatineau - 206 and 208
10:40	Invasive Species Centre presentation	Gatineau - 205 and 207

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

Session IX: Biological Forest Pest Control and Application Technologies

10:50 Integrated research and development of biological forest pest control products and application technologies
Peter Amirault, Forest Protection Limited and
Stefan Richard, Sylvar Technologies Inc.

11:30 **Lunch break (not provided)**

Chair: *Judi Beck, Natural Resources Canada, Canadian Forest Service*

Session X: Ecosystem Resilience

13:00 Putting forest diseases on the map
Rona Sturrock, Natural Resources Canada, Canadian Forest Service

13:25 Mountain pine beetle: a serious threat to Saskatchewan
Rory McIntosh, Saskatchewan Ministry of Environment, Forest Service Branch

13:50 Yellow cedar decline
Stefan Zeglen, British Columbia Ministry of Forests and Range

14:15 Brown spruce longhorn beetle in the Atlantic Provinces
Ron Neville, Canadian Food Inspection Agency

14:40 Risk assessment for white pine blister rust in Quebec: recent developments
Michel Huot, Ministère des Ressources naturelles et de la Faune du Québec

15:00 **Break** Gatineau - 206 and 208

Chair: *Ron Hall, Natural Resources Canada, Canadian Forest Service* Gatineau - 205 and 207

Session XI: Detection Tools

15:30 Comparing visual and molecular detection of tree pathogens, a case study with white pine blister rust (WPBR) in a nursery
Philippe Tanguay, Natural Resources Canada, Canadian Forest Service

15:50 Remote sensing for insect defoliation: advances and challenges
Ron Hall, Natural Resources Canada, Canadian Forest Service

16:10 Development of detection and genotyping tools for plant pathogens detection (*Phytophthora* and fungi) using genomic data information
Guillaume Bilodeau, Canadian Food Inspection Agency

16:30 DNA barcoding and forest biosecurity: applying molecular tools to the identification of forest pests
Lee Humble, Natural Resources Canada, Canadian Forest Service

17:00 Adjourn

Science and Technology à la Carte is no longer provided

THURSDAY, DECEMBER 8th

08:00	**Registration**	Prefunction- 2nd floor
Chair: *Cameron Duff, Canadian Food Inspection Agency*		Gatineau - 205 and 207
08:20	Introduction *Cameron Duff, Canadian Food Inspection Agency*	
08:30	Emerald ash borer research update *Barry Lyons, Natural Resources Canada, Canadian Forest Service*	
08:50	Plant-eating beetles from the Asia Pacific Region posing a risk to Canadian plant resources: 2011 update *Vasily Grebennikov and Eduard Jendek, Canadian Food Inspection Agency*	
09:10	Update on CFIA's forest pest surveys *Robert Favrin, Canadian Food Inspection Agency*	
09:30	Inferring introduction pathways for recently detected non-indigenous species *Lee Humble, Natural Resources Canada, Canadian Forest Service*	
10:00	**Break**	Gatineau - 206 and 208
10:15	Advancing the National Forest Pest Strategy (NFPS) decision support framework: a Forest Invasive Alien Species (FIAS) pilot *Nitin Verma, Canadian Food Inspection Agency*	Gatineau - 205 and 207
10:35	BSLB update: ecology and non-regulatory control methods *Jon Sweeney, Natural Resources Canada, Canadian Forest Service*	
11:05	BSLB impacts, spread, and best management practices *Wayne Mackinnon, Natural Resources Canada, Canadian Forest Service*	
11:25	Overview of research efforts on Asian longhorned beetle in Canada *Jean Turgeon, Natural Resources Canada, Canadian Forest Service*	
12:00	**Adjourn of Forest Pest Management Forum meeting** **Lunch not provided**	

Additional Meetings

13:30	**CFS-CFIA Decision Support Framework** (closed meeting, by invitation only) Meeting Room: Gatineau - 205 and 207
13:30	**CFS Genomics strategy meeting** (open to all interested individuals) Meeting Room: Gatineau - 206 and 208

FORUM 2011 SUR LA RÉPRESSION DES RAVAGEURS FORESTIERS

6-8 DÉCEMBRE 2011
Centre des congrès d'Ottawa
Ottawa, Ontario
2e étage – Salon Gatineau

MARDI 6 DÉCEMBRE

08 h 00	**Inscription**	Préfonction 2e étage
08 h 30	**Mot de bienvenue** *Anthony Hopkin, Ressources naturelles Canada, Service canadien des forêts*	Gatineau 205 et 207

Président : *Taylor Scarr, Ministère des Richesses naturelles de l'Ontario*

Séance I : La répression des ravageurs dans l'Ouest

08 h 40	Rapport de la Colombie-Britannique *Lorraine Maclauchlan, British Columbia Ministry of Forests, Lands and Natural Resource Operations*	
09 h 00	Rapport de l'Alberta *Dan Lux, Alberta Sustainable Resource Development, Forest Division*	
09 h 20	Rapport de la Saskatchewan *Rory McIntosh, Saskatchewan Ministry of Environment, Forest Service Branch*	
09 h 40	Rapport du Manitoba *Irene Pines, Manitoba Conservation, Forestry Branch*	
10 h 00	**Pause et séance d'affiches**	Gatineau 206 et 208

Président : *Taylor Scarr, Ministère des Richesses naturelles de l'Ontario*

Séance II : Au nord du 60e parallèle

Gatineau 205 et 207

10 h 40	Rapport des Territoires du Nord-Ouest *Mike Gravel, Government of the Northwest Territories, Environment and Natural Resources*	
10 h 50	Rapport du Yukon *Rory McIntosh, Saskatchewan Ministry of Environment, Forest Service Branch, pour le Government of Yukon, Energy, Mines, and Resources*	

Président : *Taylor Scarr, Ministère des Richesses naturelles de l'Ontario*

Séance III : Rapport des États-Unis

11 h 00 Survol des insectes et des maladies des arbres aux États-Unis
Rona Sturrock, Ressources naturelles Canada, Service canadien des forêts, pour le United States Department of Agriculture, Forest Health Protection

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

13 h 00 **Mot de bienvenue** — Gatineau 205 et 207
Tom Rosser, Sous-ministre adjoint
Ressources naturelles Canada, Service canadien des forêts

Séance IV : Exposé sur Génome Canada

13 h 10 Annonce de financement de Génome Canada
Alan Winter, Génome Canada

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

Séance V : Le point sur la Stratégie nationale de lutte contre les ravageurs forestiers

13 h 40 Mise à jour sur la Stratégie nationale de lutte contre les ravageurs forestiers
Kami Ramcharan, Ressources naturelles Canada, Service canadien des forêts

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

Séance VI : Discussion sur la Stratégie nationale de lutte contre les ravageurs forestiers

14 h 00 Pourquoi le Canada a besoin d'une stratégie de lutte contre les ravageurs forestiers
Vince Nealis, Ressources naturelles Canada, Service canadien des forêts

14 h 20 Perspective d'un nouveau venu dans la lutte contre les ravageurs forestiers
Mike Gravel, Government of the Northwest Territories, Environment and Natural Resources

14 h 30 Perspective d'un nouveau venu dans la lutte contre les ravageurs forestier
Rory McIntosh, Saskatchewan Ministry of Environment, Forest Service Branch pour le Government of Yukon, Energy, Mines, and Resource

14 h 45 Perspective d'un programme établi de lutte contre les ravageurs forestiers
Taylor Scarr, Ministère des Richesses naturelles de l'Ontario

15 h 00 Discussions en groupe

15 h 15 **Pause et séance d'affiches** — Gatineau 206 et 208

Président : *Michael Irvine, Ministère des Richesses naturelles de l'Ontario* — Gatineau 205 et 207

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

15 h 45 Introduction
Michael Irvine, Ministère des Richesses naturelles de l'Ontario

15 h 55 Mise à jour de l'ARLA, dont une proposition de créer des groupes de travail sur les forêts
Terry Caunter, Santé Canada, Agence de réglementation de la lutte antiparasitaire

16 h 25 Mise à jour sur les approches privilégiées par l'ARLA contre les espèces exotiques envahissantes (EEE)
Imme Gerke, Santé Canada, Agence de réglementation de la lutte antiparasitaire

16 h 50 Ajournement des travaux

17 h 00 Comité d'orientation du Forum sur les ravageurs (Séance privée) — Gatineau 205 et 207

MERCREDI 7 DÉCEMBRE

08 h 00 **Inscription** — Préfonction 2e étage

Présidente : *Lise Caron, Ressources naturelles Canada, Service canadien des forêts* — Gatineau 205 et 207

Séance VIII : La répression des ravageurs dans l'Est

08 h 20 Rapport de l'Ontario
Taylor Scarr, Ministère des Richesses naturelles de l'Ontario

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

09 h 00 Rapport du Nouveau-Brunswick
Nelson Carter, Ministère des Ressources naturelles du Nouveau-Brunswick

09 h 20 Rapport de la Nouvelle-Écosse
Peter Amirault, Forest Protection Limited pour le Nova Scotia Department of Natural Resources

09 h 40 Rapport de Terre-Neuve-et-Labrador
Nelson Carter, Ministère des Ressources naturelles du Nouveau-Brunswick pour le Newfoundland and Labrador Department of Natural Resources

10 h 00	**Pause et séance d'affiches**	Gatineau 206 et 208
10 h 40	Présentation sur l'Invasive Species Centre	Gatineau 205 et 207

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

Séance IX : Lutte biologique contre les ravageurs forestiers et technologies d'application

10 h 50 Travaux intégrés de recherche et de développement en vue de la mise au point de produits de lutte biologique contre les ravageurs forestiers et de technologies d'application connexes
Peter Amirault, Forest Protection Limited, et
Stefan Richard, Sylvar Technologies Inc.

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

Présidente : *Judi Beck, Ressources naturelles Canada, Service canadien des forêts*

Séance X : Résilience des écosystèmes

13 h 00 Pour une cartographie des maladies des forêts
Rona Sturrock, Ressources naturelles Canada, Service canadien des forêts

13 h 25 Le dendroctone du pin ponderosa : une menace importante pour la Saskatchewan
Rory McIntosh, Saskatchewan Ministry of Environment, Forest Service Branch

13 h 50 Déclin du cyprès jaune
Stefan Zeglen, British Columbia Ministry of Forests and Range

14 h 15 Le longicorne brun de l'épinette dans les provinces de l'Atlantique
Ron Neville, Agence canadienne d'inspection des aliments

14 h 40 Évaluation de risques pour la rouille vésiculeuse du pin blanc au Québec : développements récents
Michel Huot, Ministère des Ressources naturelles et de la Faune du Québec

15 h 00 **Pause** — Gatineau 206 et 208

Président : *Ron Hall, Ressources naturelles Canada, Service canadien des forêts* — Gatineau 205 et 207

Séance XI : Outils de détection

15 h 30 Détection visuelle et moléculaire des agents phytopathogènes, l'exemple de la rouille vésiculeuse du pin blanc (RVPB) en pépinière
Philippe Tanguay, Ressources naturelles Canada, Service canadien des forêts

15 h 50 Télédétection de la défoliation par les insectes : percées récentes et problèmes à surmonter
Ron Hall, Ressources naturelles Canada, Service canadien des forêts

16 h 10	Développement d'outils de détection et de génotypage pour détecter des agents pathogènes (*Phytophthora* et champignons) à l'aide de la génomique *Guillaume Bilodeau, Agence canadienne d'inspection des aliments*	
16 h 30	Outils moléculaires et biosécurité forestière : application du barcoding moléculaire à la détection des ravageurs forestiers *Lee Humble, Ressources naturelles Canada, Service canadien des forêts*	
17 h 00	Ajournement des travaux	

Science et Technologie à la Carte n'est plus offert

JEUDI 8 DÉCEMBRE

08 h 00	**Inscription**	Préfonction 2e étage
Président :	*Cameron Duff, Agence canadienne d'inspection des aliments*	Gatineau 205 et 207
08 h 20	Introduction *Cameron Duff, Agence canadienne d'inspection des aliments*	
08 h 30	Mise à jour des recherches sur l'agrile du frêne *Barry Lyons, Ressources naturelles Canada, Service canadien des forêts*	
08 h 50	Coléoptères phytophages originaires de l'Asie-Pacifique représentant une menace pour les ressources végétales du Canada : état de la situation en 2011 *Vasily Grebennikov et Eduard Jendek, Agence canadienne d'inspection des aliments*	
09 h 10	Mise à jour sur les relevés d'organismes nuisibles forestiers menés par l'ACIA *Robert Favrin, Agence canadienne d'inspection des aliments*	
09 h 30	Inférence des voies d'introduction d'espèces non indigènes détectées récemment *Lee Humble, Ressources naturelles Canada, Service canadien des forêts*	
10 h 00	**Pause**	Gatineau 206 et 208
10 h 15	Faire progresser le cadre décisionnel de la Stratégie nationale canadienne de lutte contre les ravageurs forestiers (SNLCRF) : Projet pilote sur les espèces exotiques envahissantes forestières (EEEF) *Nitin Verma, Agence canadienne d'inspection des aliments*	Gatineau 205 et 207
10 h 35	Le point sur le longicorne brun de l'épinette : écologie et méthodes de lutte non réglementaires *Jon Sweeney, Ressources naturelles Canada, Service canadien des forêts*	

11 h 05 Impact et propagation du longicorne brun de l'épinette et mesures de lutte optimales
Wayne Mackinnon, Ressources naturelles Canada, Service canadien des forêts

11 h 25 Aperçu de la recherche sur le longicorne asiatique au Canada
Jean Turgeon, Ressources naturelles Canada, Service canadien des forêts

12 h 00 **Ajournement du Forum sur la répression des ravageurs forestiers**

Le dîner n'est pas fourni

Réunions additionnelles

13 h 30 **Cadre décisionnel SCF-ACIA (réunion à huis clos, sur invitation seulement)**
Salon Gatineau 205 et 207

13 h 30 **Stratégie du SCF en matière de génomique (réunion ouverte à tous)**
Salon Gatineau 206 et 208

SESSION I: WESTERN PEST MANAGEMENT ISSUES

Chair: ***Taylor Scarr***
Ontario Ministry of Natural Resources

SÉANCE I : LA RÉPRESSION DES RAVAGEURS DANS L'OUEST

Président : ***Taylor Scarr***
Ministère des Richesses naturelles de l'Ontario

BRITISH COLUMBIA REPORT

Time Ebata, Lorraine Maclauchlan

British Columbia Ministry of Forests,
Lands and Natural Resource Operations

The report presented the results of the 2011 Provincial Aerial Overview survey conducted from July to September 2011. The survey covered more than 85% of the provincial land area (figure 1) and surveyed all provincial, federal and private forest land for signs of forest disturbances. The weather was nearly ideal through most of the province except in the Northwest where cloudy conditions dominated the survey season. Fortunately, nearly all of the area of the province currently under attack by the mountain pine beetle was surveyed including an area within 80 km of the Yukon border representing the most northern distribution of the MPB recorded to date.

Mountain pine beetle (MPB) continued to be the most dominant forest disturbance but the area affected continued to decline dropping to about 4.7 million ha compared to 6.2 million ha in 2010 (figure 2). While most of the outbreak ended in the central interior, very active outbreak populations continue to kill pine stands in northern B.C., particularly in the Mackenzie and Peace districts. The most current aerial survey data is translated into an estimate of annual pine volume killed which is then used to update a projection model that provides an estimate of the full impact of the beetle by the end of the outbreak. The revised cumulative volume killed to date is estimated to be 710 million cubic meters which represents 53% of the total mature pine volume on the operable land base (Walton 2012). Each year's aerial survey data has reduced the estimate of the total volume killed by the end of the outbreak in 2021 and this year's projection estimates that 58% or 788 million cubic metres of mature pine volume will be killed (Walton 2012). The drop in the cumulative volume estimate is because the outbreak appears to be collapsing faster than originally projected and did not expand as rapidly in mixed stands and mountainous areas in the southern part of the province.

Douglas-fir beetle is a common killer of mature Douglas-fir found throughout the host's range. Where the damage is particularly problematic is where the MPB has decimated mature pine stands leaving only non-pine stands for mule deer winter range. The province conducts detailed aerial surveys, ground surveys and limited treatments to keep the beetle populations from reach outbreak levels. Accurate mapping of

Douglas-fir beetle was difficult to achieve as the damage was masked by the MPB kill during the peak of the outbreak. Now that the outbreak has subsided, the mapping should improve.

Spruce beetle is another destructive bark beetle that can erupt into severe outbreaks in mature spruce. Populations have declined since 2010 to 22,463 ha mapped in 2011. This beetle is difficult to survey for as the foliar symptoms change rapidly and timing of the survey must coincide with the brief window when this symptoms are visible.

B.C. is currently undergoing defoliation by several major species of moths. Western spruce budworm is causing the most significant damage although total area mapped with visible defoliation has dropped to 620,587 ha in 2011 from 766,125 ha (figure 3). The damage appears to be shifting in intensity and is expanding further north and east than have previously been noted. The largest aerial spray program to date was conducted in both the Cariboo and Thompson / Okanagan Regions in 2011. Over 54,000 ha of Douglas-fir forest was treated with Foray 48B at 2.4 l per ha. Douglas-fir tussock moth was another significant defoliator of interior Douglas-fir. The caterpillars severely defoliate and kill young Douglas-fir usually located in lower valley stands that are frequently inhabited. The caterpillar's hairs cause allergic reactions to many people and over 7,000 ha of forest was treated to protect crown timber and human health using the last remaining stocks of NPV (virus) and Btk. Tussock moth populations are expected to decline in 2012.

Another major defoliator on the increase is the western hemlock looper. This insect typically erupts in major outbreaks whose severe defoliation of western redcedar, western hemlock, Douglas-fir and several other species can lead to significant mortality. Ongoing pheromone trapping and 3-tree beatings have shown a marked increase in looper populations expecting to result in visible defoliation in 2012.

Other major defoliators of note are the two year cycle budworm, *Choristoneura biennis*, that caused over 182,000 ha of visible defoliation in 2011. A small trial to determine the timing of Btk treatments is being planned for implementation in 2012. Blackheaded budworm, *Acleris gloverana*, caused severe defoliation on Haida Gwaii and on northern Vancouver Island but the defoliation has declined by over half of what was recorded in 2010.

Monitoring for the North American strain of European gypsy moth was conducted by CFIA and by the province. Only 6 moths were caught in four locations – Richmond, Victoria, Langley and Revelstoke. This is the lowest number of positive trap catches in the last two decades. No treatments are planned for 2012 and more intensive trapping will be conducted at the locations where moths were caught in 2011 while the rest of the province's high priority areas will undergo monitoring trapping.

Aspen leaf miner was the most significant deciduous defoliator recorded in 2011. Over 600,000 ha of damage was recorded representing a three-fold increase in the area defoliated in 2010.

The most significant damage caused by a pathogen noted in 2011 was in the Kootenay / Boundary Region where over 33,000 ha of larch needle blight, *Hypodermella larcis*, was mapped mostly near Nelson, B.C. (figure 4.).

The early summer of 2011 was plagued by heavy rain that caused severe flooding damage to areas like Chetwynd, BC. Damage to transportation routes caused significant inconvenience until the rains subsided in mid-July. Other interesting damage noted during the aerial overview survey was the decline in young pine mortality caused by mountain pine beetle. Young pine mortality increased in some areas of the Thompson / Okanagan Region but it was found to be caused by secondary bark beetles (*Pityopthorus, Piyokeines*, and *Pityogenes* spp.).

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

Figures

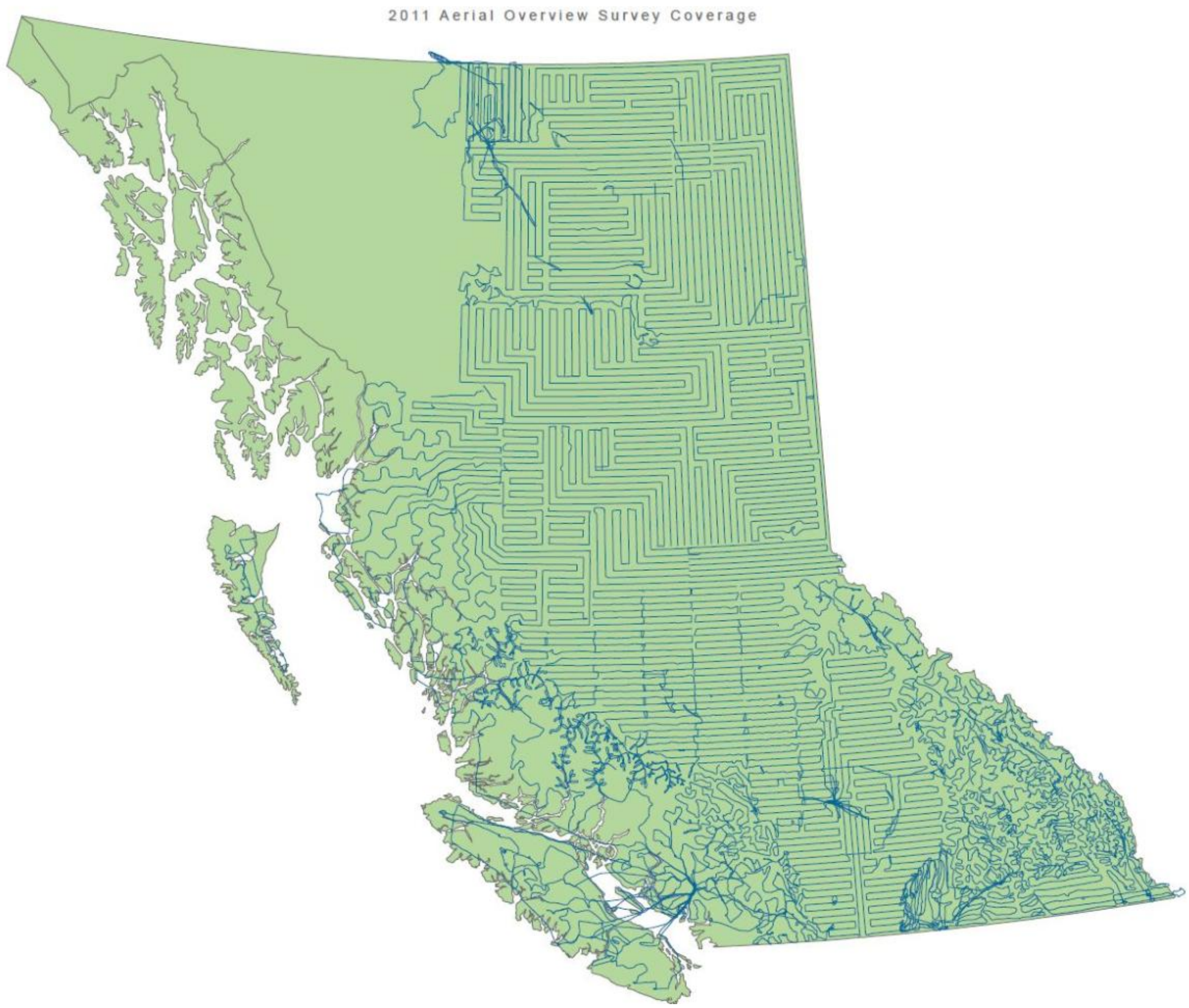


Figure 1 – 2011 aerial overview survey flight lines in British Columbia. 85% of the province land area was surveyed.

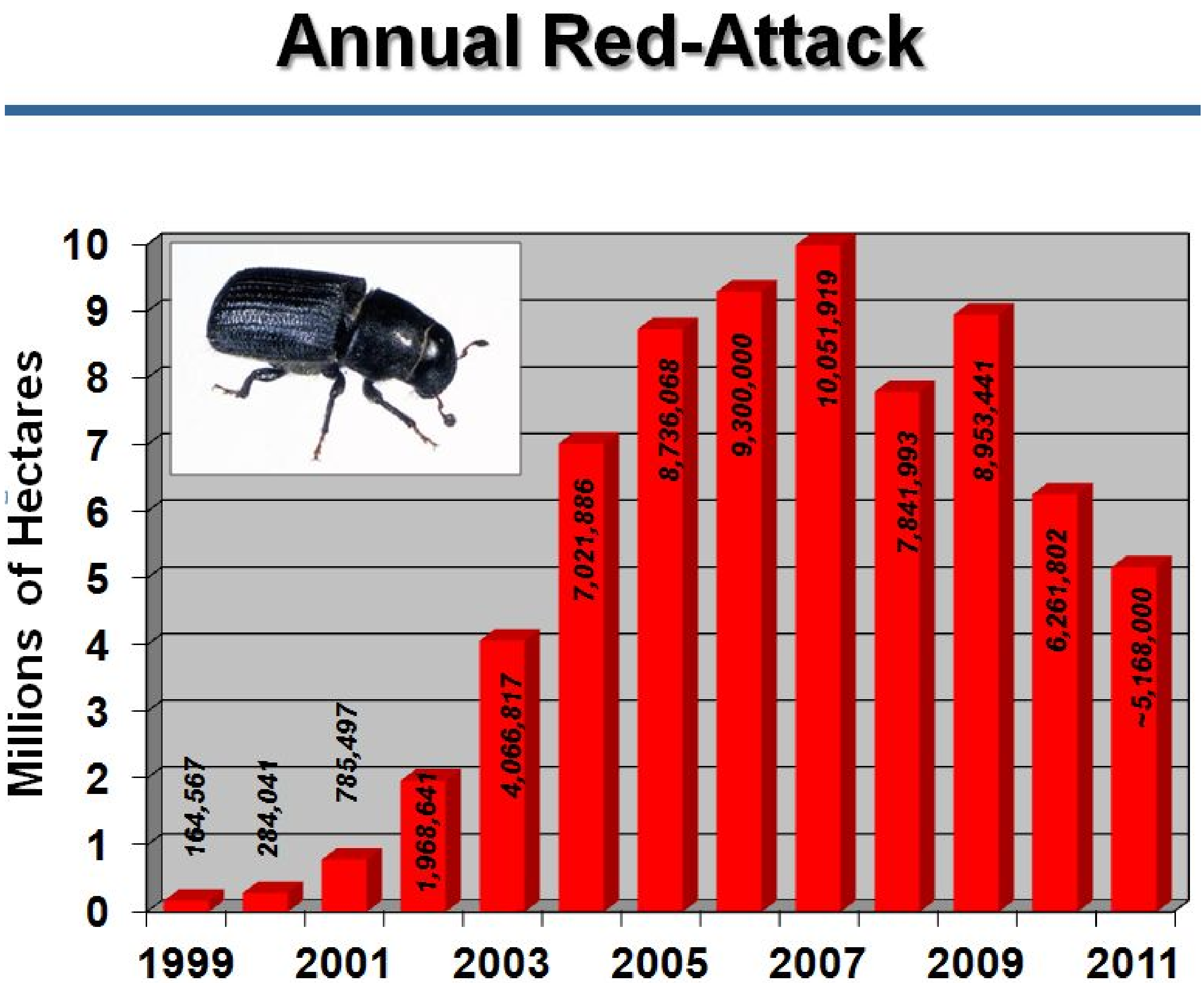


Figure 2 – Annual area of attack by mountain pine beetle in British Columbia from 1999 to 2011.

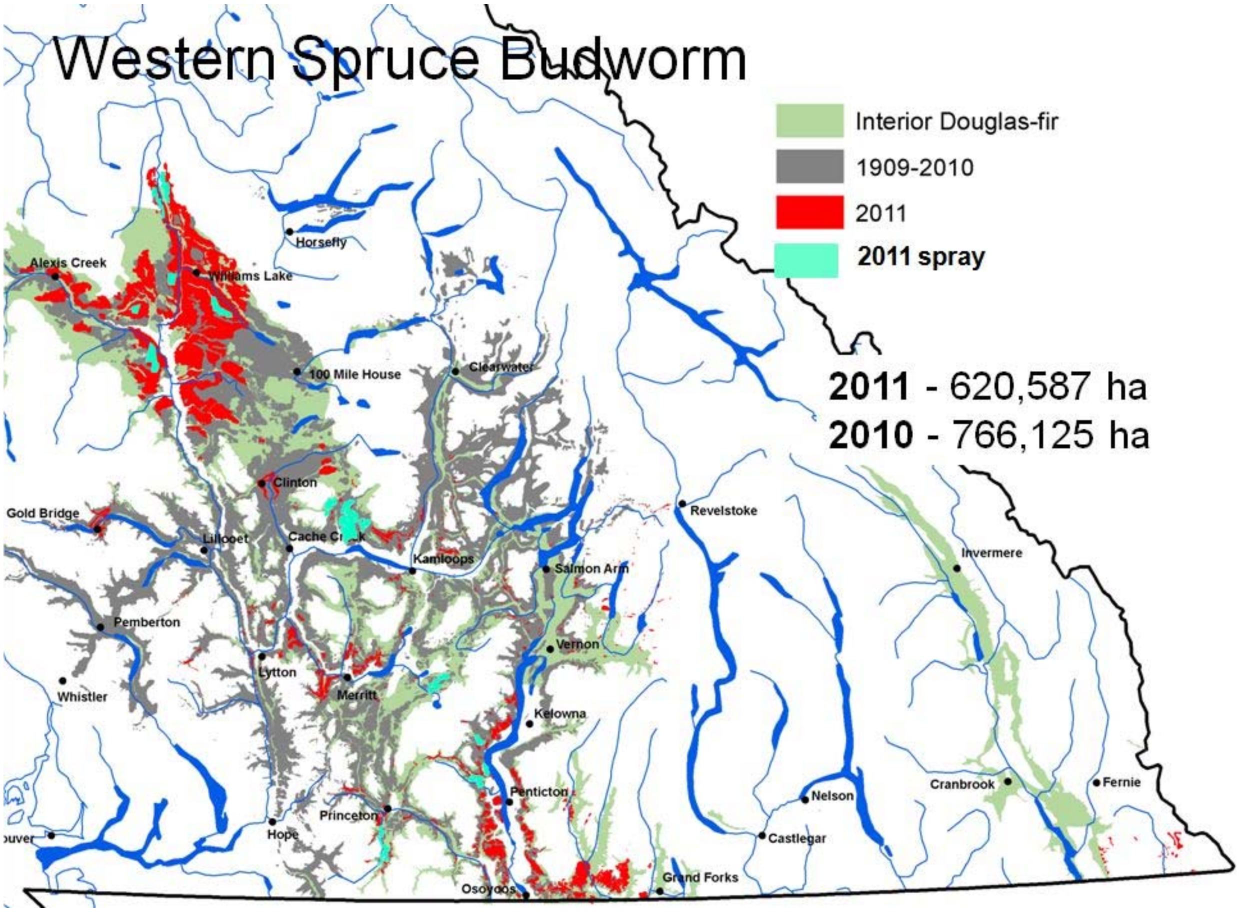


Figure 3 – Western spruce budworm defoliation and treatment in British Columbia in 2011 compared to its historical distribution.

Figure 4. Larch needle blight damage observed near Nelson, B.C.

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

SUMMARY OF THE 2011

FOREST HEALTH CONDITIONS IN ALBERTA

Dan Lux

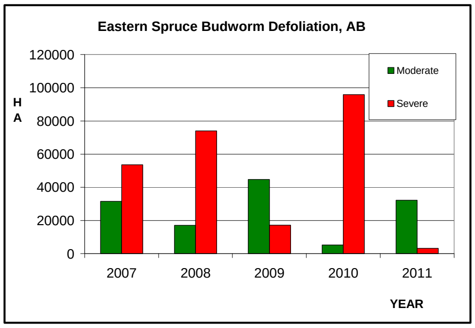
Alberta Sustainable Resource Development,
Forest Division

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

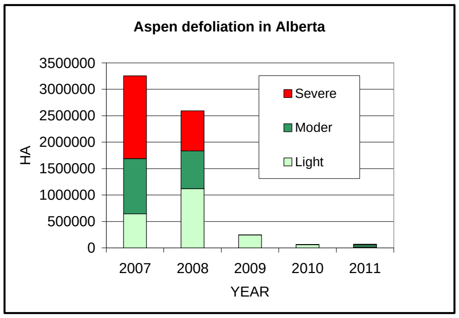
Defoliation Severity	2010 (ha) net	2011 (ha) net
Moderate (35 – 70%)	90,782	32,195
Severe (Over 70%)	175,585	3,208
Total	269,367	35,403



We aerially sprayed Btk over 2,750 ha of high priority white spruce stands in NE Alberta in 2011 spring. Overall, spruce budworm infestations collapsed in NE Alberta and greatly reduced in NW Alberta mainly due to inclement climate.

Aspen Defoliators

Causative Agent	2010 (ha) gross	2011 (ha) gross
Bruce Spanworm	50,765	309
Forest Tent Cat	10,333	68,117
Large Aspen Tortrix	1,502	0
TOTAL	62,600	68,426



Other interesting forest health projects

Western Spruce Budworm – In 2011, there was resurgence of western spruce budworm infestations at a few new locations in SW Alberta. An estimated 6,914 ha were defoliated by this pest in 2011.

Hail Damage – Hail damage impacted 6,663 ha of forest stands in 2011. 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.

Invasive Alien Plant Species – Tall Hawkweed, a new invasive species, was reported for the first time in Alberta in 2011. ASRD will focus on using bio-control to manage invasive alien plant species. Natural Successional Advancement of willow and poplar is being used as a tool to deal with invasive plant species in Alberta.

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, 2011. 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.

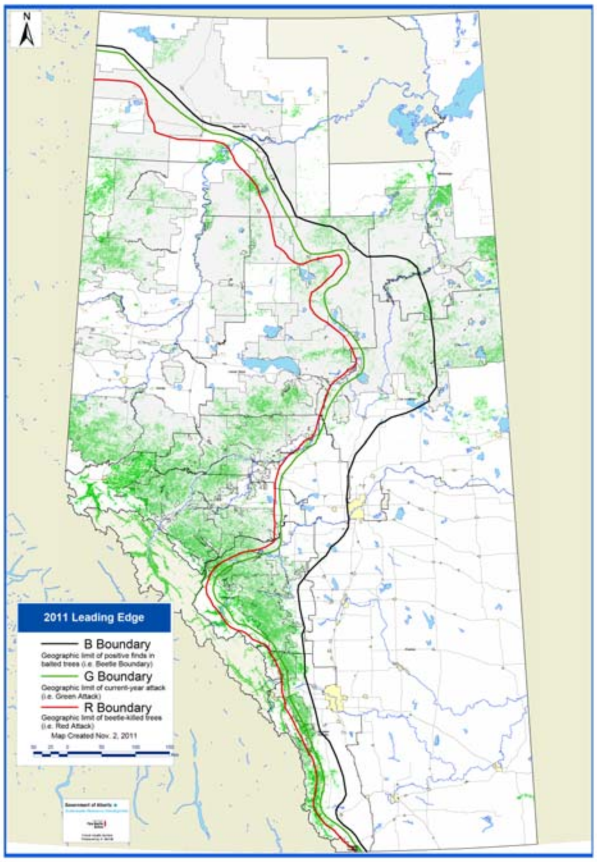
Initial ground surveys this fall indicated that there was no large in-flight of beetles from British Columbia in 2011. However, the MPB that attacked trees in 2010 successfully reproduced and flew in July this year to infest more trees. Beetle populations showed signs of increase in northwest and west central Alberta but declined along the eastern slopes and along the eastern fringe of the infestation.

Researchers at the University of Alberta have shown that the mountain pine beetle has successfully colonized genetically pure jack pine, a predominant tree species in boreal forest.

The beetle control program is essential to contain the risk of spread in the leading edge as much as possible. In the 2010-11 beetle year approximately 150,000 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.

In mid-November, a National Forest Pest Strategy Workshop to disseminate current knowledge on beetle spread rate, current status and management was organized by our Department. Invitees representing the beetle research community, forest industry leaders, and senior managers of forestry in provinces and territories participated in this 3-day workshop held in Edmonton and Hinton. The workshop participants ere exposed to latest risk analysis, strategies and tactics to manage the mountain pine beetle.



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 in 2011 in Alberta.

FOREST PEST CONDITIONS IN SASKATCHEWAN IN 2011

Rory McIntosh

Saskatchewan Ministry of Environment, Forest Service Branch

Defoliators – softwood

Spruce budworm, *Choristoneura fumiferana*

Following a general decline 2002-2008 the eastern spruce budworm *Choristoneura fumiferana* outbreak is beginning to increase again in Saskatchewan. Aerial surveys conducted in 2009 revealed 33,407 hectares but in 2010 the area increased to 85,466 hectares of moderate to severe defoliation. 2011 surveys detected 90,548 ha of moderate and severe defoliation (Figure 1). A new area in the northwest was detected as well as increasing defoliation in north-central Saskatchewan west of LaRonge (Figure 2). Of interest an area 1,858 hectares of Tamarack (*Larix laricina)* was defoliated by spruce budworm near LaRonge.

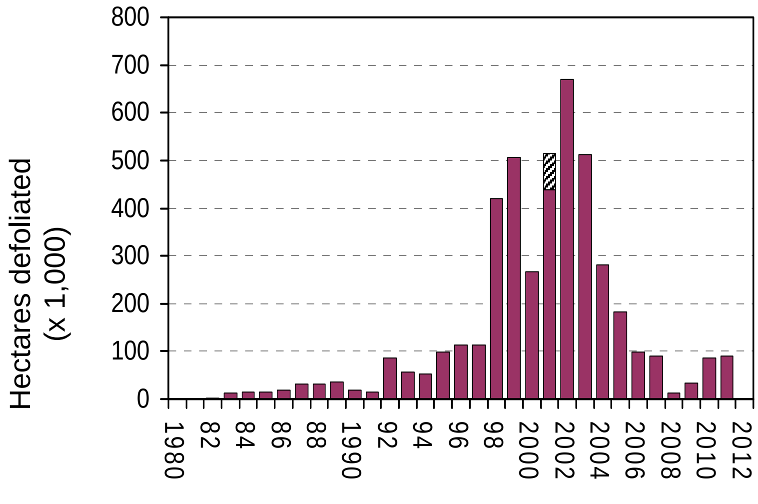


Figure 1. Area of moderate to severe defoliation caused by the spruce budworm *Choristoneura fumiferana* in Saskatchewan 1982-2011**.**

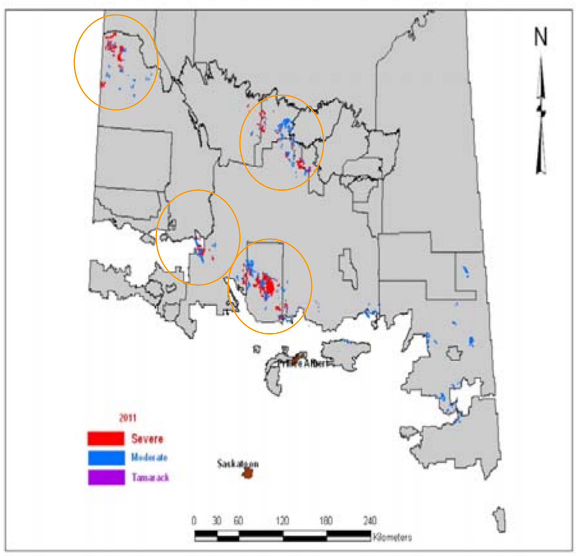


Figure 2. Area of moderate to severe defoliation caused by the spruce budworm *Choristoneura fumiferana* in Saskatchewan 2011.

Conclusions for 2011, predictions for 2012

In 2011 20,000 hectares of forest was sprayed using a double application of Foray 76B, at a rate of 30 BIU/1.5L/ha. Conditions for spray treatment were perfect with operations starting on June 5 and completed by June 11. The 40% defoliation target was achieved in all sample spray blocks as compared to control.

SBW populations continue to build in four areas of SK:

1. North central SK in Besnard Lake area west of LaRonge, south of the Churchill River; (second orange circle);
2. Prince Albert National Park (PANP);
3. In the Green Lake Big River area west of PANP;
4. In the Dillon area in the north-western part of the province, south of Clearwater River Provincial Park.

Overwintering L2 surveys reveal significant population growth. The Ministry is considering a spray program for 2012 to treat approximately 20,000 hectares.

Jack pine budworm, *Choristoneura pinus*

In 2011, there was again no detectable Jack pine budworm defoliation in Saskatchewan. Jack pine budworm – a periodic defoliator of jack pine – has not reached outbreak levels in Saskatchewan since the 1980s. As part of an ongoing monitoring and early detection program initiated in 2006, the Ministry continues to monitor using a grid of 72 pheromone traps, deployed in mature jack pine stands across the commercial forest zone.

Defoliators – hardwood

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

The area defoliated by Large Aspen Tortrix increased from 11,067 ha in 2010 to 24,577 ha in 2011. Defoliation detected in 2010 in the Deschambault and Jan Lake areas in the northeast, and in Duck Mountain Provincial Park, collapsed. The damage in 2011 was located in the forest fringe near Glaslyn (Figure 3).

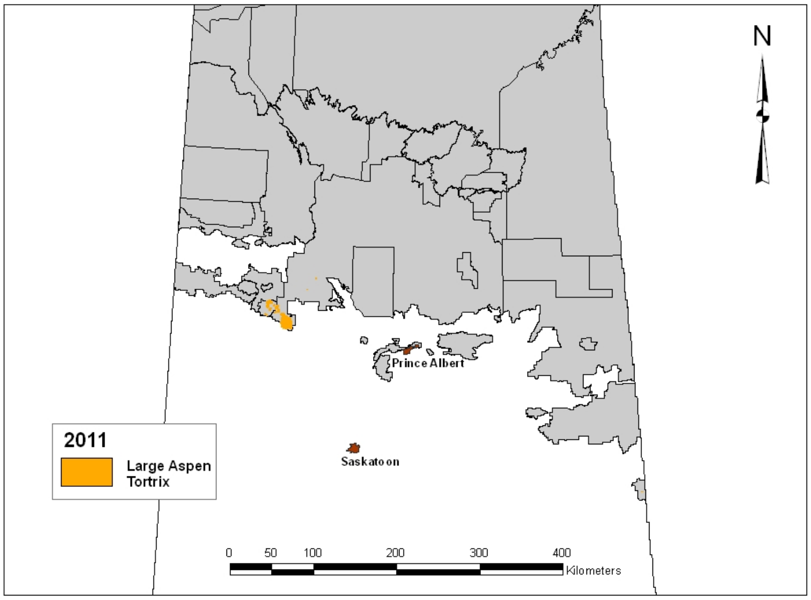


Figure 3 Area of moderate to severe defoliation caused by the Large Aspen Tortrix, *Choristoneura conflictana,* in Saskatchewan 2011.

Foliar Diseases

Spruce needle rust, *Chrysomyxa ledicola*

Spruce needle rust *Chrysomyxa ledicola* (Figure 4) was detected again in 2011. Aerial and ground surveys revealed 1,433 ha of spruce needle rust damage north of the Cold Lake Air Weapons Range Northwest of Prince Albert National Park (Figure 5) and small pockets in the Pasquia Hills.

Figure 4. Spruce needle rust, *Chrysomyxa ledicola*.

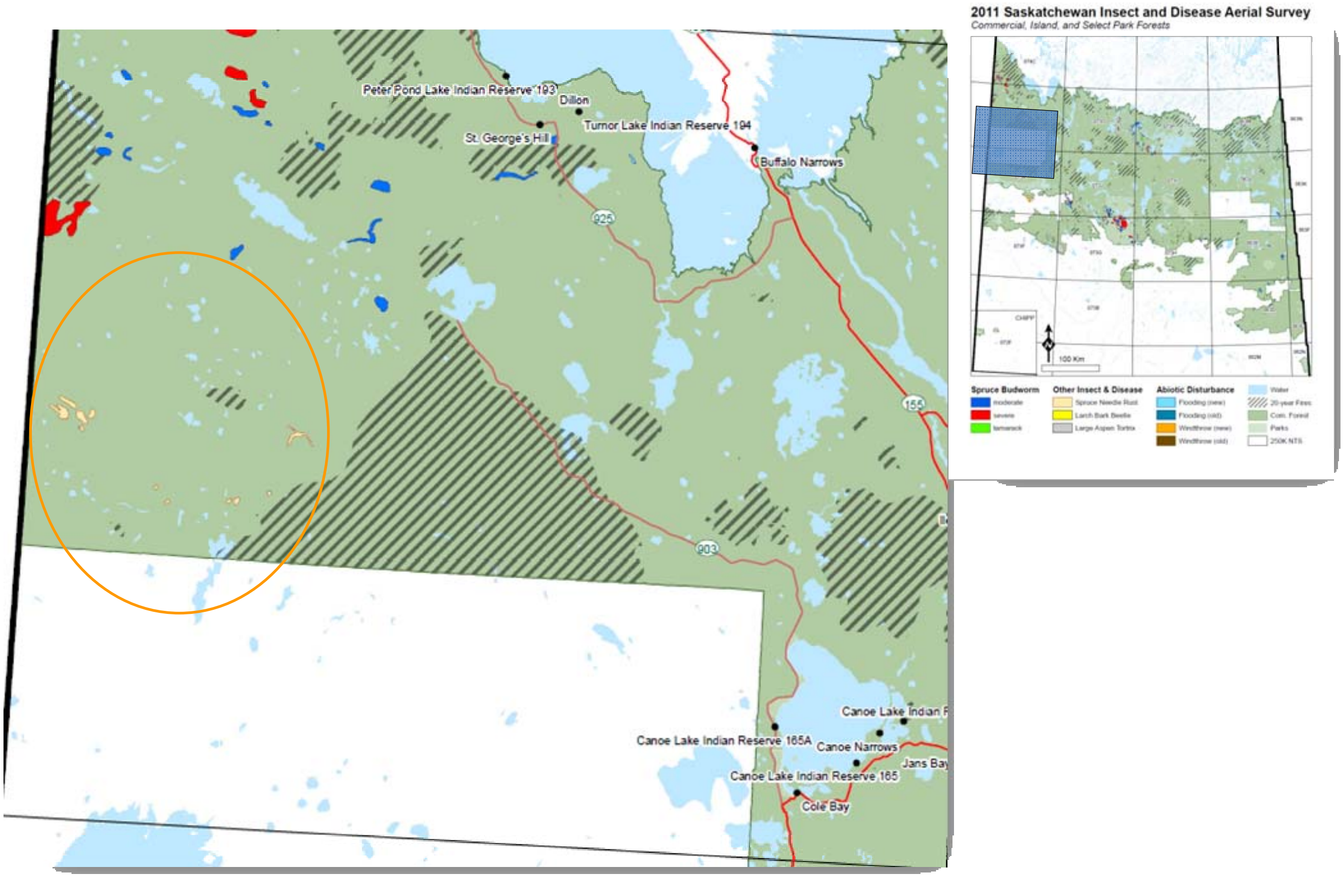


Figure 5. Area of spruce needle rust defoliation (light yellow), north of the Cold Lake Air Weapons Range in western Saskatchewan.

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 through most of the native elms in Saskatchewan (Figure 6). Saskatchewan Ministry of Environment's DED program was delivered using a $500,000 allocation and focused on protecting elm trees in communities (>400 elms & 800 residents); and managing elm in wild forest areas in buffer zones outside urban areas.

Program components included:

- Regulatory controls.
- Surveillance and early detection.
- Rapid removal and disposal of DED-infected trees.
- Cost share partnerships in 43 communities**.**

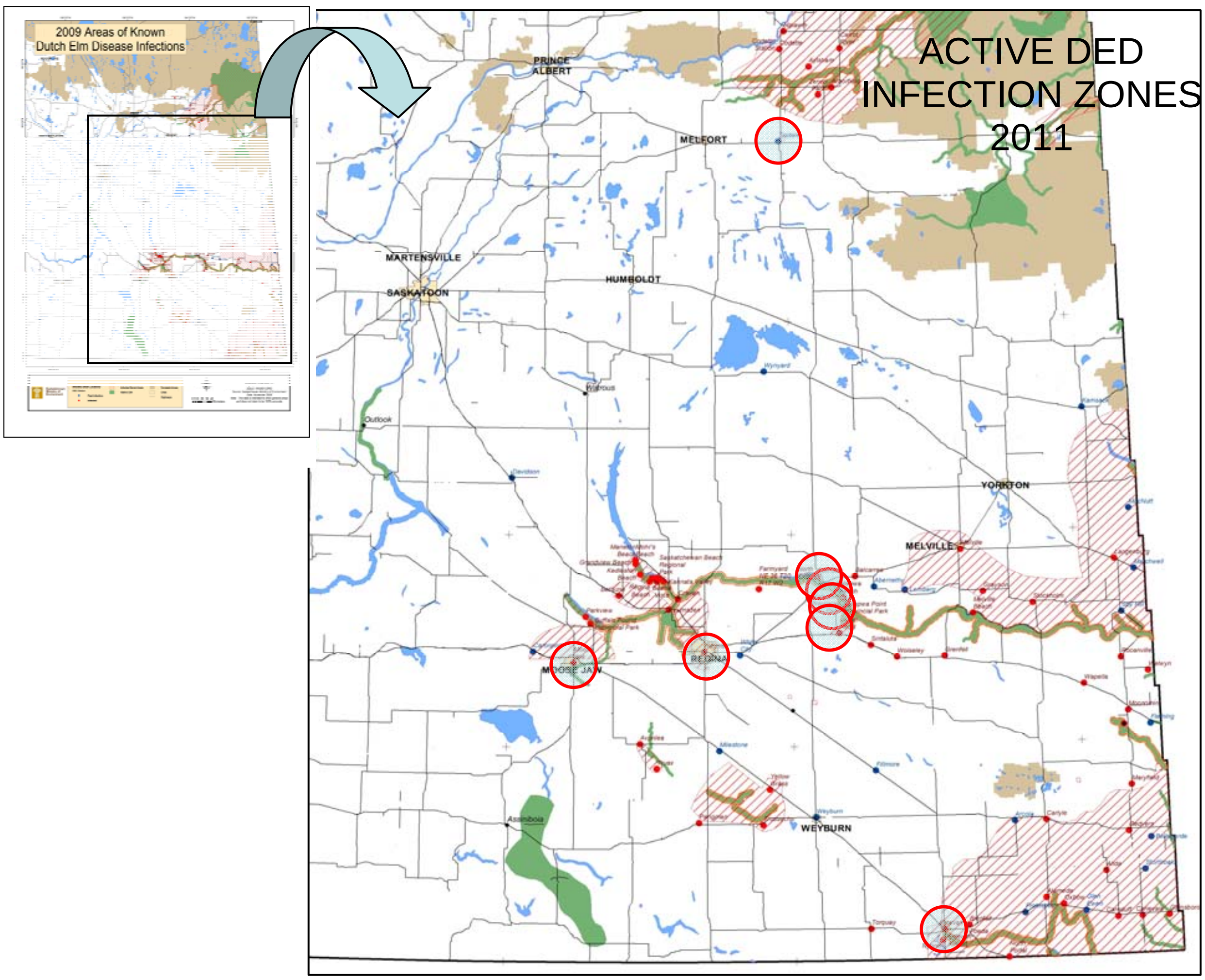


Figure 6. Distribution of Dutch elm disease active zones (red cross hatch) throughout Saskatchewan in 2011. Saskatchewan Ministry of Environment continues to survey in wild stands in six buffer areas outside major communities and in two Provincial Parks (circles).

Until April 1, 2010, Saskatchewan Ministry of Environment Forest Service Branch was responsible for implementing surveillance, detection and removal services to manage DED in 43 communities and buffer areas across Saskatchewan. In these communities, responsibility for the cost of these activities was shared through a cost-share agreement with the ministry. Following the 2010 spring budget decision, the Ministry still surveys buffers in rural areas around six urban communities in the high risk areas in southeastern Saskatchewan. It is the responsibility of the private land owners to remove and dispose of the infected trees as well as cover the expense of removals. The Ministry also surveys two provincial parks in the high risk area (Echo Valley and Katepwa) under a Memorandum of Understanding between The Ministry of Environment and the Ministry of Tourism, Parks, Culture and (TPCS), the Parks are responsible for cost or removals. In 2010, 53 trees were removed in the municipalities, the figure increased slightly to 64 in 2011. The Ministry no longer surveys and removes these trees.

In 2011, survey results show that the number of DED infected trees in the buffers and provincial parks, with the exception of Katepwa) are down slightly from the previous year (Table 1). It is anticipated that the effects of the reduction in DED management services will likely be felt in the next couple of years.

Table 1. Number of DED infected trees marked for removal in the six buffers and two parks in Saskatchewan in 2010 and 2011.

Buffers	Removed		Parks	Removed	
	2010	2011		2010	2011
Estevan	2	0	Katepwa	1	0
Regina	29	24	Echo Valley	100	72
Moose jaw	20	13		0	0
Indian Head	13	12		0	0
Fort Qu'Appelle	69	42		0	0
Tisdale	0	1		0	0
Total	**133**	**92**		**101**	**72**

European gypsy moth, *Lymantria dispar*

In 2011, the Canadian Food Inspection Agency (CFIA) continued ongoing monitoring in Saskatchewan deploying 447 Tréce delta traps baited with Gypsy Moth String Lure (Table 2). All traps were targeted at the European Gypsy moth, *Lymantria dispar.*

Table 2. Distribution of gypsy moth traps in Saskatchewan 2011.

LOCATION	NUMBER TRAPS
REGINA	117
SASKATOON	180
YORKTON	45
N. BATTLEFORD	55
NIPAWIN	25
MELFORT	25

In 2011, the CFIA initiated an Emerald ash borer survey both trapping and visual surveillance. In total, 18 green panel traps were deployed in 2011. None were positive.

NO GYPSY MOTHS WERE FOUND IN ANY OF THE TRAPS IN SASKATCHEWAN IN 2011.

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, *Scolytus schevyrewi* (BEBB), 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 using sticky panel traps baited with 90-day elm bark beetle lures[1]. BEBB were detected in traps located in **five** 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 7.

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

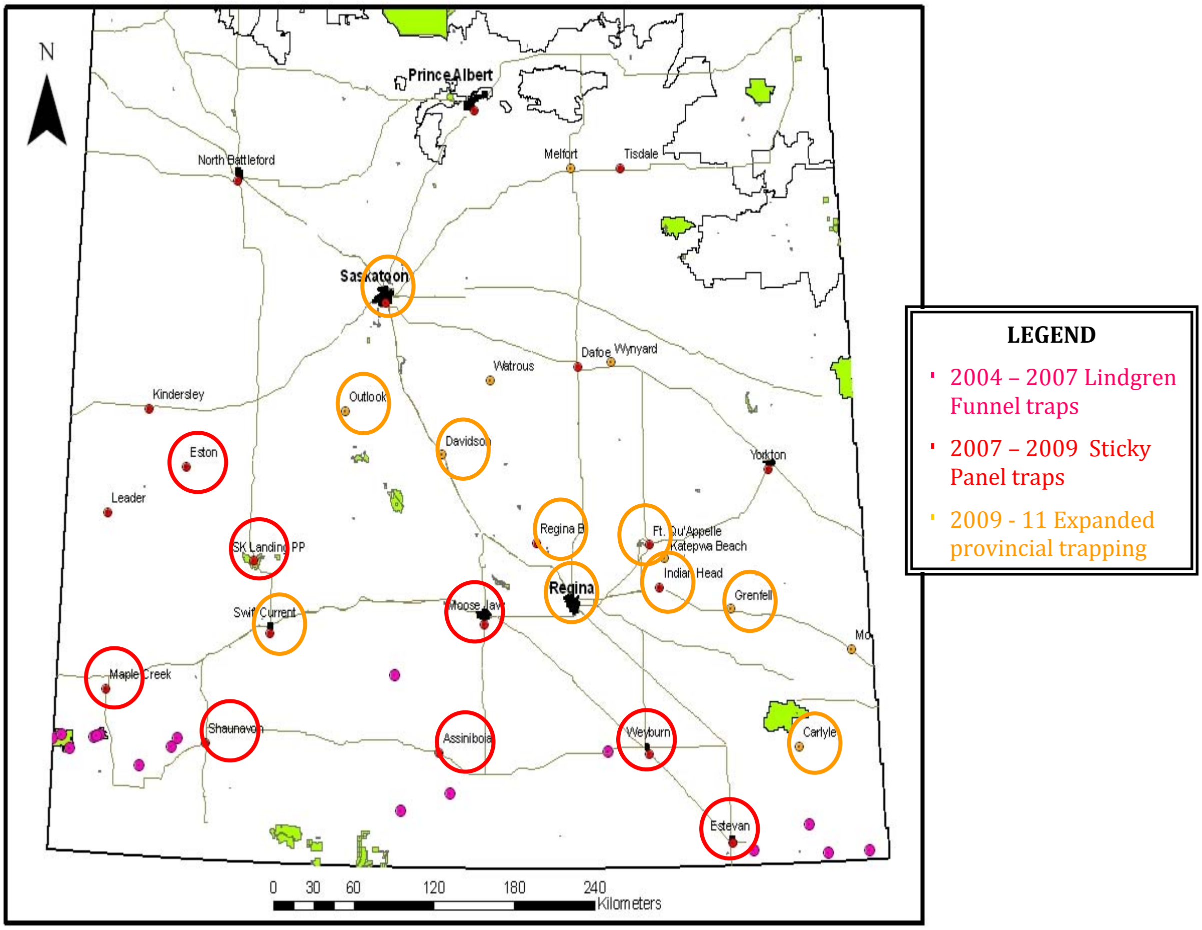


Figure 7. Map showing focus of monitoring program and the spatial distribution and spread of Banded elm bark beetles discovered in Saskatchewan, 2004-2010.

By 2011, 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 Saskatchewan there still remains the opportunity to focus on proactive, **preventive** approaches instead of active beetle-focused **suppressive** action.

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.

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 8).

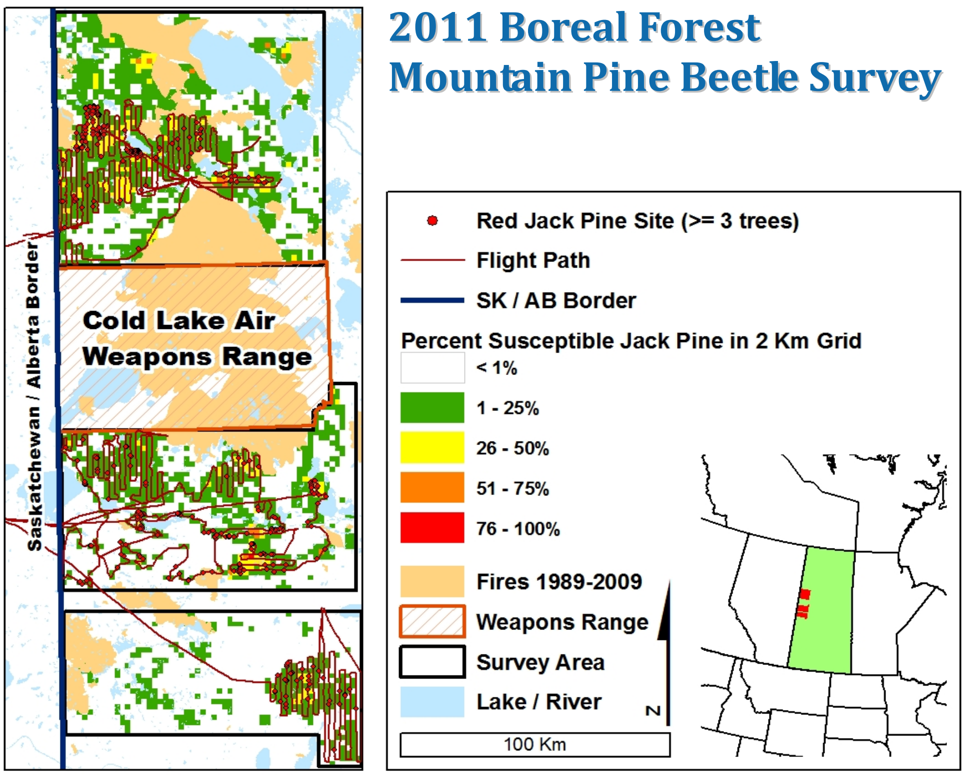


Figure 8. Map of western Saskatchewan showing areas north and south of the Cold Lake Air Weapons Range where Saskatchewan Ministry of Environment conducts extended aerial monitoring prioritized on the distribution of susceptible pine stands**.**

The surveillance program is divided into two components: the Northern Boreal Forest and Cypress Hills Inter-Provincial Park (CHIPP).

Northern boreal forest surveys

The 2011 aerial survey of the boreal forest identified 336 sites with over 1,500 suspect "reds" (i.e., recently dead jack pine). A proportion of these locations were ground-truthed (where access permitted). During the ground survey of the boreal forest, 31 locations with approximately 200 dead jack pine trees were examined for evidence of attack by MPB and other biotic and abiotic agents. The most common damage agents found in the "red" trees in the boreal forest were engraver beetles, *Ips* spp., sawyer beetles, *Monochamus* spp., and root rot, *Armillaria* spp.

Cypress Hills inter-provincial park (CHIPP) surveys

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 9). These observations are then verified with detailed ground surveys. All locations shown on the map are confirmed, heavily MPB-attacked trees that have been marked for removal in fall and burn operations.

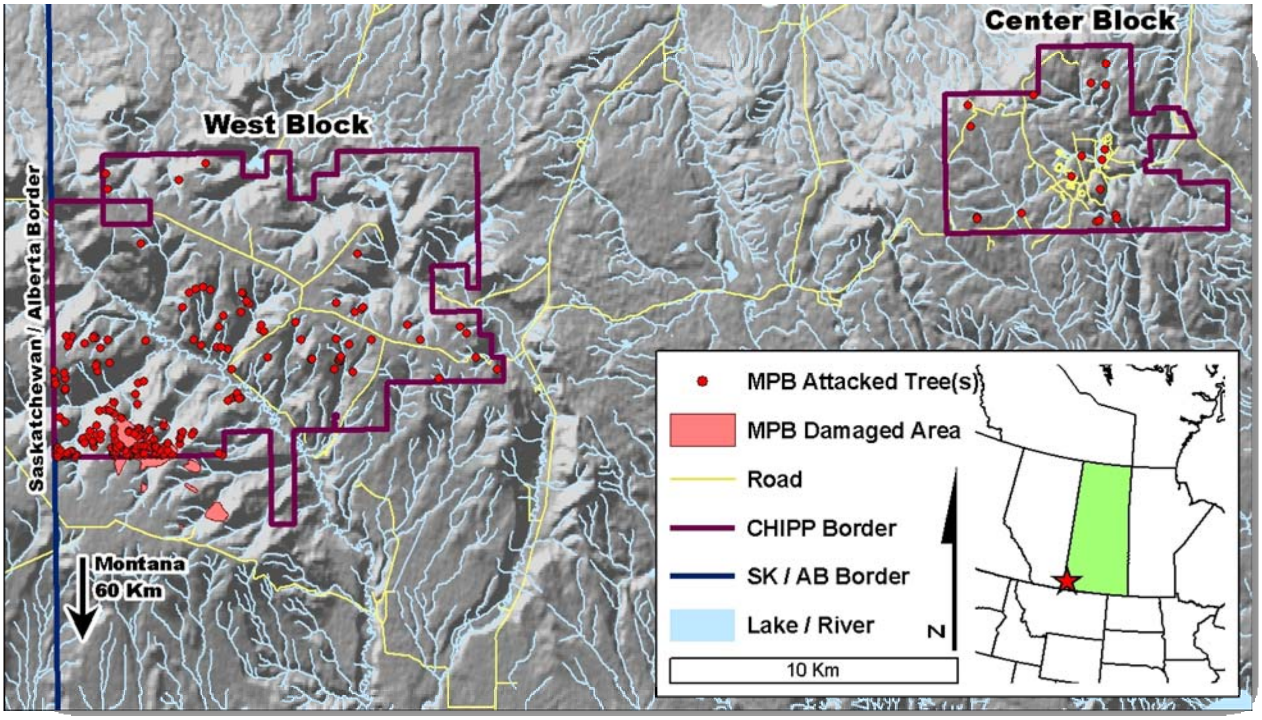


Figure 9. Location and distribution of Mountain pine beetle infested trees detected through aerial surveys and confirmed by ground checks in the West Block of the Cypress Hills Inter-Provincial Park in southwestern Saskatchewan, 2011.

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

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. An unique opportunity exists now to reduce MPB spread into the boreal Jack pine in the boreal bridge zone east of Slave Lake Alberta. The forest is fragmented, beetle survival is currently poor, and the extent of damage is low.

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.

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.

<u>CURRENTLY NO MOUNTAIN PINE BEETLES ARE FOUND IN SASKATCHEWAN'S BOREAL FOREST</u>

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.

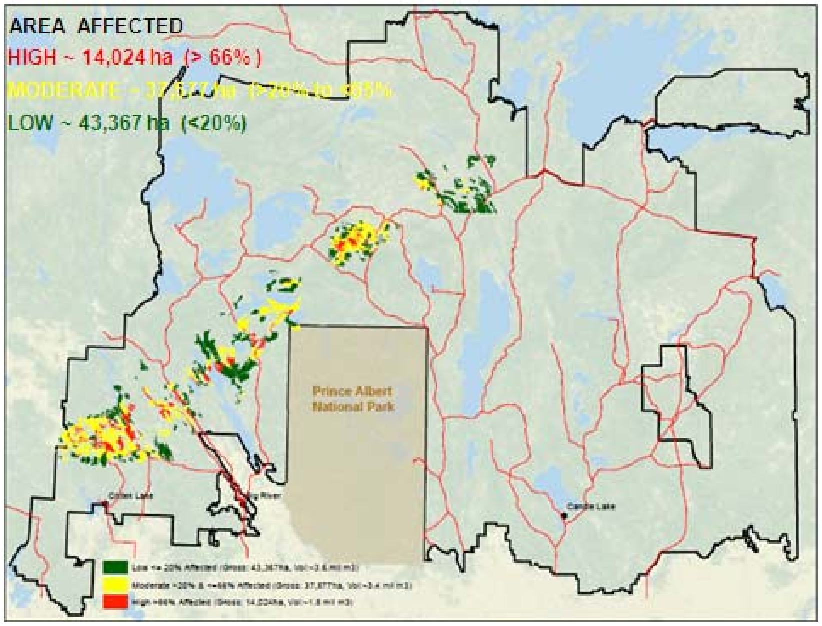


Figure 10. Spruce blown down damage caused by plough winds near Chitek Lake, Saskatchewan.

On August 1, 2011, plough winds touched down damaging an area approximately 100,000 hectares of forests north of Chitek Lake and sliced a path heading northeast north of Delaronde Lake past the northern tip of Prince Albert National Park southwest of Dore and Smoothstone lakes (Figure 10).

Figure 11. Spruce blown down damage caused by plough winds near Chitek Lake, Saskatchewan.

Damage on the ground ranged from trees snapped off to blown down and uprooted (Figure 11). The total volume damaged is estimated to be in the region of 5 million cubic meters. Saskatchewan Ministry of Environment is currently in discussions with industry to work of a plan to salvage the area.

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

FOREST PESTS IN MANITOBA IN 2011

Irene Pines

Manitoba Conservation, Forestry Branch

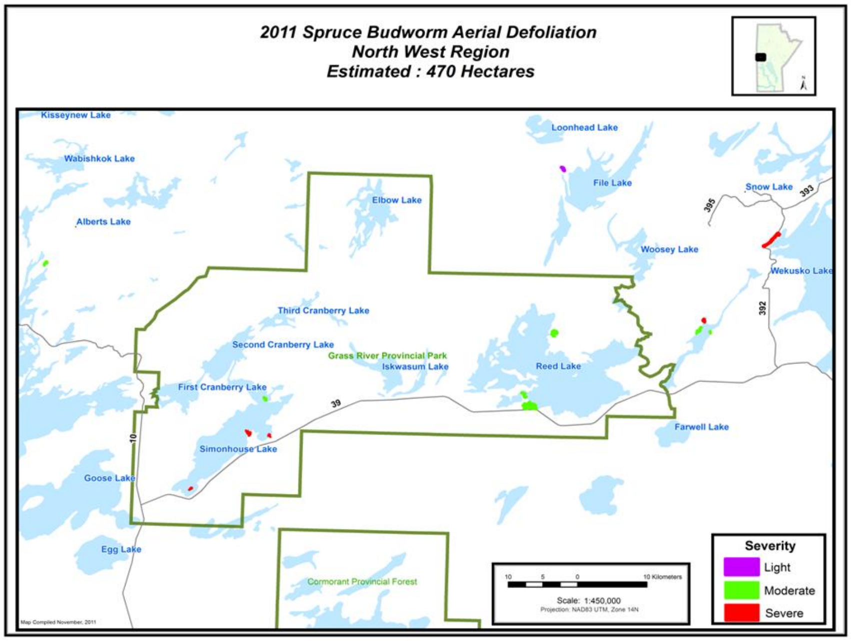
Climatic extremes

Heavy rainfall in May and June caused severe flooding in the major waterways of southern Manitoba especially along the Assiniboine River and other tributaries that flow into Lake Manitoba. Almost no rainfall in July and August, lead to an extreme drought condition in the south eastern part of the province. These weather events impacted the delivery of our Forest Health and Integrated Dutch elm disease Management Programs.

Spruce budworm

In 2011 pockets of defoliation by spruce budworm, *Choristoneura fumiferama*, were observed throughout Manitoba. An aerial survey was conducted in the Northwest region to map spruce budworm defoliation using mobile PC Tablets. Scattered pockets of mainly moderate to severe defoliation were detected and totaled approximately 470 ha (Figure 1). In the Spruce Woods area, spruce budworm defoliation was mapped via ground surveys resulting in an estimated 1000 ha with moderate to severe defoliation.

Figure 1. Spruce Budworm 2011 Defoliation in Northwestern Manitoba.



Based on the 2010 defoliation predictions derived from the fall egg mass surveys and hazard rating for tree condition, an operational spruce budworm suppression program was implemented in 2011 within the Northwest Region. The biosynthetic insecticide, Mimic 240LV (tebufenozide) was applied aerially to a land base of 5427 ha and spray blocks received a single application at a rate of 70 g/ha. The Grass River Provincial Park received a double application of the biological insecticide, Foray 48B *(Bacillus thuringiensis kurstaki)*, to a land base of 828 ha.

Each aerial spray aircraft was equipped with the Satloc AirStar M3 real-time differential Global Positioning System (GPS) aerial navigation system. This system provided guidance over the treatment areas and provided pilots with feedback on their performance after each spray session. Spray application data from each spray aircraft was imported into the Pesticide Application Information System and facilitated faster correction of spray application problems. A Cessna 182 aircraft was used for additional navigational support.

Weather monitoring stations from Environment Canada and the provincial Fire Program were utilized in the 2011 spruce budworm management program. The weather components of temperature, relative humidity, wind speed, wind direction and precipitation are used in timing of application and deploying the spray aircraft.

The 2011 spray project was successful. The mean larval population reduction due to treatment was estimated at 60% (Table 1).

Table 1. Spruce Budworm - Percent Reduction in Larval Numbers.

Northwest Region	Pre Spray Larvae[a]	Post Spray Larvae[a]	Larval Mortality
Treated	37	15	60%
Untreated Controls	19	12	37%

[a] Number of budworm/45-cm branch

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 2012 defoliation (Table 2).

Table 2. 2011 Spruce Budworm Defoliation and Predictions for 2012.

Location	2011 Defoliation*	2011 Egg Mass/10m^2	2012 Defoliation Prediction
Northeast	Light	6	Light
Northwest	Light	3	Light
Western	Light	0	Light
Riding Mt. Nat. Park	Light	0	Light
Southwest	Light	144	Moderate
Interlake	Light	13	Light
Eastern	Light	0	Light

*Defoliation classes are as follows:

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

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

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

Spruce budworm pheromone traps were placed at 33 locations throughout the province and traps/lures were provided to Riding Mountain National Park for monitoring 8 sites. Three MULTIPHER® insect traps containing spruce budworm pheromone (PVC lure containing 0.3% by weight of a 95:5 blend of (E)- and (Z)-11-tetradecenal) were placed 40 m apart at each plot location in either a straight or triangular configuration. Average moth captures per trap decreased in three of the seven regions with large drop in moth captures for the Spruce Woods area in Southwestern Manitoba and Riding Mtn. National Park (Table 3).

Table 3. Spruce Budworm Pheromone Trapping.

Location	2010 Moth Capture/Trap	2011 Moth Capture/Trap	% Change
Northwest Region	462	476	+3%
Northeast Region	567	797	+41%
Western Region	139	163	+17%
Southwest Region (Spruce Woods area)	2118	938	-56%
Riding Mtn. National Park	255	105	-59%
Interlake Region	156	123	-21%
Eastern Region	20	31	+55%

Dutch elm disease

Provincial Dutch elm disease (DED) sanitation crews removed 5210 trees in 2010/11; 2294 within the DED buffer zone of Winnipeg and 2916 throughout the remainder of the province. The City of Winnipeg removed 3842 elms and Brandon removed 234 elms. Total elm tree removals were 9286.

In 2011, Cost-Sharing Agreements were administered within 31 communities. Flooding in the major waterways of Manitoba prevented or delayed surveying and marking riverbank elm trees infected with Dutch elm disease. River bottom forests were under water for several months in some Cost-Sharing Communities. Provincial survey crews marked 5717 elms for removal (3043 within the Winnipeg buffer zone, 308 in the City of Brandon and 2366 in and around the 31 Cost-Sharing Agreement communities). In addition, 196 elm firewood piles were identified for removal. In the City of Winnipeg, 5948 elms were marked for removal.

A trial to test the feasibility of including trap trees in the provincial DED Integrated Management Program began in the fall of 2010. Trap trees are created by applying herbicide to the bole of a healthy elm tree which causes rapid tree mortality and may be effective in attracting and reducing elm bark beetle populations in a localized area. Eleven elms were treated in one community and assessments of the herbicide’s effectiveness were conducted July 2011. Application methodology, onset of tree mortality and attractiveness to elm bark beetles were all within expected limits however only some mortality occurred in the developing larvae.

In 1982, Manitoba Conservation began monitoring for presence of the invasive forest pest, the smaller European elm bark beetle (*Scolytus multistriatus*) which is another vector of Dutch elm disease in Canada. Pheromone traps were situated at several locations throughout southern Manitoba and until 2006 only eight specimens of *S. multistriatus* had been captured. In 2007, eleven adults of a new invasive forest pest, banded elm bark beetle *Scolytus schevyrewi,* were captured in Otterburne and positively identified by the Canadian Food Inspection Agency. This new invasive insect to Canada attacks and breeds in both American and Siberian elm and has the potential to transmit Dutch elm disease. In 2008, Manitoba Conservation increased the number of elm bark beetle trapping locations across southern Manitoba and several *S. schevyrewi*, were captured in 2008 and 2009 but none in 2010. In 2011, 39 adults of the banded elm bark beetle and an adult smaller European elm bark beetle were caught on the baited sticky traps.

Manitoba Conservation has been collaborating in a University of Manitoba Masters of Science project investigating the biology and life cycle of *S. schevyrewi* in the Prairie Provinces. This project captured 64 adults on baited traps in 2011. As part of the Masters project in 2010, a small trial of 10 trees was selected to determine the attraction of *S. schevyrewi* to girdled and non-girdled Siberian elm (*Ulmus pumila*) trees. Trap captures showed *S. schevyrewi* was attracted to the girdled Siberian elms and exit holes in the bark indicated brood production had occurred in some of these trees. All five girdled trees were removed November 2011 and two of them were destructively sampled. Only one of the two girdled Siberian elms contained galleries and larvae of the banded elm bark beetle. The remaining three trees were placed in an unheated storage shed for the winter to be destructively sampled in the spring of 2012.

Eastern larch beetle

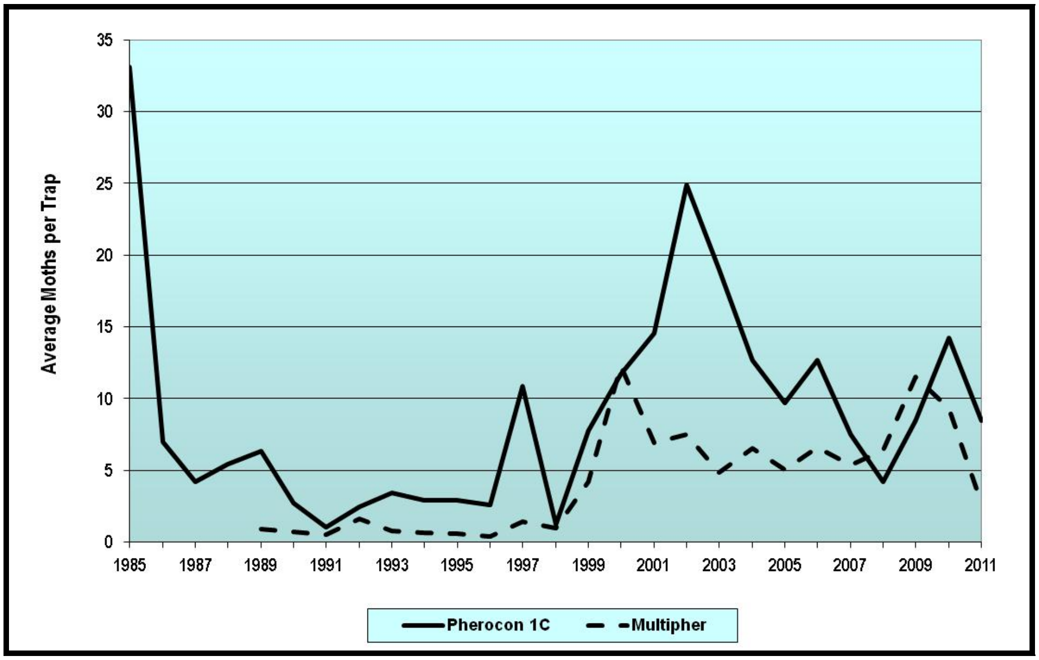
The infestation and impact of this insect continues to increase. Plots, established in spring 2008 to monitor tamarack (*Larix laricina*) mortality from eastern larch beetle (*Dendroctonus simplex*), were again assessed in the fall of 2011. Tree condition and measurements of height and diameter of the tamarack were recorded and data from infested trees were summarized. After four seasons, tree mortality has averaged over 10% per year. There was a significant increase in eastern larch beetle attacks in 2011 and 65% of the tamarack larch are now dead and declining. The remaining healthy larch trees are small with bole diameters of less than 15cm dbh. Other notable effects of the continuing eastern larch beetle outbreak are: 1) loss of large trees and habitat for the Great Grey Owl, 2) little cone/seed production and poor regeneration, and 3) an increase in vegetative competition in infested tamarack stands.

Jack pine budworm

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

In 2011 the same three trapping location were used as previous years; Belair, Shilo and Nopiming. Two trap types, Pherocon 1C and MULTIPHER®, are being field tested for capture efficiency using a 0.03% or 100 µg concentration of pheromone lure. In 2011, the average number of male moths decreased in the Pherocon traps while even fewer moths were captured the MULTIPHER® traps (Figure 2). This year's average was 9 moths per Pherocon trap and 3 moths per MULTIPHER® trap.

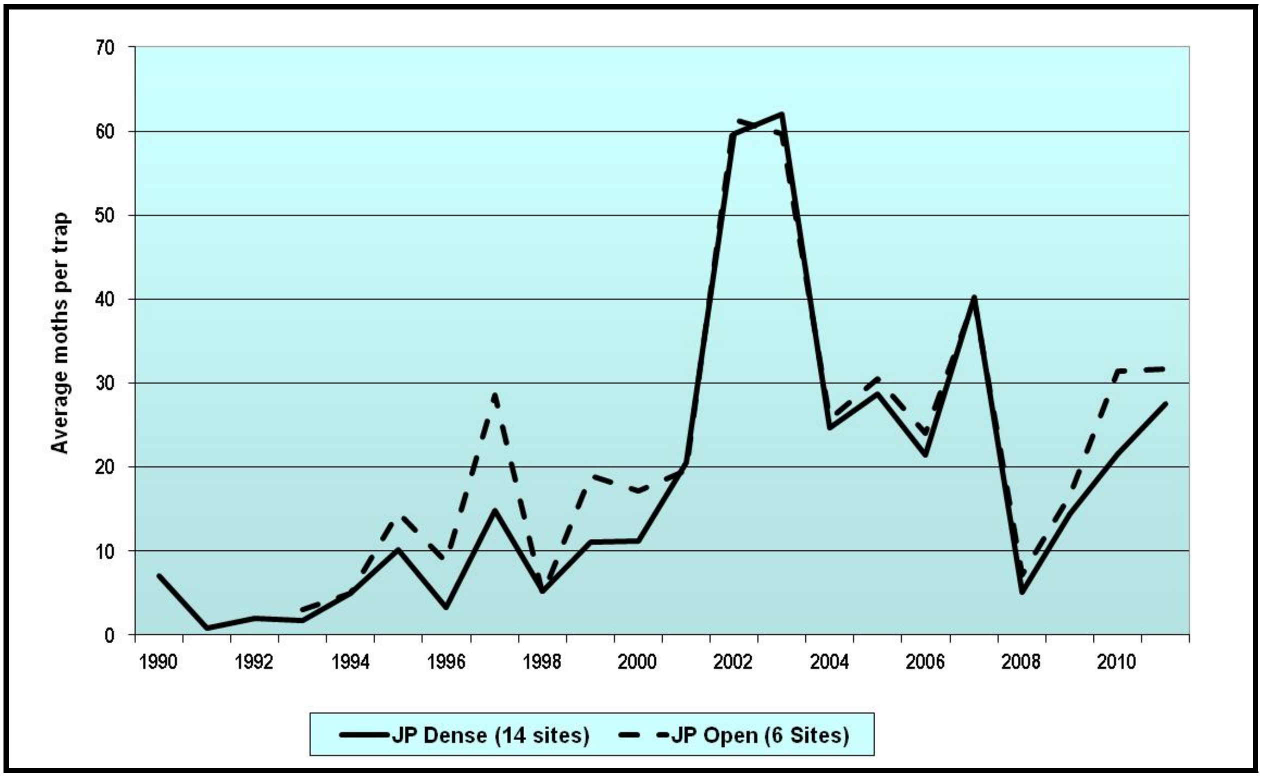
Figure 2. Annual Average Capture of Male Jack Pine Budworm Moths in Two Trap Types.



Jack pine branches were collected in September and assessed for defoliation and egg masses. No defoliation and no egg masses were recorded. Pollen cone bud levels for 2011 are predicted to be 40% on the branch tips.

The Sandilands Provincial Forest was designated as a demonstration site for the Jack Pine Budworm Decision Support System in 1991. Fourteen pheromone locations were established and situated in mature, dense jack pine stands with three Pherocon 1C traps per site. An additional 10 sites were established in 1993 in overmature, open-growing jack pine stands to compare jack pine budworm population levels between the two stand types (Figure 3). Over time four locations have been removed due to harvesting activities and fires, leaving 20 locations. Since 2001, moth capture levels had been similar between stand types. In 2010, the open jack pine stands showed an increase in the average number of captured moths compared to the dense stands. However in 2011 the two stand types were again almost equal in moth captures. No defoliation and no egg masses were found during assessment of the jack pine branches. There has been little difference, in the last decade, in the annual pollen cone bud levels between the dense and open jack pine stands.

Figure 3. Annual Average Capture of Male Jack Pine Budworm Moths in Two Stand Types.



Gypsy moth

In the fall of 2011, Manitoba Conservation assisted the Canadian Food Inspection Agency (CFIA) in conducting a survey for Gypsy moth egg masses within the City of Winnipeg. For two consecutive years, an intensive grid of pheromone traps in this small area has captured an increasing number of moths. The ground survey resulted in positive finds of egg masses and pupal casings. An eradication program is now being planned for 2012. An aerial suppression program in June 2009 successfully eradicated Gypsy moth from two areas outside of the City of Winnipeg; La Salle and St. Germain, Manitoba.

Invasive forest pests and movement of firewood

Manitoba is concerned about the spread of invasive forest insects and diseases through the movement of firewood. Since 2008, four wood collecting bins have been established on major highways at the provincial boundaries: two along the TransCanada Highway and one each at Highways 5 and 16. Manitoba Conservation is asking the public not to transport firewood into the province and to deposit any wood they have with them in the bins. For 2011, travelers deposited wood, pine, ash and other tree species, in both bins along Highway 1.

SESSION II: NORTH OF 60 REPORT

Chair: *Taylor Scarr*
Ontario Ministry of Natural Resources

SÉANCE II : AU NORD DU 60e PARALLÈLE

Président : *Taylor Scarr*
Ministère des Richesses naturelles de l'Ontario

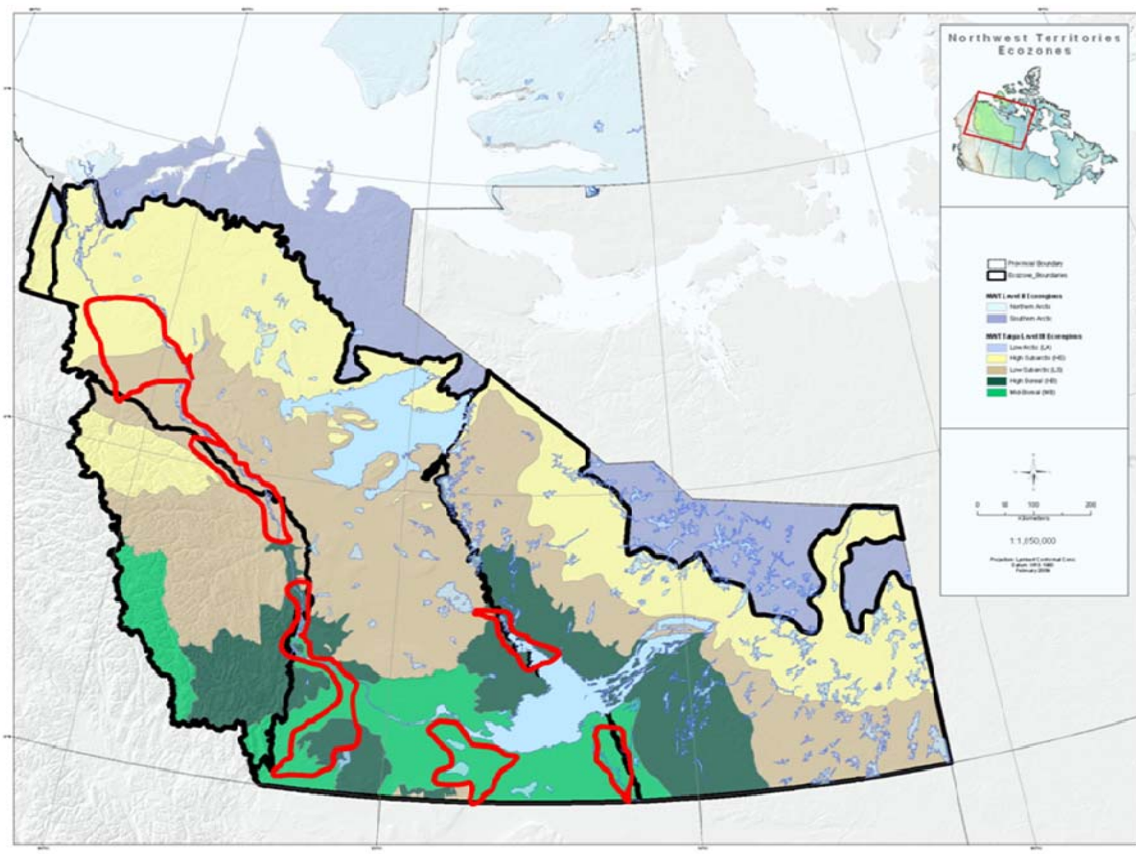
NORTHWEST TERRITORIES REPORT

Mike Gravel

Government of the Northwest Territories,
Environment and Natural Resources

The Government of the Northwest Territories' Department of Environment and Natural Resources (ENR) delivers forest health monitoring across the NWT. Only areas identified as high risk are surveyed (major rivers and water ways). In 2011, over 5,000 kilometers were surveyed (Fig. 1).

Figure 1. Approximate flight lines for aerial forest health surveys conducted in 2011, the area flown is greater than 5,000 kilometers.



Overall, 2011 was another slow year with respect to serious insect infestation. A cold snap in early summer appears to have had a dramatic effect on many of the insects. The area affected was much lower in 2011 and the severity of the infestations was much lower as well. While over 100,000 hectares of forests were affected by various pests or abiotic factors, no serious problems were observed.

Spruce budworm (*Choristoneura fumiferana*)

Spruce budworm is the most serious forest insect pest in the NWT; Spruce budworm populations crashed following 2002 and have remained at low numbers in the years since. The total area affected by spruce budworm in 2011 was almost half of what we saw in 2010 with approximately 41,328 hectares (ha) affected.

The majority of NWT infestations are occurring in the Sahtu Region. Small populations of spruce budworm have remained in the Slave River area and a new area has been detected in the far north in the Ramparts River area near Fort Good Hope (Fig. 2).

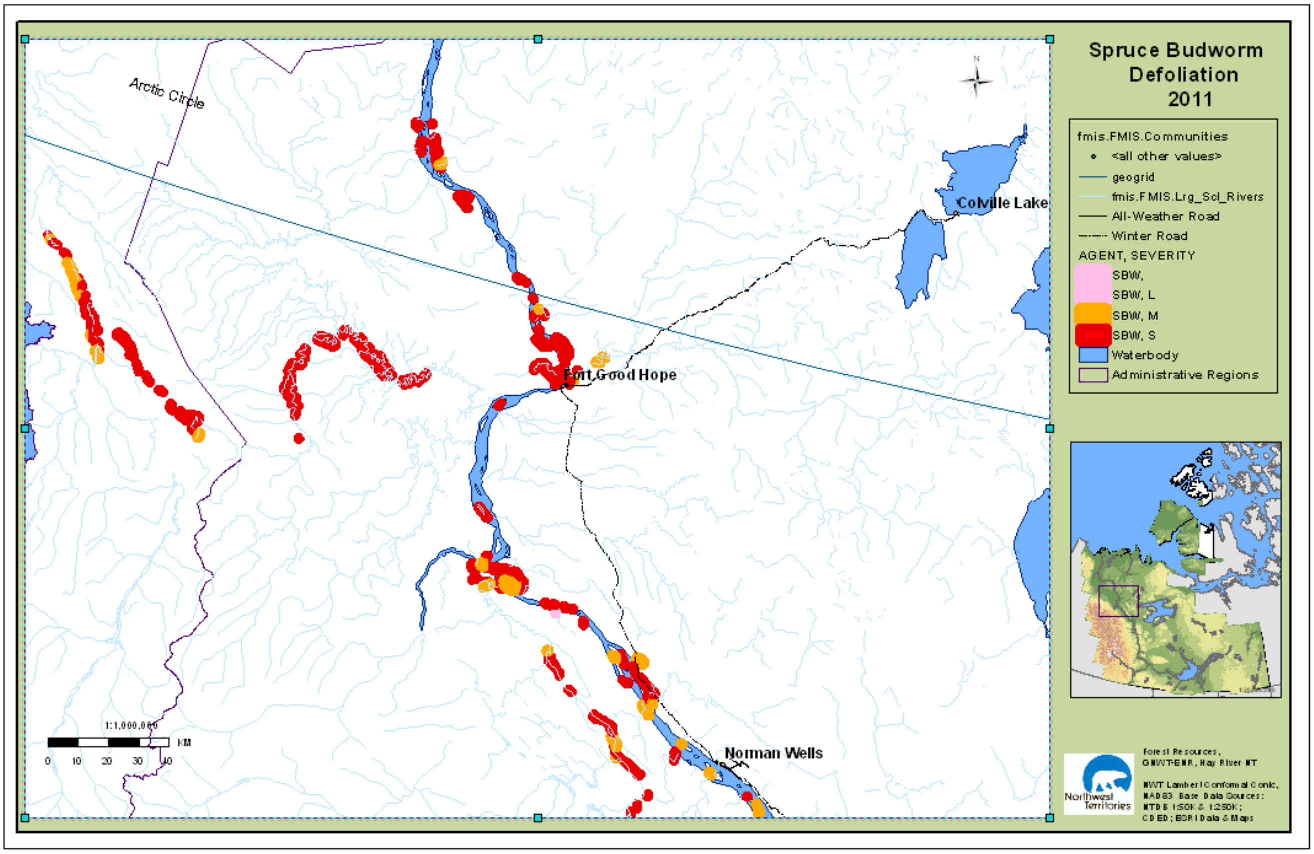


Figure 2. Spruce Budworm in northern NWT. A new area along the Ramparts River was found in 2011 (between Fort Good Hope and Arctic Red River (western most defoliation). An area of spruce budworm also persisted north of the Arctic Circle.

Aspen serpentine leafminer (*Phyllocnistis populiella)*

Aspen Serpentine Leafminer has been very prevalent in recent years; however, in 2011 Aspen Serpentine Leafminer appears to have dropped considerably. The area of defoliation dropped nearly 75% from 2010. No areas surveyed showed severe defoliation, all defoliation was moderate or low. The majority of defoliation was in the Dehcho Region with just over 40,000 hectares affected (Fig. 3). Another 6,000 hectares was defoliated in the Cameron Hills area.

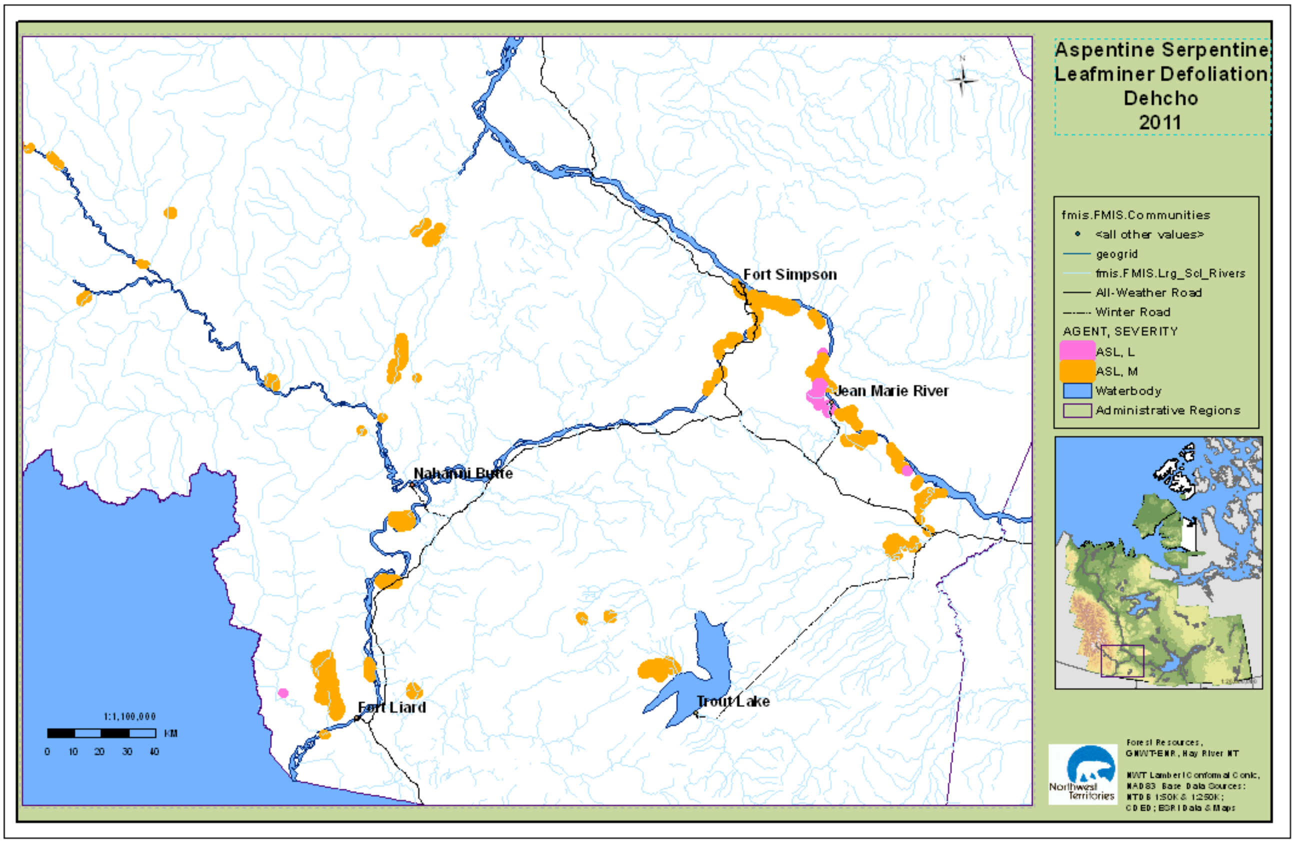


Figure 3. Defoliation in Aspen caused by Aspen Serpentine Leafminer in the Dehcho Region.

Willow leafminer *(Micrurapteryx salicifoliella)*

The Willow Leafminer was widely noticeable along the highways in southern NWT. The Willow Leafminer was seen from Fort Smith all the way north to Tsiigehtchic. Like other infestations in 2011, the willow Leafminer did not appear to be as severe as in 2011.

Mountain pine beetle (*Dendroctonus ponderosae*)

No incidents or signs of Mountain Pine Beetle have been detected in the NWT; however, Alberta has positive findings only 50 kilometers south of the NWT border, near Bistcho Lake.

All other insects seem to be at natural levels and are not of significant concern.

SESSION III: UNITED STATES REPORT

Chair: ***Taylor Scarr***
Ontario Ministry of Natural Resources

SÉANCE III : RAPPORT DES ÉTATS-UNIS

Président : ***Taylor Scarr***
Ministère des Richesses naturelles de l'Ontario

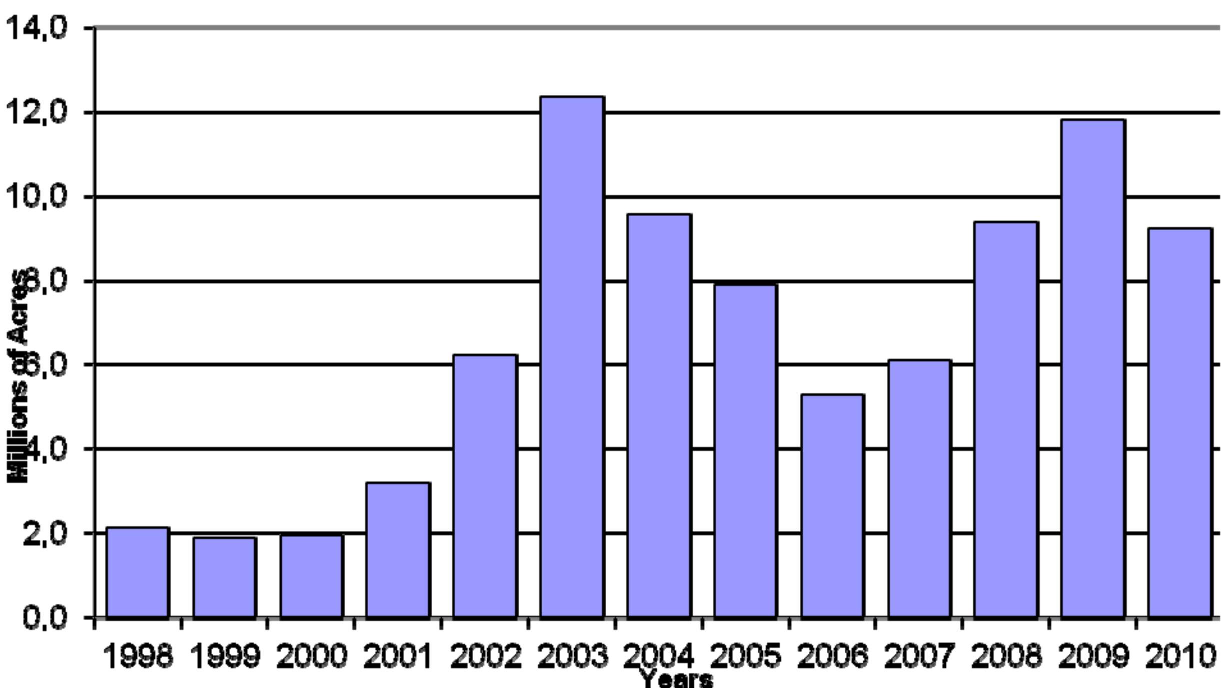
Overview of forest pest conditions in the U.S.A.

Rona Sturrock

Natural Resources Canada, Canadian Forest Service on behalf of the United States Department of Agriculture, Forest Health Protection

Summary

America is fortunate to have forests that cover nearly one-third of the country, providing a wide array of services and commodities such as timber and other forest products, recreation, wildlife, clean water, carbon sequestration, and jobs. Healthy forests, regardless of ownership, are important to providing these goods and services on a sustainable basis. One aspect of maintaining and even enhancing a healthy forest is to protect and restore forests from native and nonnative insects and diseases, which can cause significant damage. Surveys describing the forest insect and disease conditions are important tools to help prioritize actions by Federal agencies, States, and other stakeholders. As with most biological systems, the overall mortality that insects and diseases cause varies from year to year and pest to pest. The following chart illustrates how mortality has varied over the past 13 years.



In 2010, nearly 9.2 million acres with mortality caused by insects and diseases were reported nationally, a 2.6-million acre decrease from 2009, when 11.8 million acres of mortality were reported. Nearly 74 percent of the mortality is attributed to one pest, the mountain pine beetle, a native insect found in forests in the Western United States. Although only mortality is represented in the chart, defoliation also can significantly affect our forests. The western spruce budworm caused more than 2.4 million acres of defoliation damage in 2010. Reports of European gypsy moth defoliation increased more than 37 percent from last year; the moth defoliated more than 1.2 million acres.

Other pests that continue to impact both rural and urban forests include the emerald ash borer, hemlock southern pine beetle, wooly adelgid, Asian longhorn beetle, sudden oak death, and laurel wilt. Federal, State, and local agencies continue to survey for these pests and respond as appropriate.

SESSION IV: GENOME CANADA PRESENTATION

SÉANCE IV : EXPOSÉ SUR GÉNOME CANADA

GENOME CANADA FUNDING ANNOUNCEMENT

Alan Winter

Genome Canada

PRESS RELEASE
For Immediate Release
December 6th, 2011

Canadian scientist leading revolutionary approach to tackling forest pests

Ottawa, ON – The sight of trees affected by disease -- blighted leaves, spotted needles, bare branches, cankered stems -- is heartbreaking, and often means whatever pest is attacking the trees has won the fight. These small battles are part of a much larger war being fought in Canada's forests, a war that is costing more than $2 billion annually. With our global economy, new diseases are being introduced to our forests by pests gaining entry through the worldwide movement of goods and people.

In an effort to halt these diseases, Genome British Columbia and Genome Canada are providing $4,250,116 for a new and innovative research project entitled "**Genomics-Based Forest Health Diagnostics and Monitoring"** which is being led by Dr. Richard Hamelin, a professor at UBC and senior research scientist at Natural Resources Canada.

Currently, the diagnosis of transmittable diseases on trees is performed mainly by visual inspection. However, this traditional approach cannot identify the many microscopic pathogens that can be transmitted without obvious symptoms. Dr. Hamelin and his team aim to change this, and are using genomics to develop a DNA-based diagnostic test to detect and monitor pathogens. Dr. Hamelin is an expert in this area and this project is a culmination of decades of experience. More importantly, this research is being done at the request of partners in both government and the forestry industry to develop an improved method to diagnose forest pests.

"Prevention is a large part of managing forest pests. In fact, once we see the damage caused by a pest, it's often already too late," says Dr. Hamelin. "With earlier and faster pest detection methods, we can act much more quickly to eradicate infections, determine where the pests originated and where they are going."

The project will generate a number of important benefits, including averting potentially detrimental pathogens spreading through our forests, assisting the forest and nursery industries with plant and product certification, and ensuring that Canadian products and materials are sought after in international markets. The solutions provided by the project are expected to produce annual economic benefits in the tens of millions of dollars.

"Forests have always been fundamental to our environment, economy and culture, and it is our duty to safeguard them for future generations," says the Honourable Joe Oliver, Minister of Natural Resources. "Investments in research projects like this one clearly demonstrate our collective commitment to the well-being of this vital natural resource."

"Canadian researchers are introducing 21st century solutions to protect and preserve forests that are fundamental to Canada's economic and social fabric," says Dr. Pierre Meulien, President of Genome Canada. "This is the kind of science that powers innovation, that powers Canada."

Dr. Jeremy Hall at Simon Fraser University is leading the social science research component of the project. His team is examining current public policies and societal issues around the use of genomics in the management of our forests and will recommend commercialization opportunities for outcomes of the research.

"This project will make significant inroads in diagnosing and hopefully reducing the effects of forest pests in Canada, and ultimately globally," says Dr. Alan Winter, President and CEO of Genome BC. "We are proud to be supporting the largest forest pathogen sequencing effort in the world."

Genome BC is funding the "**Genomics-Based Forest Health Diagnostics and Monitoring**" project as part of Genome Canada's 2010 Large-Scale Applied Research Project Competition. Appropriately, the project is being announced today at the 54th annual Forest Pest Management Forum in Ottawa. Natural Resources Canada, Canadian Food Inspection Agency (CFIA), FP Innovations and Boreal Genomics also fund the project.

-30-

About Genome British Columbia:
Genome British Columbia is a catalyst for the life sciences cluster on Canada's West Coast, and manages a cumulative portfolio of over $550M in research projects and technology platforms. Working with governments, academia and industry across sectors such as forestry, fisheries, agriculture, environment, bioenergy, mining and human health, the goal of the organization is to generate social and economic benefits for British Columbia and Canada. www.genomebc.ca

Contact: Jennifer Boon
Communications Specialist, Genome BC
Cell: 778-327-8374 Email: jboon@genomebc.ca

COMMUNIQUÉ DE PRESSE
Pour diffusion immédiate
Le 6 décembre 2011

Un scientifique canadien à la tête d'une approche révolutionnaire visant à contrer les ravageurs forestiers

Ottawa (Ontario) – Le décor d'arbres touchés par la maladie – caractérisé par la présence de feuilles rouillées, d'aiguilles tachetées, de branches dénudées, de troncs chancreux – fend le cœur et signifie souvent que peu importe quel était le ravageur qui s'est attaqué ces arbres, il a gagné la bataille. Ces petites batailles font partie d'une guerre à beaucoup plus grande échelle qui se livre dans les forêts canadiennes, une guerre qui nous coûte plus de 2 milliards de dollars par année et qui signifie, avec le déplacement de biens et de personnes, que bien d'autres nouvelles maladies seront introduites et s'établiront si nous ne réagissons pas rapidement.

Dans le cadre d'un effort visant à mettre fin au siège imposé à nos forêts, Génome Colombie-Britannique et Génome Canada ont subventionné le D^r^ Richard Hamelin, professeur à l'UCB et chercheur scientifique principal à Ressources naturelles Canada, en lui octroyant collectivement 4 250 116 $ pour son projet de **Diagnostic et surveillance de la santé des forêts au moyen de la génomique**. C'est donc fort à propos que l'on annonce aujourd'hui ce projet durant le 54^e^ Forum annuel sur la répression des ravageurs forestiers à Ottawa. Le projet est également financé par Ressources naturelles Canada, l'Agence canadienne d'inspection des aliments (ACIA), FP Innovations et Boreal Genomics.

Les chercheurs canadiens mettent en place des solutions du 21e siècle pour protéger et préserver les forêts, une ressource fondamentale au tissu économique et social du Canada », explique le Dr Pierre Meulien, président de Génome Canada. "C'est ce genre de science qui fait avancer l'innovation, et qui fait avancer le Canada.

À l'heure actuelle, le diagnostic des maladies transmissibles des arbres se fait principalement au moyen d'une inspection visuelle. Cependant, cette approche ne permet pas de déterminer les nombreux agents pathogènes qui peuvent être transmis sans que cela n'entraîne de symptôme évident. Le D^r^ Hamelin et son équipe ont l'intention de changer cela et ils élaborent actuellement un test de diagnostic fondé sur l'ADN permettant de détecter et de surveiller les agents pathogènes. Le D^r^ Hamelin est un expert dans ce domaine et ce projet est une culmination de décennies d'expérience et, surtout, c'est un projet réalisé à la demande des partenaires du gouvernement et de l'industrie afin d'élaborer une méthode améliorée permettant de diagnostiquer la présence de ces ravageurs forestiers.

« La prévention représente une grande partie de la gestion des ravageurs forestiers. En fait, une fois que nous constatons les dommages causés par un ravageur, il est souvent déjà trop tard », déplore le Dr Hamelin. « Avec des méthodes de détection des ravageurs plus hâtives et plus rapides, nous pouvons agir plus rapidement pour éradiquer les infections et déterminer d'où proviennent les ravageurs et où ils se dirigent. »

Le projet produira un certain nombre d'avantages importants, notamment éviter la propagation d'agents pathogènes potentiellement préjudiciables dans nos forêts, aider les industries des pépinières et forestière à procéder à la certification des végétaux et des produits et veiller à ce que les produits et les matériaux canadiens soient recherchés sur les marchés internationaux. Les solutions découlant du projet contribueront également à renverser les pertes économiques, actuellement de l'ordre de plusieurs dizaines de millions de dollars et qui s'avèrent être une conséquence directe des ravageurs forestiers qui détruisent nos forêts.

« Les forêts ont toujours été fondamentales à notre environnement, notre économie et notre culture et c'est notre devoir de les préserver pour les générations futures », a déclaré l'honorable Joe Oliver, ministre des Ressources naturelles. « Les investissements dans les projets de recherche comme celui-ci montrent clairement notre engagement collectif à l'égard du bien-être de cette ressource naturelle vitale. »

« Ce projet fera d'importantes percées dans la capacité à diagnostiquer et, espère-t-on, à éradiquer ces ravageurs forestiers au Canada et, en fin de compte, partout dans le monde », indique le Dr Alan Winter, président-directeur général de Génome C.-B. « Nous sommes fiers de soutenir le plus grand effort de séquençage des agents pathogènes forestiers au monde. »

À titre de province qui dépend fortement de l'industrie forestière, la Colombie-Britannique est fière de disposer d'une masse critique de gens investis dans le maintien en santé des forêts; le volet de la recherche en sciences sociales de ce projet sera dirigé par une équipe de l'Université Simon Fraser, qui examinera les possibilités de commercialisation et les questions de société et d'intérêt public entourant le recours à la génomique dans la gestion de nos forêts.

Génome C.-B. a financé le projet de **Diagnostic et surveillance de la santé des forêts au moyen de la génomique** dans le cadre du Concours 2010 : Projets de recherche appliquée à grande échelle de Génome Canada.

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À propos de Génome Colombie-Britannique :
Génome Colombie-Britannique est un catalyseur pour la grappe des sciences de la vie sur la côte Ouest du Canada et l'organisme gère un portefeuille cumulatif de plus de 550 millions de dollars en projets de recherche et en plateformes technologiques. Collaborant avec les gouvernements, le monde universitaire et l'industrie dans plusieurs secteurs, comme ceux de la foresterie, des pêches, de l'agriculture, de l'environnement, de la bioénergie, des mines et de la santé humaine, le but de l'organisation consiste à générer des avantages sociaux et économiques pour la Colombie-Britannique et le Canada.
www.genomebc.ca

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SESSION V: NATIONAL FOREST PEST STRATEGY UPDATE

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

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

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

An update of the National Forest Pest Strategy

Kami Ramcharan

Natural Resources Canada, Canadian Forest Service,
Pacific Forestry Centre

Abstract

The Forest Pest Working Group of the Canadian Council of Forest Ministers (CCFM) is the Federal/Provincial/Territorial driving force of the National Forest Pest Strategy. Last year, CCFM restructuring into a new and more focused model triggered a realignment of the Working Group's and Strategy's activities toward a few targeted strategic priorities. This enabled realignment to the Strategy's founding principle of collaborative, transparent and risk-based decision-making but also toward the collection of lessons learned over the years through various syntheses. Recent concerns raised by CCFM partners about the mountain pine beetle have also been addressed in this year's activities. The presentation will provide an overview of the initiatives underway within the Forest Pest Working Group and will highlight opportunities of future work under the auspices of CCFM.

Résumé

Le Groupe de travail sur les ravageurs forestiers du Conseil canadien des ministres des forêts (CCMF) est l'organe moteur fédéral/provincial/territorial de la Stratégie national de lutte contre les ravageurs forestiers. L'an dernier, la restructuration du CCMF vers un nouveau modèle plus focalisé a demandé une réorientation des activités de la Stratégie vers des priorités stratégiques ciblées. Ceci a permis un recentrage vers son principe fondateur de prise de décision collaborative, transparente et fondée sur le risque et également vers le regroupement des leçons apprises au fil des ans à travers diverses synthèses. Les inquiétudes récentes au sujet du dendrochtone du pin soulevées par les partenaires du CCMF on également été prises en compte dans les activités de cette année. La présentation donnera un aperçu des initiatives en cours au sein du Groupe de travail sur les ravageurs forestiers et mettra en lumière les opportunités de travail futur sous les auspices du CCMF.

SESSION VI: NATIONAL FOREST PEST STRATEGY DISCUSSION

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

SÉANCE VI : DISCUSSION SUR LA STRATÉGIE NATIONALE DE LUTTE CONTRE LES RAVAGEURS FORESTIERS

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

WHY CANADA NEEDS A FOREST PEST MANAGEMENT STRATEGY

Vince Nealis

Natural Resources Canada, Canadian Forest Service

NOT AVAILABLE

PERSPECTIVE FROM THE NEWCOMER IN FOREST PEST MANAGEMENT

Mike Gravel

Government of the Northwest Territories, Environment and Natural Resources

NOT AVAILABLE

PERSPECTIVE FROM AN ESTABLISHED FOREST PEST MANAGEMENT PROGRAM

Taylor Scarr

Ontario Ministry of Natural Resources

NOT AVAILABLE

SESSION VII: PESTICIDE REGULATIONS, ALTERNATIVES, MINOR USE

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

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

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

PMRA UPDATE, INCLUDING A PROPOSAL FOR FOREST WORKING GROUPS

Terry Caunter

Health Canada, Pest Management Regulatory Agency

NOT AVAILABLE

UPDATE ON IAS APPROACHES FROM THE PMRA PERSPECTIVE

Imme Gerke

Health Canada, Pest Management Regulatory Agency

NOT AVAILABLE

SESSION VIII: EASTERN PEST MANAGEMENT ISSUES

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

SÉANCE VIII : LA RÉPRESSION DES RAVAGEURS DANS L'EST

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

ONTARIO REPORT

Taylor Scarr

Ontario Ministry of Natural Resources

NOT AVAILABLE

RAPPORT DU QUÉBEC

Louis Morneau, Pierre Therrien, Julie Bouchard, Cédric Fournier, Louise Innes

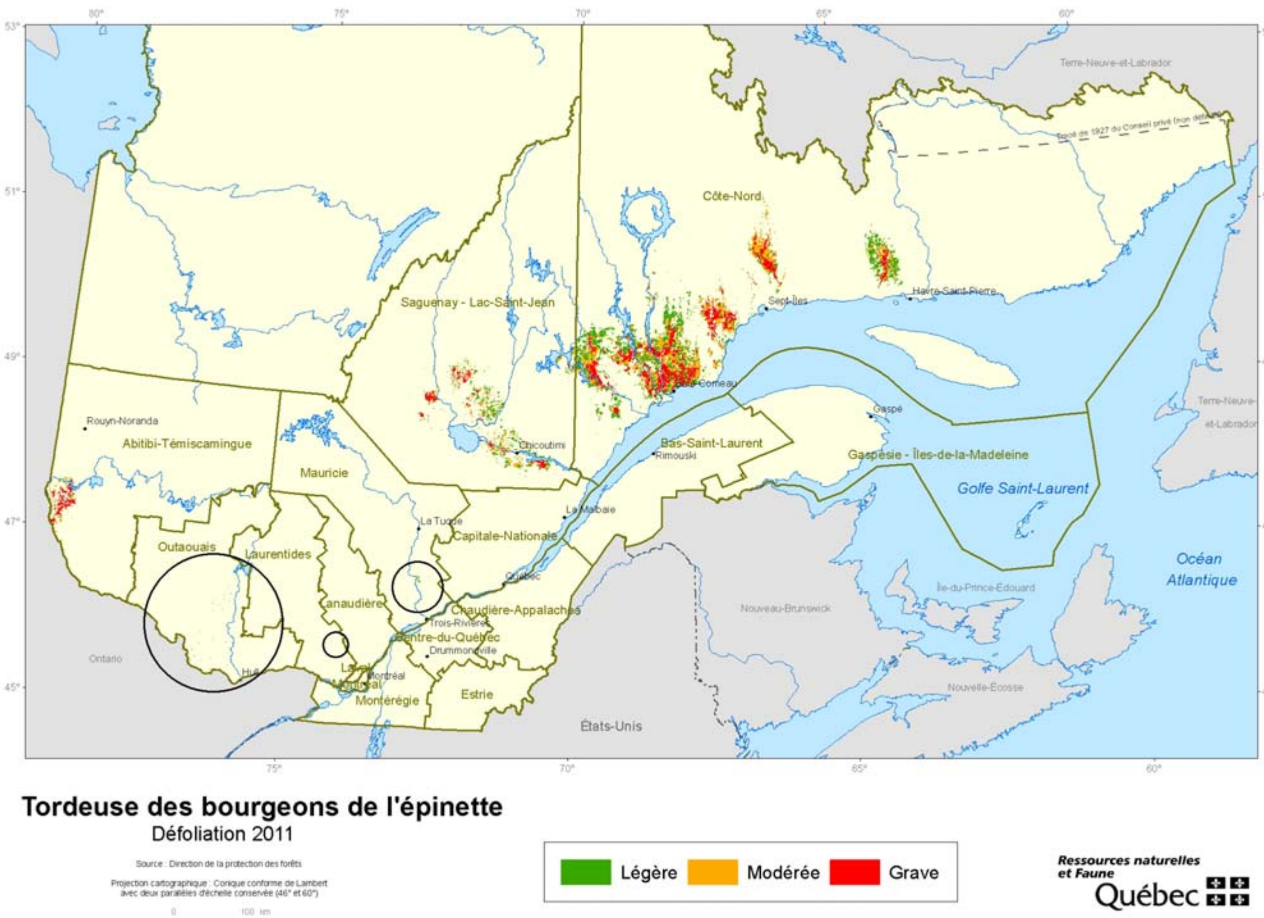
Ministère des Ressources naturelles et de la Faune du Québec
Direction de la protection des forêts
http://www.mrnf.gouv.qc.ca/forets/fimaq/insectes/fimaq-insectes-portrait.jsp

État de situation des principaux ravageurs forestiers au Québec en 2011

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 et de la Faune (MRNF). 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 17 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 2011, les techniciens en protection des forêts ont visité 2 693 sites d'observation, dont 604 plantations de pins, d'épinettes, de mélèzes et de feuillus, et ont réalisé 8 737 rapports d'échantillonnage. 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 sur des superficies totalisant 139 300 km^2, ce qui a requis plus de 275 heures de vol. Enfin, 22 pépinières publiques et privées ont fait l'objet d'inspections phytosanitaires. Des lots totalisant quelque 179,1 millions de plants ont été examinés lors des inspections de certification et quelque 12,9 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 2011 totalisent 1 642 957 hectares (carte 1) comparativement à 765 740 hectares en 2010 et 321 146 hectares en 2009. Les régions les plus touchées sont la Côte-Nord, le Saguenay–Lac-Saint-Jean et l'Abitibi-Témiscamingue avec, respectivement 80%, 15% et 4% du total provincial des aires défoliées. Les infestations relevées dans les régions de la Mauricie (2 260 ha) et des Laurentides (84 ha) n'ont pas connu d'expansion significative par rapport à

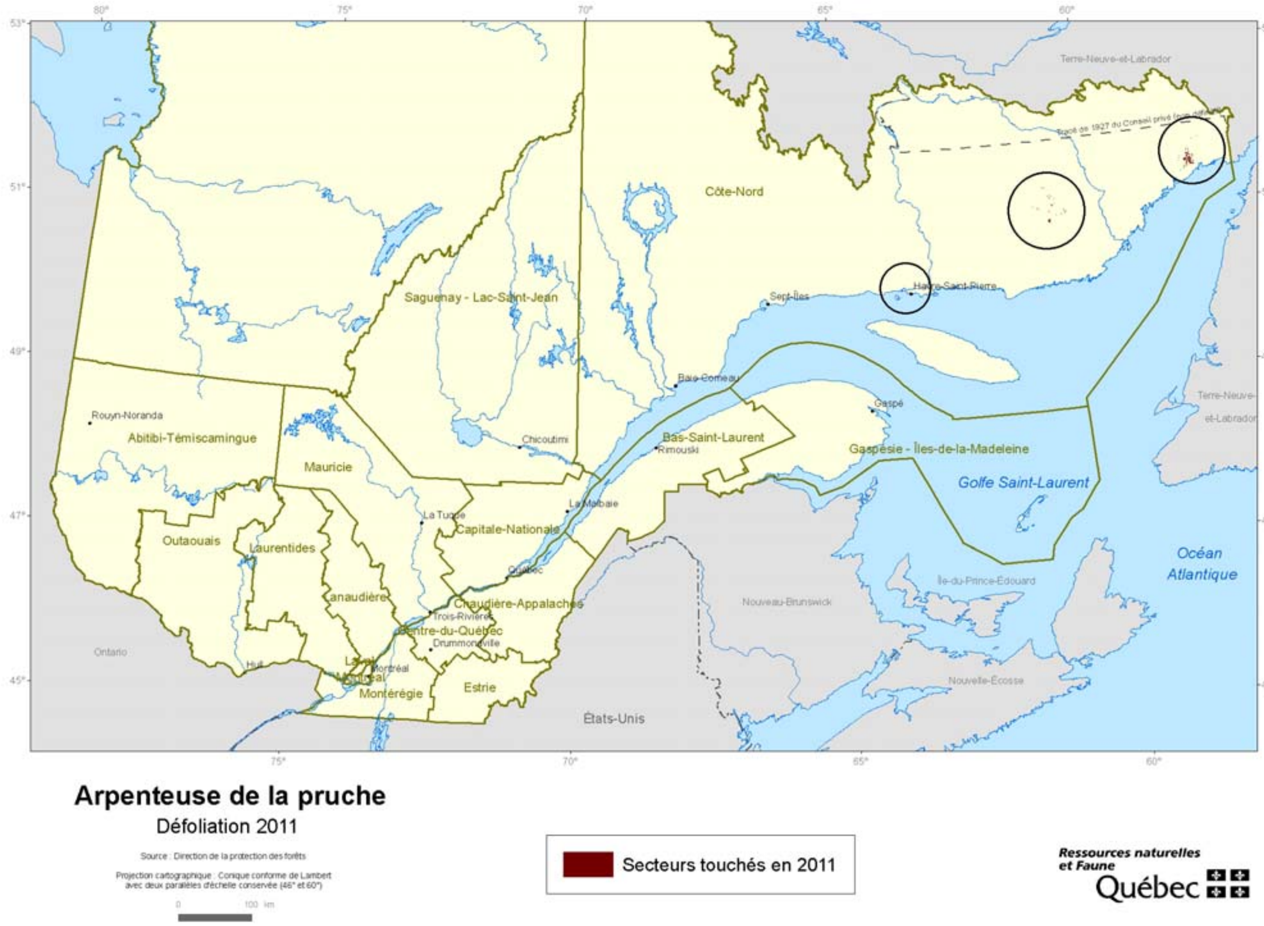
2010 alors qu’une baisse importante des superficies touchées a été observée dans l’Outaouais (2 280 hectares). En 2011, un programme de pulvérisations aériennes contre la TBE a été mis en œuvre pour une troisième année consécutive dans la région de la Côte-Nord et pour une deuxième année dans la région 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 réalisés du 1er juin au 5 juillet sur une superficie totale de 62 553 hectares. Le site Internet de la SOPFIM (www.sopfim.qc.ca) contient de plus amples renseignements sur les résultats du plan d’intervention 2011.



Carte 1. Défoliations causées par la tordeuse des bourgeons de l’épinette au Québec en 2011.

Les foyers d’infestation de l’**arpenteuse de la pruche**, *Lambdina f. fiscellaria* détectés sur la Côte-Nord en 2009 (7 685 hectares) étaient toujours actifs en 2010 (12 936 hectares). De plus, une infestation d’une trentaine d’hectares a été observée sur les îles de Mingan. En 2011, seul le secteur des îles Mingan a été survolé. Les dommages dans les autres secteurs ont été identifiés et délimités grâce à l’utilisation d'imagerie satellitaire et des données antérieures. Les superficies touchées par l'arpenteuse de la pruche s'étendent sur 13 106 hectares au nord-ouest de Vieux-Fort entre Saint-Augustin et Blanc-Sablon et entre La Romaine et Chevery (carte 2). Quant au foyer relevé sur les îles de Mingan, la majorité des arbres sont morts en 2011 et les populations de l'insecte ont chuté.

En 2011, un foyer d'infestation du **diprion de Swaine**, *Neodiprion swainei*, de 787 hectares a été délimité dans la région de l'Outaouais, au nord du réservoir Dozois. La présence de pins gris morts laisse supposer que ce foyer date de quelques années déjà. Des coupes récentes ont été réalisées sur quelques centaines d'hectares de peuplements adjacents qui étaient très probablement endommagés par l'insecte. L'infestation semble en déclin car les relevés de populations du diprion indiquent une faible densité de larves. Des foyers locaux de populations faibles ont aussi été relevés en 2011 dans les régions du Saguenay–Lac-Saint-Jean, de l'Abitibi-Témiscamingue et du Bas-Saint-Laurent. Plusieurs de ces foyers persistent depuis les quelques dernières années.



Carte 2. Défoliations causées par l'arpenteuse de la pruche au Québec en 2011.

Aucune défoliation par la **tordeuse du pin gris**, *Choristoneura p. pinus*, n'a été détectée par le relevé aérien des dommages en 2011. Les relevés terrestres confirment encore la présence locale de l'insecte dans un site au Saguenay–Lac-Saint-Jean et ce, depuis 2004.

La présence de dommages causés par le **papillon satiné**, *Leucoma salicis*, continue d'être observée dans certaines régions du Québec en 2011. Des défoliations par l'insecte ont été notées dans les régions de la Gaspésie–Îles-de-la-Madeleine, du Bas-Saint-Laurent et de la Capitale-Nationale.

Aucun dommage par la **livrée des forêts**, *Malacosoma disstria,* n'a été noté en 2011 dans la province.

Des **maladies du feuillage et des pousses** ont été rapportées fréquemment en 2011 dans plusieurs secteurs de la province à cause du temps très humide du printemps et du début de l'été. Les feuilles de plusieurs érables, chênes, saules et frênes ont présenté des dégâts causés par l'**anthracnose**, *Discula umbrinella* et *Discula fraxinea*, dès le début de la feuillaison. Les taches de feuilles ont aussi été très abondantes telle la **tache goudronneuse**, *Rhytisma acerinum*, très remarquable sur les érables de Norvège et les érables à sucre dans de nombreuses municipalités du Québec et la **tache septorienne**, causée par *Septoria betulae* sur le bouleau à papier et le bouleau gris ainsi que *Septoria aceris* sur l'érable à sucre.

Pour une quatrième année en 2011, un suivi a été fait sur les maladies affectant les aiguilles du pin blanc. La **brûlure en bandes brunes**, *Lecanosticta acicola* (téléomorphe : *Mycosphaerella dearnessii*), le **rouge des aiguilles** causé par *Canavirgella bandfieldii* et d'autres champignons associés à un brunissement des aiguilles ont été de nouveau rapportés sur le feuillage de première année et de deuxième année du pin blanc. Plusieurs pins blancs présentent une cime très clairsemée suite à la chute des aiguilles infectées.

La **brûlure de pousses** causée par *Delphinella abietis* continue sa progression dans les régions du Bas-Saint-Laurent et de la Gaspésie–Îles-de-la-Madeleine. Elle a également été rapportée dans des productions de sapins de Noël dans la région de l'Estrie. Les secteurs les plus à risques sont ceux situés dans les zones humides et les dépressions où l'air humide se trouve emprisonné, comme les vallées, les bordures de cours d'eau et le bas des pentes.

Quelques tornades et plusieurs tempêtes de vents violents ont eu lieu à l'été 2011, causant du **chablis** par endroits. L'événement le plus important s'est produit le 6 août 2011 dans la région du Saguenay–Lac-Saint-Jean. Une superficie de 3 290 hectares a été balayée par une tornade. Cet incident a donné lieu à un programme spécial de récupération des bois d'environ 100 000 m^3.

L'Agence canadienne d'inspection des aliments a confirmé la présence de l'**agrile du frêne**, *Agrilus planipennis*, dans la région de la Montérégie, au Québec, en juin 2008. Un partenariat entre les gouvernements fédéral et provincial ainsi que la municipalité de Carignan a permis la réalisation d'une opération d'abattage de 350 frênes infestés par l'agrile du frêne à Carignan en février et mars 2011. L'objectif visé était de réduire la population d'agrile du frêne, de freiner la dispersion naturelle de l'insecte et de contribuer à la réalisation d'activités de recherche sur la lutte biologique contre ce ravageur exotique. À l'automne, une visite par le personnel du MRNF et de l'ACIA de la zone infestée ayant fait l'objet de la coupe phytosanitaire de 2011 a permis d'identifier plus de 1 000 nouveaux arbres infestés ou potentiellement infestés par l'agrile du frêne.

Bilans du relevé des insectes et maladies des arbres du Québec :

http://www.mrnf.gouv.qc.ca/forets/fimaq/insectes/fimaq-insectes-portrait.jsp

Cartes des relevés aériens de défoliation :

http://www.mrnf.gouv.qc.ca/forets/fimaq/insectes/fimaq-insectes-portrait-superficies.jsp

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Quebec pest reports:

http://www.mrnf.gouv.qc.ca/forets/fimaq/insectes/fimaq-insectes-portrait.jsp

Aerial survey maps:

http://www.mrnf.gouv.qc.ca/forets/fimaq/insectes/fimaq-insectes-portrait-superficies.jsp

New Brunswick report

Nelson Carter

New Brunswick Department of Natural Resources

Preamble

This year brought extra challenges to the Forest Pest Management Section. The Section was initiated in 1983 and once had 12 full-time staff and numerous students and casual staff during the years that we were actively engaged in large-scale, multimillion dollar, operational aerial control programs against the infamous spruce budworm. Due to normal staff turn-over over the years, the Section entered 2011 with a complement of 8 full-time staff; specifically, a Section Manager, 3 Professionals and 4 Technicians, and the general expectations of hiring 4 casuals (down from 5 last year). However, due to budget reductions in the spring, one less casual was approved for the core surveys that had been anticipated. Then in May, two full-time Technicians retired after 27 years with the Section (one with excellent taxonomic skills and the other with excellent data management and GIS skills). And, this was followed in July by the retirement of a professional Forester, also after 27 years with the Section. This person had excellent supervisory, GIS and data management skills. This put significant pressure on the planning and delivery of surveys throughout the Province. Nonetheless, it was decided to increase the sampling intensity for Spruce Budworm in the northern part of the Province (fortunately with some extra resources). And finally, for the first time since 1995, FPMS was involved in planning, timing and assessing a biological aerial insect control program using virus (Abietiv™) – this time it was against the Balsam Fir Sawfly, which we never had to control in the past. As a consequence, these decisions meant that we were unable to do an over-winter survival survey for Gypsy Moth or Balsam Woolly Adelgid; nor did we do a pheromone trap survey for Jack Pine Budworm; the aerial survey was done by a single technician; and routine diagnostics for general and specific insect and disease enquiries from the public and forest industry were reduced, including some tick identifications and follow-up submissions to Health Canada for Lyme disease diagnosis. Moreover, supplementary and follow-up investigations for pests of concern were constrained in 2011. Nevertheless, a substantial amount of survey and control work was done as briefly presented in this report. On a final note, the Section Manager also tendered his retirement notice for the end of December, 2011 (after 27½ years with the Section), thereby cutting the Section's full-time staff from 8 to 4 positions. The New Brunswick government is facing extreme fiscal pressures and it remains unknown at this time what size and type of pest monitoring survey will be delivered in the coming year(s).

Pests of Softwoods

Spruce budworm: Since 1997, there has been an irregular though gradual increasing trend of populations in New Brunswick as shown by annual changes in moth catches in the pheromone trapping survey. The highest counts tend to be in the northern part of the Province and this trend has gained more attention in light of the increasing outbreak in Québec, which had elevated populations on the Gaspé Peninsula in 2010.

In 2011, the pheromone trapping survey was modified to better define local areas in northern New Brunswick where budworm numbers might be higher than surrounding areas. This was done to provide background information for examining the possibility of initiating a program of "Anticipatory Action" or early intervention should this option be deemed worth implementing in 2012 or 2013. It was not completely surprising, but moth counts up to 321 were encountered. Trap catches in the hundreds of moths have not been recorded since before the operational pheromone trapping survey was adopted in 1997 towards the end of the last outbreak in the Province. Although these trap catch numbers are of concern, defoliation is still not forecast for 2012.

In 2011, the L2 survey was also modified and more plots were sampled in the northern area. There were 11 positive plots all with very low numbers (1-4 larvae per plot); yet, this is the most positive plots since 1995 when the outbreak was collapsing. Although there is a bias in putting more plots where it is expected that populations are rising, these data might still be indicative of localized increasing populations.

Jack pine budworm: 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 2011, no pheromone trapping survey was conducted due to staff reductions and other priorities.

Hemlock looper: In 2010, the maximum pheromone trap catch had reached its second lowest level since this monitoring system began and the mean trap catch reached its lowest point. In 2011, there was a slight increase in the maximum trap catch but the mean trap catch almost doubled from the previous year. These numbers, however, are well within the range of previous data and hence no defoliation is expected in 2012. Nonetheless, yearly increases and trend analyses are worth doing to ensure prompt detection of an outbreak and decision-making because this insect can kill trees in a single year.

Whitemarked tussock moth: Despite an unexpected 'jump' in pheromone trap catches in 2010 no defoliation was forecast for 2011 and none was detected. In 2011, there was another increase in pheromone trap catches. Unfortunately resources were not available to do egg mass searching; hence, the possibility of localized defoliation for 2012 is unknown.

Rusty tussock moth: No defoliation was expected in 2011, and none was detected. However, trap catches again increased slightly following an apparent increasing trend since 2008. Nonetheless, these numbers do not suggest any threat of defoliation for 2012

Balsam twig aphid: Populations peaked in 1992 and fell to a low point in 1995 after which they increased for three consecutive years, decreased for two years and rebounded to a new high level in 2001. The following decline halted in 2004 and 2005 followed by three years with higher populations once again, though lower than the previous peaks. Since 2008, populations have declined and in 2011 they approximated the low level of 1995. It remains unclear whether there will be a few years of low populations or whether they will again increase like the period from 1996 to 2001.

Balsam gall midge: In 2010, balsam gall midge was detected on fir branches at 94% of the plots which surpassed the peaks of the last two "outbreaks" (i.e., 61% in 1990 and 71% in 1998) which declined somewhat precipitously after three years. Overall, the survey data indicated that gall midge populations would likely remain high for yet another year. In 2011, there appeared to be only a minor decrease in populations and it is now anticipated that a decline might occur in 2012 if the previous two trends repeat again.

Balsam woolly adelgid: 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 in recent years. Although galling and distorted tops are common, we have yet to encounter any area suffering from stem attack – a condition that is more associated with tree mortality. In the spring of 2003 (and up to 2010), a system to monitor annual changes of balsam woolly adelgid populations was initiated at 12 locations in the southern region of the Province. Tree damage was also rated at these sites over the previous 8 years. Unfortunately none of these activities were conducted in 2011 due to other obligations and priorities.

Brown spruce longhorn beetle: The BSLB 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. Eradication actions, under the leadership of the Canadian Food Inspection Agency (CFIA) under the federal *Plant Protection Act*, were initiated in 2000. As a result of the continued expansion of the infested area in NS, in 2006, the CFIA switched to a 'slow-the-spread' policy with regulated movement of specified high-risk spruce materials along with annual surveys and research.

In 2011, there were 21 positive sites, of which 6 were new, and raised the total to 64 positive sites outside the regulated area since 2007. **Most significantly was the finding of BSLB in New Brunswick for the first time in 2011.** The CFIA had placed traps at 211 sites in New Brunswick including 5 in Kouchibouguac National Park on the east coast of the Province. One of these traps caught a single adult female beetle. It is speculated that this likely originated from firewood brought into the Park by a visitor from (or who had visited) Nova Scotia. Plans for 2012 have yet to be developed though meetings will be held between the CFIA, Parks Canada, NB Department of Natural Resources and industrial partners this winter to examine the implications of surveys and research conducted this past summer. Since 2007, the New Brunswick forest industry has maintained a self-imposed moratorium on regulated spruce materials coming from the Containment Area within Nova Scotia.

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

Pine leaf adelgid: This insect causes damage mainly on white pine, but alternates its life-cycle on red/black spruce. Damage on white pine is most evident in alternating years. In 2005, widespread attack was noted on white pine in central and eastern New Brunswick and follow-up surveys and observations were made up to 2009. In 2010, no damage was observed or reported, but damage was expected be evident on white pine in 2011. Unfortunately, no surveys were done in 2011 due to other obligations and priorities.

Hemlock woolly adelgid: FPMS conducted its first survey for this pest in 30 hemlock stands in 2005 and 52 stands in 2007, but no signs or symptoms of attack were detected. No surveys have been conducted by FPMS since then.

European larch canker: This disease is known to be present throughout south-eastern New Brunswick and has been occasionally surveyed by the CFS in the past. No specific surveys have been done since 2000.

Scleroderris canker of pine: The European race of Scleroderris was once thought to occur at about a dozen sites in New Brunswick, but newer testing methods used by the CFS confirmed only three sites to be positive. These occur in 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 survey was conducted in 2010 or 2011.

Sirococcus shoot blight on red pine: From time to time, isolated stands of red pine with damage and mortality from Sirococcus shoot blight have been identified in New Brunswick. In 2008, two stands – one in north-western New Brunswick and one in south-western New Brunswick – had mortality and damage caused by Sirococcus. In 2010, three small areas of damage were detected in southern NB during the aerial survey. In 2011, observations of symptomatic trees in parts of southern New Brunswick were again reported, but no detailed surveys were conducted.

Needle blight on white pine: In 2009, discoloration on white pine foliage was noticed throughout much of the Province. In 2010, foliage samples were collected and submitted to the CFS Laurentian Forest Research Centre who subsequently advised that they found the fungus *Canavirgella banfieldii* which they think is synonymous as *Lophophacidium dooksii*. No detailed information is available to report on this problem in 2011.

Balsam fir sawfly

Note 1: Survey results and other details about the balsam fir sawfly in New Brunswick were not available at reporting time for the 2010 Forest Pest Management Forum; hence, they are recorded here in some detail.

Note 2: In 2011, a limited aerial biological control program using the viral insecticide Abietiv™ was conducted in New Brunswick for the first time ever. Although some information is provided below, a report on the program's efficacy will be prepared and reported separately.

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. Younger-aged trees are most heavily damaged and this is especially important in stands thinned to enhance their volume. 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 2010, defoliation by balsam fir sawfly was noticed in southern New Brunswick on roadside balsam fir trees over an unexpectedly large area well beyond where it had been seen in 2009. Also, during the aerial survey 530 ha of defoliation were mapped from the air. These observations led to an egg survey throughout an area roughly 115 km x 30 km south of Sussex. At each site, defoliation was also recorded, including some damage by other insects and disease that could not be separated out. When all observations were combined, damage caused by the sawfly was detected over an interpolated total gross area of 278 300 ha (i.e., Trace = 1 300 ha; Light = 230 400 ha; Moderate = 33 200 ha; and Severe = 13 400 ha) (Figure 1). The infested area fell within Crown Timber License 7, managed by J.D. Irving, Limited (JDI), and also included parts of Fundy Model Forest; Fundy National Park; J.D. Irving, Limited freehold land; and small private landowners.

Based on egg survey data in 2010, detectable populations (Figure 2) occurred over a total area of about 181 800 ha (i.e., Trace = 127 000 ha; Low = 25 000 ha; Moderate = 17 200 ha; and High = 12 600 ha), representing an infestation of unprecedented size in New Brunswick.

Three short-term scenarios were considered to assess potential impacts as follows: # 1. Moderate to Severe defoliation ends in 2014; # 2. Moderate to Severe defoliation ends in 2015; and # 3. the infestation intensifies throughout areas with Trace populations and causes Moderate to Severe defoliation up to 2015. The Balsam Fir Sawfly impact model developed in Newfoundland was used to examine possible volume and economic impacts on infested stands on Crown Land within the forecast infested area. These analyses indicated substantial potential reductions as summarized in Table 1. If no action were taken in 2011, further population build-up and intensification of the outbreak was likely and could also jeopardize investment in thinning activities within Government’s Silviculture program.

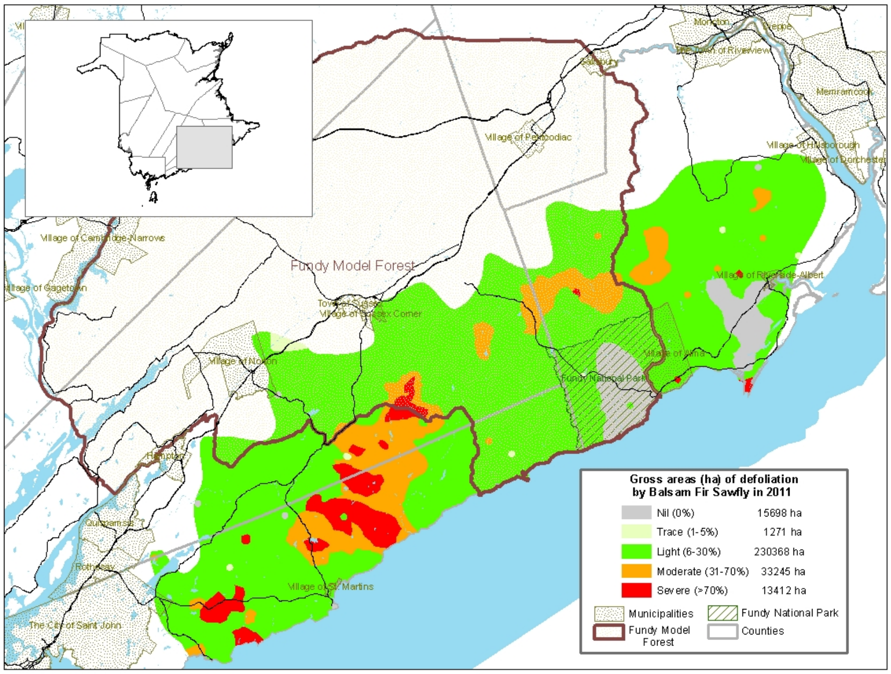


Figure 1. Composite areas within which balsam fir defoliation by balsam fir sawfly was estimated to have occurred in southern New Brunswick in 2010 as determined by interpolated values from ground plot and aerial estimates of defoliation. Some defoliation may have been caused by other pests.

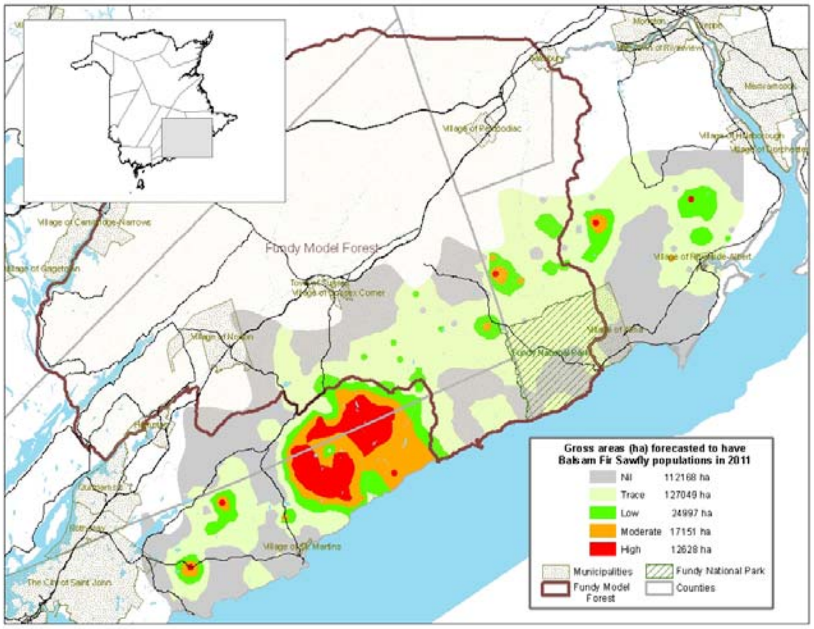


Figure 2. Composite areas within which balsam fir defoliation by balsam fir sawfly is forecast to occur in southern New Brunswick in 2011 based on interpolated values from the 2010 fall egg survey.

Table 1. Summary statistics for three outbreak scenarios estimating potential impacts of a short-term balsam fir sawfly outbreak in New Brunswick.

Impact Category	Scenario # 1	Scenario # 2	Scenario # 3
Avg. yield in natural stands reduced by…	20 m^3/ha (18% reduction)		
Avg. yield in thinned stands reduced by…	20-25 m^3/ha (20-25% reduction)		
Standing Volume reduced by…	134 000 m^3	156 000 m^3	248 000 m^3
Harvest over 25 years reduced by…	103 000 m^3	124 000 m^3	217 000 m^3
Fair Market Value reduced by…	$1.9 million	$2.2 million	$3.9 million

There are no chemical insecticides currently registered for use against this insect and the most-commonly used forestry insecticide *Bacillus thuringiensis* (Bt) does not affect sawfly larvae. There is, however, as noted above a federally-registered biological insecticide (i.e., Abietiv™) based on a balsam fir sawfly virus (*Neab*NPV) that is available and was used in Newfoundland from 2006-2009. This virus naturally occurs in balsam fir sawfly populations, only replicates inside its host, only affects sawfly larvae and does not affect humans, animals or other insects.

After considering various options, Government decided to conduct a limited aerial biological control program using Abietiv™ over an area up to 10 000 ha. This option was taken: (i) to allow the opportunity for the majority of the outbreak to collapse or increase naturally; (ii) to evaluate the product and gather data on desired application rates and biological information not available under local conditions; and (iii) to provide a "bridge" year to deal with governmental procedures and gauge public concerns in the event a larger operational program might be needed in 2012 or beyond.

A detailed report on the program is being prepared for later availability. An apparent collapse in populations, however, in treated areas and control plots may mask the effects of the treatments. After some initial planning and iterations the plan was modified due to field observations of stand types and road accessibility for assessment. The final total area of Crown Land that was treated amounted to 7 282 ha (Table 2; Figure 3). The treatments that were applied consisted of: one 628-ha block treated at 1 Billion PIBs/ha*; one 1601-ha block treated at 2 Billion PIBs/ha; one large 4751-ha block treated at 3 Billion PIBs/ha; and one 302-ha block of thinned stands also treated at 3 Billion PIBs/ha. The final product was applied as a 20% aqueous molasses solution at 2.5 litres/ha. [*PIBs = Polyhedral Inclusion Bodies]. All these areas were located on Crown Land. J.D. Irving, Limited also contracted (separately) to have control applied on some of their freehold land.

Table 2. Summary of areas on Crown Land treated with the virus insecticide Abietiv against balsam fir sawfly in southern New Brunswick in 2011.

Block Number	Area (ha)*	Treatment Rate*
1	628	1 BPIBs/ha
2	1601	2 BPIBs/ha
3	4751	3 BPIBs/ha
4	302	3 BPIBS/ha
Totals	**7 282**	

* BPIBs = Billion Polyhedral Inclusion Bodies

During the summer, while monitoring the control program, it was noticed that a lot of the untreated as well as treated plots were showing signs of disease. Nonetheless, defoliation had become visible in some areas by roadside observations. This, however, was not noticeable from the air. Consequently, a road survey was conducted to provide an appreciation for the severity and extent of damage. Unfortunately these data have yet to be fully analyzed at this time.

Likewise, data from the fall egg survey have yet to be analyzed; although cursory observations indicate a significant decrease in the overall extent and severity of infestation expected for 2012. Control action is not anticipated.

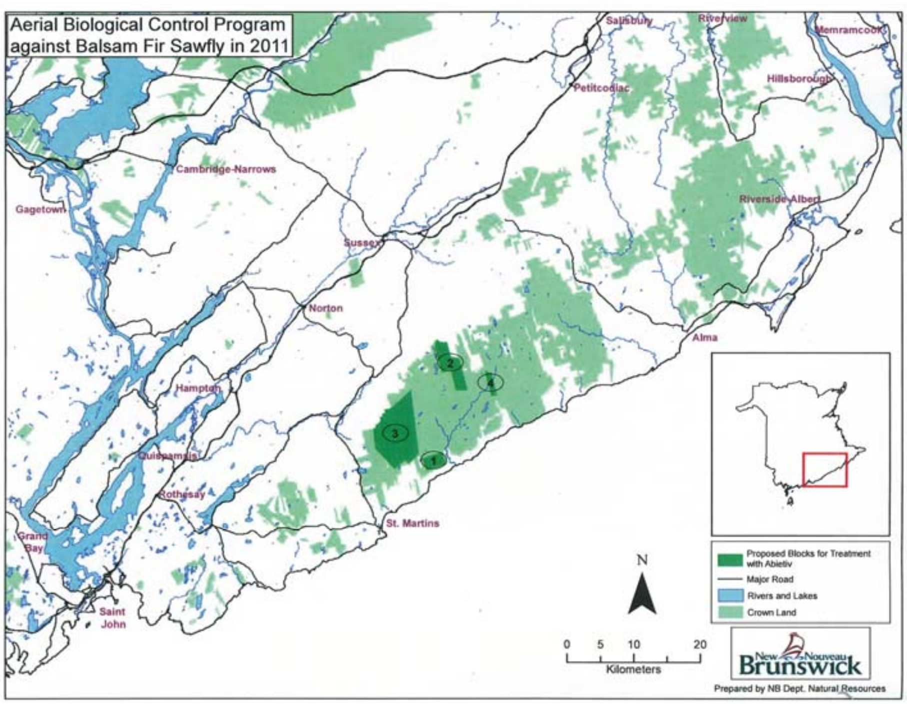


Figure 3. Location of areas on Crown Land treated with the virus insecticide Abietiv against balsam fir sawfly in southern New Brunswick in 2011.

Pests of hardwoods

Gypsy moth: Over-winter survival had been monitored annually from the winter of 2005-06 to the winter of 2009-10; but, resources were not available to conduct the survey in 2010-11. However, pheromone trap catches increased in 2011 throughout southern New Brunswick, but not at levels high enough to expect defoliation in 2012. A number of pheromone trapping sites outside the regulated areas were positive for gypsy moth adults similar to past years. Resources were not available to do egg mass searching at these sites except for Rogersville (in Northumberland County) where a search confirmed the presence of new egg masses for a second consecutive year. The CFIA has yet to indicate how this site will be regarded for regulatory purposes. Egg mass searching at the historic sampling sites within the known infested area showed an overall increase in mean egg-mass density, but also not sufficient to expect defoliation in 2012.

Forest tent caterpillar: In 2011, the total area defoliated by forest tent caterpillar rose to about 7 515 ha in areas around Bathurst. This compares to ~2 000 ha of defoliation mapped in 2010 at a number of sites in north-eastern New Brunswick and south-central New Brunswick.

Large aspen tortrix: 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.

Fall cankerworm: This insect periodically reaches outbreak levels throughout its range in North America. Host trees include elm, oak, ash, and maples as well as many fruit trees and shrubs. No observations were reported in 2011.

Butternut canker: This disease was first confirmed present in New Brunswick by the CFS in 1997, and they eventually confirmed its presence at a total of 18 locations. Since the retirement of the forest pathologist at the CFS-Atlantic Forest Research Centre in 2009, there have been no more reports made of this disease. 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 trees were put on the Endangered List under the Canadian *Species at Risk Act*, partly because of the presence of butternut canker.

Hickory tussock moth: 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.

In 2010, this insect was reported on hardwoods (especially birch) at many locations in south-central New Brunswick. In 2011, numerous enquiries were again received, but this year's reports seemed to be more numerous and extensive in distribution (e.g., Yoho Lake, Kingsclear, Bear Island, Keswick Ridge, Nackawic, Douglas to Mactaquac to Woodstock, Bloomfield north-west of Woodstock, Florenceville and Hartland). Similar increases in prominence were reported in Nova Scotia and Maine.

Assessments in Plantations and Thinnings

Regional DNR staff, designated as Pest Detection Officers (PDOs), conducted pest assessments in a sub-set of high-value plantations and thinned stands on Crown Land in each of DNR's four Administrative Regions, as well as general surveillance of forest pests around the Province. Detailed results are not available at this time, but it appeared that the same pests as in 2010 were primarily detected again in 2011 (e.g., white pine weevil; balsam gall midge; pitch nodule maker and birch leaf miner).

Monitoring in DNR's Seed Orchards and Tree Nursery

Up to 2010, FPMS conducted routine monitoring of pest conditions in DNR's first- and second-generation seed orchards (mostly located in the Fredericton area) and assisted the Provincial Tree Nursery when they had signs or symptoms of biotic or abiotic problems. Due to staff retirement in 2011, FPMS was unable to provide these services.

In 2010, very few cones were produced at any spruce orchard; hence, no cone maggot egg sampling was necessary. No damage by any defoliators was detected. Pheromone surveys for spruce budworm and jack pine budworm had indicated no threat for 2011.

Based on recommendations from 2010 regarding the threat of cone maggot damage, the white spruce orchards at Queensbury and Kingsclear were treated in 2011 to ensure there would be minimal damage to the cone crop by cone maggot.

In 2010, white pine weevil damage was evident in the Norway spruce stand at the Queensbury seed orchard and dead leaders were found on several dozen trees. No observations were reported in 2011.

In 2011, DNR's Kingsclear forest tree nursery again reported a serious problem with Lygus bugs, and having to cope with cutworms and crickets. They also monitored for powdery mildew, botrytis, root diseases, and damping off, as well as mice.

Miscellaneous

Aerial survey: In 2011, a total of 45 hours of flying time were used for the aerial survey. Flying occurred between June 28th and July 17th. Only one technician was available to conduct the survey. Areas of the Province with a high percentage of non-forested area were not flown in 2011. The only damage mapped was 7 515 ha of forest tent caterpillar defoliation in the vicinity of Bathurst and 785 ha of defoliation by large aspen tortrix near Canterbury and Meductic (as noted above).

Ticks and lyme disease: From 1999 to 2010, small numbers of ticks had been submitted by concerned public and processed by FPMS on an annual basis. In 2011, FPMS was unable to provide as much assistance related to ticks and Lyme disease as in the past due to staff retirements. One tick on a human, however, was identified to be sure that it was not a deer tick. In 2010, four black-legged (deer) ticks, identified by FPMS, had been submitted to the Health Canada lab in Winnipeg for confirmation and testing. The first specimen, found in late May (originating from a dog from Chamcook Lake near St. Andrews), tested negative for the Lyme disease bacterium. One submission, consisting of three specimens, was received in late October. These originated from the same general location in southern New Brunswick as the specimen from May (visitors to St. Andrews). Two specimens were found on a dog and one on its owner. These specimens were also reported to be negative for Lyme disease.

SUMMARY OF FOREST PEST CONDITIONS IN NOVA SCOTIA – 2011

Gina Penny

Nova Scotia Department of Natural Resources

The spruce budworm (*Choristoneura fumiferana*) has caused more damage to Nova Scotian softwood forests than any other insect. Defoliation was last detected in 1994 when the last outbreak subsided. Since that time spruce budworm population levels have decreased dramatically, with low moth catches being recorded throughout the province. In 2011, Forest Health staff monitored 150 traps province wide. Of these traps 35% were positive, down from 57% recorded in 2010 which was the highest percentage we've seen since 1994. Since 1997, with the exception of 2010, the average number of moths caught has consistently remained below one moth per trap; in 2011 the average moth catch rose to one moth per trap. No overwintering larvae (L2's) were detected during our 2011 branch survey and none have been found since 1994.

Defoliation of mature white pine by Jack pine budworm (*Choristoneura pinus pinus*) was first detected in the Western Region in 2005. 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%. This year, the percentage of positive traps rose to 48%. The average number of moths per trap has increased almost three fold from 2010 but at 1.3 moths per trap it's still well below the high of eight recorded in 2006. No overwintering larvae were detected during our branch surveys.

Eastern blackheaded budworm (*Acleris variana*) eggs were detected at 83.9% of the sites surveyed in the Eastern Region in 2011. This is a slight increase from 74.1% in 2010. Egg numbers still remain low but have increased three fold from the maximum of five found in 2010 to 15.3 in 2011.

Recorded outbreaks of the balsam fir sawfly (*Neodiprion abietis*) in Nova Scotia date back to 1942. Defoliation last occurred in 1995 and 1997. Our overwintering egg survey for 2011 included 123 sites; 59% of which were positive, up from 51% in 2010 and the highest percentage we've seen since 1998.

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. Percent positive traps increased slightly from 93.9% in 2010 to 94.9% in 2011 while the mean trap catch increased from 19.8 to 70.6. Follow up egg surveys are conducted around pheromone traps with the highest moth catches. Branch samples were taken at 46 sites in the Eastern Region. Eggs were detected at 28.3% of the sites sampled, up from 10% in 2010 and 0% in 2009.

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 2011 with 343 sites sampled province wide. The percentage of sites where egg masses were detected has risen slightly from 7.8% in 2010 to 10.8% in 2011.

Spruce beetle (*Dendroctonus rufipennis*) activity in Nova Scotia has been both chronic and widespread. We're seeing mortality of mature and over-mature white and red spruce province wide. Along with our aerial survey 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. When plots were surveyed 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 4 fold and red spruce by half. This can be attributed to the fact that many of the trees previously marked as dead were this year recorded as either missing or not found due to factors such as blow down. These plots are reaching the end of their lives and usefulness.

The brown spruce longhorn beetle (*Tetropium fuscum*), native to north and central Europe, arrived in Halifax in the 1990's. As part of a joint effort the Nova Scotia Department of Natural Resources works with the Canadian Food Inspection Agency and Canadian Forest Service to monitor the spread of the beetle within the province. In 2011, the detection survey for the brown spruce longhorn beetle continued to include extensive trapping throughout Atlantic Canada. This year's survey resulted in 20 positive sites outside the beetle containment area. Of these positive sites, five are new for Nova Scotia in the counties of

Halifax, Hants, and Luneburg. Also, there was a positive find in New Brunswick located near a campground in Kouchibouguac National Park. This is the first time the beetle has been detected outside the province of Nova Scotia. These six new finds brings the the total number of positive sites outside of the beetle containment area to 65. Additional pheromone traps were also deployed throughout Atlantic Canada in Prince Edward Island, New Brunswick and Newfoundland and Labrador. All, with the exception of the one positive in New Brunswick, were negative for brown spruce longhorn beetle.

Damage due to balsam woolly adelgid (*Adelges piceae*) can be found throughout the province. In the fall of 2009 Forest Health established 14 permanent monitoring plots. 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. In the spring of 2011 overwintering was monitored at 11 of the 14 plots. The population had increased at 1 plot, decreased at 3 and no change was found at the remaining 7 plots. Mortality of overwintering nymphs occurs below -20^{o}C. So the recorded decreases weren't unexpected due to the cold winter temperatures measured at the plots during 2010-2011.

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 and balsam gall midge damage. In 2011, of the 123 sites surveyed, there were no sites with balsam twig aphid affected shoots and only one site that had balsam gall midge affected shoots.

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.

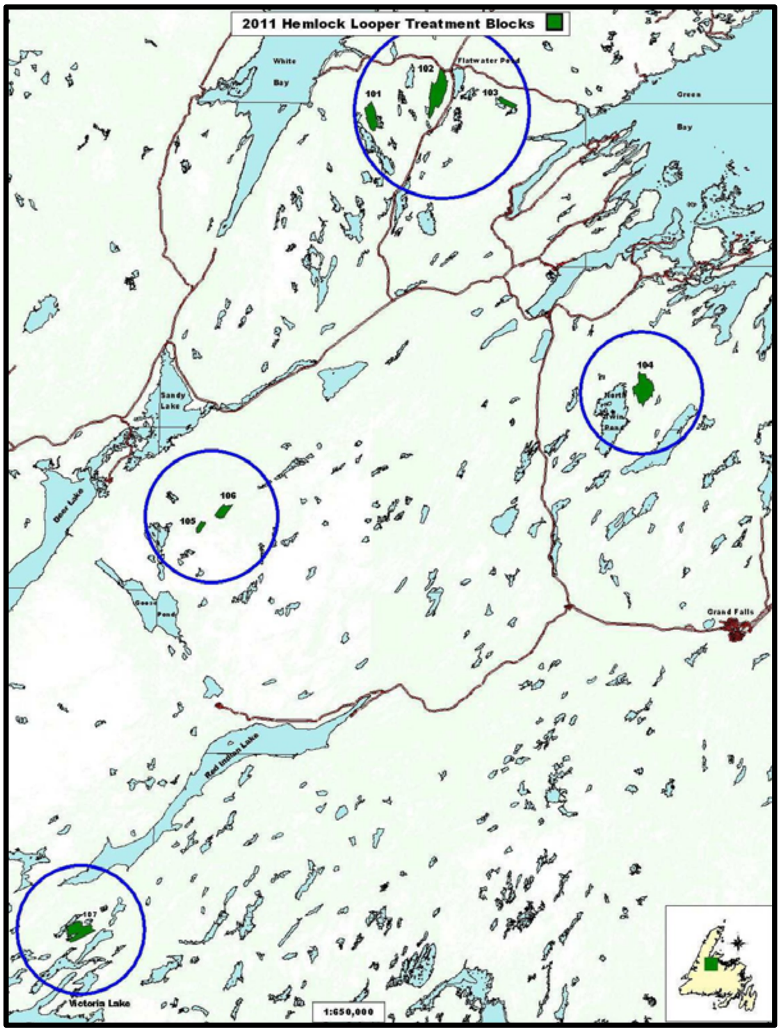
Multipher traps are deployed at designated sites province wide to monitor population trends. In 2011, 19 traps were placed; 68% of these traps were positive up from 58% the year before. The total number of moths caught has remained fairly stable, with 3188 moths caught up from 3093 recorded in 2010. Based on our 2011 survey results trap catches remained fairly stable with changes detected in two counties within the CFIA regulated zone: an increase in Digby County and a decrease in Annapolis County. Delta traps are also placed in towns outside the regulated zone to determine if the population is spreading into new areas where it wasn't previously detected. Based on these trap results the only town that continues to show any population levels is New Glasgow in Pictou County. However, since 2009 the average moth catch per trap has been on the decline. In 2011, this trend has held true with an average moth catch of nine down from 14 moths per trap in 2010.

NEWFOUNDLAND AND LABRADOR REPORT

Dan Lavigne

Newfoundland and Labrador Department of Natural Resources

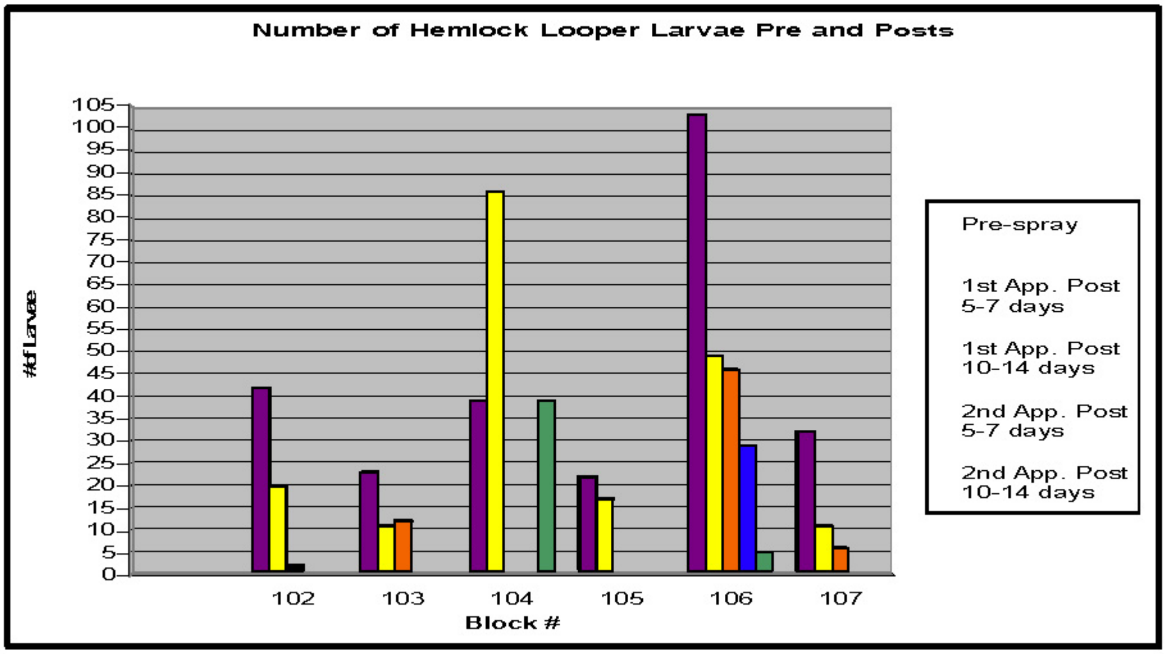
Forest insect and disease control activities – 2011



A decline in eastern hemlock looper (HL) populations was apparent from the 2010 fall forecast (egg) survey. Despite this decline small areas forecast to have moderate defoliation were identified. These were subsequently blocked for aerial control. A total of seven blocks representing 4277 ha of susceptible forest were scheduled for treatment. Surveys to monitor insect development and pre and post-spray populations were conducted to time treatments and assess efficacy.

Cooler than normal temperatures resulted in slower HL development with blocks not opened for treatment until July 18 to 27. Low pre-spray counts in one block resulted in only six of the seven blocks being treated. Four and half blocks (2948 ha) were treated with one application of B.t.k. (Foray 76B) at 2 litres/ha using an M-18 Dromader aircraft equipped with Micronair AU5000 atomizers. One and half blocks (785 ha) received two applications of B.t.k. at the same rate.

Reductions in populations were achieved in all treatment blocks and current defoliation was limited to less than ten percent.

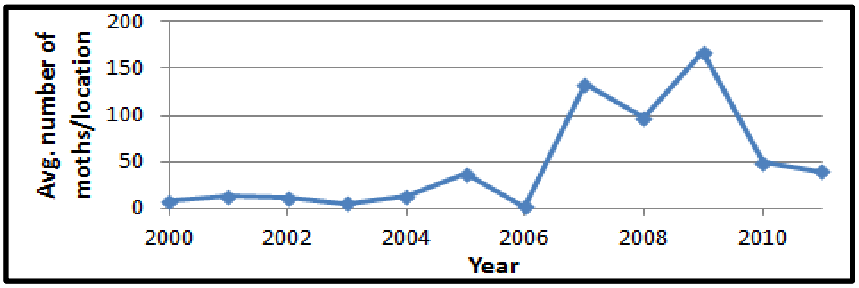


Forest insect and disease monitoring activities – 2011

Eastern hemlock looper: A small network of 50 pheromone trapping locations (one trap per location) was established on the island in 2011 (baseline year) to help in the monitoring of declining HL populations. All the traps retrieved were positive with two or more moths. Trap catches, however, were predominantly low with a range of 2 to 358 moths per trap and a mean of 60 moths per trap. Regional Department of Natural Resources (DNR) staff and industrial cooperators were asked to report any unusual HL moth activity such as large numbers of moths around street lights, businesses, and harvesting equipment etc. – no reports were received. In addition, the aerial overview survey conducted on the island and in Labrador found no visible signs of HL defoliation from the air. The low trap catches, absence of defoliation, and limited moth activity suggested a continued decline in HL populations.

Given this anticipated decline, the sampling intensity for the fall egg survey was reduced. Forecast results have confirmed a continued decline in populations with 871 locations having no eggs, 91 locations having low counts (total 1-9 eggs), 2 having moderate counts (total 10-29 eggs), and no locations with severe counts (total > 29 eggs). The two locations with a moderate forecast were also on the low end of the moderate range. Little to no damage is expected from HL on the island and in Labrador in 2012.

Eastern spruce budworm: A small network of 49 pheromone trapping locations (two traps per location) was established on the island beginning in 2000 to help monitor low density populations of this insect.



Despite a general increase in the average number of moths/location in 2007 and 2009, moth catches have declined the last two years. Despite this general decline, a number of locations had high trap catches – i.e. Sally's Cove, total of 740 moths; Zinc Mine Road, 386 moths; Botwood Highway, 311 moths. As part of the fall forecast, sampling was conducted to look at the number of egg masses found around these locations. The Botwood Highway was the only location were egg masses were found (2 egg masses, light defoliation forecast).

Unlike on the island, localized populations of eastern spruce budworm (SBW) have been active in Labrador for the past 4-5 years. Observations from the air and on the ground in 2011 indicated that populations have dramatically decreased in most areas. Other than in a few areas the 2011 damage observed was minimal with trees previously damaged showing signs of recovery and producing new foliage. Noted exceptions included an area on the south shore of Lake Melville in the vicinity of the English River. Here SBW numbers were quite high and defoliation was readily evident. Another area with moderate defoliation was also detected near Sheshatshiu. A total of 7000 ha of moderate and 13000 ha of severe defoliation were detected from the air in 2011. In addition to the areas detected with current defoliation, damage and mortality that occurred in previous years was still very much evident in the Travespine River area. Preliminary results from sampling conducted in Labrador as part of the fall forecast indicate that SBW populations will remain active with 19 locations forecast to have light damage, 2 locations forecast to have moderate damage (south shore of Lake Melville near the English River; 16 km southeast of Goose Bay (Mud Lake)) and one location forecast to have severe damage (8 km east of Goose Bay).

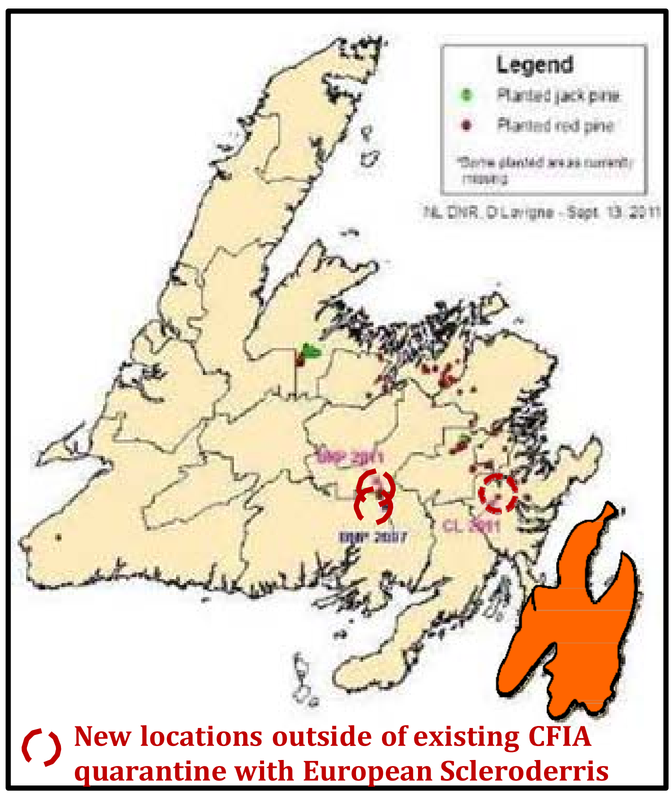
Balsam fir sawfly: Following the balsam fir sawfly (BFS) outbreak that occurred in western Newfoundland from 1991 to 2009, populations have remained low with small localized pockets of BFS still evident in west-central portions of the island. In addition to these areas, in 2011 DNR Regional/District staff reported damage from this pest on the Connaigre Peninsula, an area on the south shore of the island. Approximately 14000 ha of moderate to severe damage in non-productive (scrub) balsam fir stands were mapped from the air. Fall forecast survey results indicate that BFS populations will remain moderate to high in the

Connaigre Peninsula area in 2012. In west-central Newfoundland localized BFS populations will again be active with 7 locations forecast to have light damage and one location forecast to have severe damage.

Other insect & disease pests: Additional insect & disease pests were detected through other monitoring activities or through information provided by other cooperators. They include the following.

Spruce beetle: Aerial surveys on the island and in Labrador continue to detect areas with spruce beetle damage. Damage observed included red trees (i.e. those recently killed), and older mortality. Although there were very few new areas detected, within the areas previously detected there appeared to be more old mortality (i.e. grey trees and fallen timber) and fewer red trees. Damaged trees were observed in the Humber Valley on the island and in the Grand Lake road and Mud Lake/Kenemu River areas in Labrador. In Labrador the bulk of the spruce beetle damage appears to be found in non-commercial or scrub stands with poor sites.

Scleroderris (EU) canker: Damaged trees in red pine plantations in the Berry Hill Pond and Clarenville areas were also detected while conducting aerial surveys. Dead trees and discoloured foliage were observed in these areas. Follow-up ground sampling and lab examination of samples by Dr. Gary Warren of the Canadian Forest Service and staff of the Canadian Food Inspection Agency (CFIA) have confirmed the presence of the European strain of this disease in the above plantations and in a jack pine plantation ca. 10 km south of Berry Hill Pond on the west side of the Bay d'Espoir highway. All three



New locations outside of existing CFIA quarantine with European Scleroderris sites are outside of the area (Avalon Peninsula) currently regulated by the CFIA for this invasive disease of hard pines. This disease is not only a threat to planted red pine ($3.2 million investment) and other planted pine species, but it also poses a threat to the indigenous pine (ecological significance) found on the island.

In accordance with quarantine regulations under the federal *Plant Protection Act*, a 1 km buffer with a prohibition of movement is being established by the CFIA. Additional monitoring, eradication, a re-evaluation of the regulated commodities, and the use of other silvicultural prescriptions for management of red pine are being considered.

Red band needle blight: Damage from red band needle blight was also detected in the plantations with Scleroderris (EU) canker. It can be an economically important disease of conifers with defoliation causing premature needle loss and reductions in yield. In cases where severe defoliation occurs over a number of consecutive years it may also cause tree death, but it is not known to be a tree killer like Scleroderris (EU) canker.

European pine shoot moth: This insect continues to be a common pest found on planted red pine on the island.

Hairy poplar sawfly: Reports of localized damage by this pest were reported by the public and confirmed by DNR (Insect & Disease Control: Region/District) staff in the St. Anthony area. Large numbers of sawfly were evident and balsam poplar trees were severely defoliated.

Spruce needle rust: DNR Regional/District staff reported heavy needle rust infection on spruce in the Grand Lake Road area. Reports of heavy needle rust infection in and around Labrador City were also received. The fruiting structures, yellowish-orange spores, and discolored needles associated with this disease give the trees a distinctive off-colour appearance. This discoloration was quite evident on trees on hillsides even at a distance. In addition, the large number of spores present in these areas caused an orange-red residue to be found along the shorelines of water bodies. This would be similar to the yellow film often observed in the water and along shorelines in heavy pollen years. Although needle rust infection can be very high in some years, the rate of infection is usually not high enough in consecutive years to pose a significant threat to the trees.

Grasshoppers: Moderate to severe damage on young spruce by grasshoppers was reported by DNR Regional/District staff in a plantation in Labrador. Damage by grasshoppers to seedlings of planted jack pine and red pine were also observed and reported in Manitoba in the 1970's.

Pests found in high-value areas (plantations and thinnings): Given the significant Provincial investment being made in silviculture, a directed survey in high-value areas was initiated in 2011. A total of 97 balsam fir thinnings and 35 plantations were assessed. Preliminary analyses indicate the most prevalent damage occurring on trees in these areas was moose browse and twig attack from balsam woolly adelgid.

SESSION IX: BIOLOGICAL FOREST PEST CONTROL AND APPLICATION TECHNOLOGIES

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

SÉANCE IX : LUTTE BIOLOGIQUE CONTRE LES RAVAGEURS FORESTIERS ET TECHNOLOGIES D'APPLICATION

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

INTEGRATED RESEARCH AND DEVELOPMENT OF BIOLOGICAL FOREST PEST CONTROL PRODUCTS AND APPLICATION TECHNOLOGIES

***Peter Amirault*[1] *and Stefan Richard*[2]**

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[2]*Sylvar Technologies Inc.*

ABSTRACT

Forest Protection Limited (FPL) was the lead proponent of an integrated research submission funded by the Atlantic Innovation Fund. The award was granted to FPL and its partners (Ag-Nav, BioAtlantech, CFS, NBDNR, Sylvar Technologies Inc., and UNB) in 2006. It was a five-year project and has been recently completed.

The overall goal of the project was to launch an innovative system to identify, assess, and develop baculoviruses as alternatives to more traditional pesticides (Baculovirus Technology Component) while improving technologies used to deliver biopesticides via aerial application (Aerial Application Technology Component).

Major achievements have been the equivalency demonstrated between several Nucleopolyhedroviruses, baculovirus waivers are being developed, and the establishment of a pilot-scale Gypchek production facility. On the aerial application technology side there is now a world-class Wind Tunnel along with International testing standards and an Aerial Management System available to end users. In addition PROPS has been expanded to include forest values, forest protection costs, and a software tool for optimal protection blocking.

RÉSUMÉ

La société Forest Protection Limited (FPL) était le principal promoteur d'un projet de recherche intégrée financé par le Fonds d'innovation de l'Atlantique. La subvention a été accordée en 2006 à FPL et à ses partenaires (Ag-Nav, BioAtlantech, le SCF, le MRNNB, Sylvar Technologies Inc. et l'UNB). Ce projet de 5 ans vient de se terminer.

Le projet comportait un volet « Technologie des baculovirus », qui visait à lancer un système innovateur permettant de repérer, évaluer et mettre au point des baculovirus comme solutions de rechange aux pesticides classiques, et un volet « Technologie d'application aérienne », qui visait à améliorer les techniques servant à l'application des biopesticides par voie aérienne.

À titre de grandes réalisations, le projet a permis de démontrer l'équivalence de plusieurs nucléopolyhédrovirus, de préparer les demandes d'exemption requises et d'établir une usine pilote pour la production expérimentale du Gypchek. Dans le cadre de son volet « Technologie d'application aérienne », le projet a permis d'aménager un tunnel aérodynamique conforme aux normes internationales et de mettre à la disposition des utilisateurs un système de gestion aérienne. Le système PROPS a été élargi de manière à inclure les diverses valeurs des forêts, les coûts de protection des forêts ainsi qu'un outil logiciel permettant d'optimiser les blocs de protection.

SESSION X: ECOSYSTEM RESILIENCE

Chair: *Judi Beck*
Natural Resources Canada, Canadian Forest Service

SÉANCE X : RÉSILIENCE DES ÉCOSYSTÈMES

Présidente : *Judi Beck*
Ressources naturelles Canada, Service canadien des forêts

PUTTING FOREST DISEASES ON THE MAP

Rona Sturrock

Natural Resources Canada, Canadian Forest Service

ABSTRACT

Diseases are amongst the most important disturbances affecting the forests of North America but there is little well-organized information on their overall occurrence, distribution and impact. In Canada, a national historical database – the FIDS (Forest Insect and Disease Survey) INFOBASE – and ArcGIS, are currently being used to create baseline distribution maps for several native and naturalized forest pathogens. The intention is to, where possible and pertinent in the future, add data to these baseline maps from other sources including provincial surveys/projects, the scientific literature, and different databases (e.g., Natural Disturbance Database). Such disease maps can be used to inform forest modeling, risk analyses and other efforts addressing issues such as climate change and carbon dynamics. Two related initiatives currently under refinement in the USA under the auspices of the USDA Forest Service and of potential interest to Forum participants are: 1) the third iteration of a National Insect and Disease Risk Map (NIDRM), expected in 2012, and 2) the imminent release of the revamped North American Forest Commission Exotic Forest Pest Information System Database (NAFC EXFOR), which now has a more user friendly format and the capability to manipulate several environmental variables and view resulting changes in potential distributions of exotic pests. All of these initiatives will help manage forest health into the future.

RÉSUMÉ

Les maladies sont parmi les plus graves perturbations à toucher les forêts d'Amérique du Nord. Pourtant, il existe peu d'information bien structurée sur leur présence générale, leur répartition et leur impact. Au Canada, on fait actuellement appel à une base de données historiques nationale – l'Infobase du RIMA (Relevé des insectes et des maladies des arbres) – ainsi qu'au logiciel ArcGIS pour dresser des cartes de répartition de base pour plusieurs pathogènes forestiers indigènes et naturalisés. Dans la mesure où cela est possible et pertinent, on pourra ajouter à ces cartes les données provenant d'autres sources, qu'il s'agisse de relevés ou projets provinciaux, d'articles scientifiques ou d'autres bases de données (base de données sur les perturbations naturelles, etc.). Ces cartes de répartition des maladies pourront servir à la modélisation des forêts, à l'analyse des risques et à divers travaux sur des questions telles que le changement climatique et la dynamique du carbone. Deux projets connexes actuellement en cours de perfectionnement aux États-Unis, sous la gouverne du USDA Forest Service, pourraient intéresser les

participants du Forum : 1) la troisième mouture de la *National Insect and Disease Risk Map* (NIDRM), qui devrait être publiée en 2012; et 2) la version améliorée de la base de données *North American Forest Commission Exotic Forest Pest Information System Database* (NAFC EXFOR), bientôt disponible, qui sera plus facile à utiliser et permettra de manipuler plusieurs variables environnementales et de visionner les résultats sous forme de répartition potentielle des organismes nuisibles exotiques. Tous ces projets aideront à aménager des forêts saines pour l'avenir.

MOUNTAIN PINE BEETLE: A SERIOUS THREAT TO SASKATCHEWAN

Rory McIntosh

Saskatchewan Ministry of Environment, Forest Service Branch

NOT AVAILABLE

YELLOW CEDAR DECLINE

Stefan Zeglen

British Columbia Ministry of Forests and Range

NOT AVAILABLE

BROWN SPRUCE LONGHORN BEETLE IN THE ATLANTIC PROVINCES

Ron Neville

Canadian Food Inspection Agency

NOT AVAILABLE

RISK ASSESSMENT FOR WHITE PINE BLISTER RUST IN QUEBEC: RECENT DEVELOPMENTS

Michel Huot[1] ***and Guillaume Cyr***[2]

[1]*Ministère des Ressources naturelles et de la Faune, Direction de l'aménagement et de l'environnement forestiers*

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ABSTRACT

Blister rust has caused survival problems in several eastern white pine plantations in the past, so planting this species became less popular. Research has been conducted by Canadian Forest Service (Québec region) and a provincial map showing vulnerability zones has been first developed in 1974, and upgraded in 1986. Since then, foresters relied on vulnerability for choosing better sites for establishing plantations. Recent efforts aimed at developing pine management zoning, and developing the first provincial silviculture guide have prompted a literature review of blister rust prevalence factors. New blister rust risk classes have been mapped, based on physical attributes of each forest polygon including an index of topographical exposure (topex index). Data collected over the years since 1984, by the Forest Protection Branch, is being statistically analyzed, and used to validate the recent risk assessment. We also plan to use climatic data (via BioSim) as explanatory variables. Ultimately, zones having a lower risk will be prioritized for regeneration efforts.

RÉSUMÉ

La rouille vésiculeuse du pin blanc cause d'importants dommages et une mortalité élevée dans plusieurs plantations de pin blancs. Le reboisement de cette essence est vite devenu impopulaire. Des recherches ont été effectuées par le Service canadien des forêts (région du Québec) lesquelles ont débouchées sur une carte de vulnérabilité en 1974, et qui a été améliorée en 1986. Depuis ce temps, le personnel forestier s'est basé sur ce zonage afin de choisir les meilleurs sites pour le reboisement. Des efforts récents pour mieux définir les zones d'aménagement du pin blanc, et pour développer le premier guide sylvicole provincial ont amené à revoir la littérature au sujet des facteurs d'infection des pins. De nouvelles classes de risque ont été cartographiées en nous basant sur les caractéristiques physiques de chacun des polygones forestiers et sur un indice d'exposition topographique (indice topex). Les données de rouille recueillies depuis 1984 par la Direction de la protection des forêts du MRNF, sont actuellement analysées pour permettre de valider la récente cartographie et éventuellement la bonifier en considérant d'autres variables explicatives notamment des données climatiques (via BioSim). Les zones ayant un risque plus faible seront enfin retenues pour les efforts de régénération.

SESSION XI: DETECTION TOOLS

Chair: ***Ron Hall***
Natural Resources Canada, Canadian Forest Service

SÉANCE XI : OUTILS DE DÉTECTION

Président : ***Ron Hall***
Ressources naturelles Canada, Service canadien des forêts

Comparing visual and molecular detection of tree pathogens, a case study with white pine blister rust (WPBR) in a nursery

Philippe Tanguay

Natural Resources Canada, Canadian Forest Service

Abstract

Visual detection of tree diseases relies on the presence of disease-specific signs and symptoms. Absence of these signs and symptoms does not guarantee the absence of deleterious pathogen infection in a tree. In the case of WPBR, it takes at least 2 years following needle infection to visually detect infection in a tree. In fall 2010, phytosanitary inspection by the MRNF identified 4% of 4-year-old white pine seedlings with WPBR symptoms on four lots totalling 170 000 seedlings at the Saint-Modeste MRNF forest nursery. In spring 2011, 100 seedlings were sampled in the same lots and brought to the laboratory for molecular detection of *Cronartium ribicola*. DNA was extracted from 2 and 3 yrs old stem sections and *C. ribicola*-specific primers were used in a PCR-based detection assay. The results showed that 33% of the white pine seedlings were infected with the WPBR pathogen. Results of visual and molecular detection, along with the actions that were undertaken, will be discussed during this conference.

Résumé

En pathologie forestière, le diagnostic classique repose sur la présence d'un ensemble de signes et symptômes caractéristiques d'une maladie. L'absence de ces signes et symptômes n'est toutefois pas totalement garantie de l'absence de maladie. Chez la RVPB, il faut compter au moins deux ans suivant l'infection des aiguilles, pour visuellement détecter la maladie. À l'automne 2010, l'inspection phytosanitaire par le MRNF a montré qu'à la pépinière de Saint-Modeste, 4 % des semis de pin blanc de 4 ans, sur 4 lots totalisant 170 000 semis, étaient infectés par la RVPB. Au printemps 2011, 100 semis ont été échantillonnés de ces mêmes lots et rapportés au laboratoire afin de déceler la présence de l'agent pathogène *Cronartium ribicola* par détection moléculaire. Un test PCR, utilisant des amorces spécifiques au *C. ribicola*, a été réalisé sur l'ADN extrait des segments de tige âgés de 2 et 3 ans. Les analyses ont montré que 33 % des semis étaient infectés par la RVPB. Les résultats obtenus avec les méthodes de détection visuelle et moléculaire ainsi que les actions prises depuis seront discutés lors de cette conférence.

REMOTE SENSING FOR INSECT DEFOLIATION: ADVANCES AND CHALLENGES

Ron Hall[1], ***S.J. Thomas***[2], ***R.S. Skakun***[1], ***M. Filiatrault***[1], ***E. Arsenault***[1], ***R. Landry***[2], ***L.E. White***[2]

[1]*Natural Resources Canada, Canadian Forest Service*
[2]*Natural Resources Canada, Canada Centre for Remote Sensing*

EXTENDED ABSTRACT

An overview on the application of remote sensing technology was presented at a Theme Session on advances in forest pest detection and monitoring. Insect defoliation and drought-related dieback are important natural disturbance agents on Canada's forests, and their affects are anticipated to increase under the pressures of a changing climate (Volney and Fleming 2000; Dale et al. 2001; Allen et al. 2010). While provincial and territorial aerial and field surveys are the primary methods by which insect disturbances are currently assessed (Hodge and Westfall 2009), there is limited understanding of the spatial and temporal characteristics of insect outbreaks (Hicke et al. 2012) and dieback (Michaelian et al. 2011). By integrating provincial and territorial aerial surveys with multi-scale, remotely sensed change information, improved detection and monitoring data would be generated that could support Canada's National Forest Carbon Monitoring, Accounting and Reporting System (Kurz and Apps 2006) and update the National Forest Inventory (Gillis et al. 2005). These two programs provide a federal government rationale for building from, and integrating with, existing pest monitoring programs toward an annual, national dataset that could contribute to its reporting mandate on the status and health of Canada's forests.

What are the challenges and advances that have been made toward the use of remote sensing as a technological tool to complement existing survey methods? Addressing this question requires the integration of knowledge about the forest pest, host, and remotely sensed image that results in a framework from which challenges and advances can be discussed.

It has long been known that insect defoliation affects the morphological and physiological characteristics of trees (Murtha 1982). Morphological damage varies by insect pest and ranges from leaf loss to foliage color change. The timing and visibility of these damage patterns varies by defoliator and host species. Physiological effects resulting from loss of photosynthetic material will influence host productivity, cause predisposition to secondary mortality factors such as insects and disease, and may result in morphological indicators such as branch and partial tree mortality. For aspen defoliation, the loss of foliage when the

manifestation of damage is most visible occurs near the culmination of larval feeding but before refoliation, and this timing determines when remote sensing images should be obtained (Hall et al. 2006). Spruce budworm damage is characterized by current defoliation, which manifests itself by reddish foliage during larval feeding on current year shoots, and cumulative defoliation, which represents the cumulative loss of foliage over several consecutive years. Understanding the differences in feeding behaviour among insect species and the damage they cause is essential for detection and monitoring. The challenges of monitoring defoliation from different insect species include understanding their manifestation of damage, recognizing the influence of stand composition on defoliator damage, and capturing their activity across a geographic distribution that could cover much of Canada.

Insect defoliators tend to be host specific although some may defoliate more than one host. For example, while the forest tent caterpillar's primary host is trembling aspen, in part due to its wide geographic range, it will feed on several broadleaved tree species particularly when populations are high (Ives and Wong 1988). The eastern spruce budworm will feed on balsam fir, white spruce and black spruce although there are reported differences in levels of defoliation that are partially attributable to species differences (Nealis and Régnière 2004). Understanding these feeding preferences relative to host species and stand type is paramount when defining the relationship between defoliation patterns and the remote sensing signal. Consequently, models between percent defoliation and changes in remote sensing spectral response have been developed separately in recognition of differences attributable to stand composition.

To ensure defoliation can be mapped consistently from remotely sensed images, research has focused on many pre-processing procedures entailing geometric, radiometric, and topographic corrections, along with normalization of images between pre- and post-defoliation image dates. These procedures help support the development of an image severity model for a geographic area that can be subsequently applied to another location. A common misconception is that remote sensing is a detection tool capable of determining the casual agent. While a spectral response change that could be the result of defoliation may be detected, the casual agent can be difficult to identify. Information such as the previous year's aerial survey, knowledge of host species, and timing and manifestation of damage will provide indicators as to the likely pest species.

A difficult challenge has been to relate field or aerial estimates of defoliation severity to remotely sensed data when the ratings are based on broad categories of light, moderate, and severe. This difficulty arises from defining a remote sensing spectral basis to broad class limits of defoliation severity. Using field estimates that are as precise as possible is necessary for the development of image models for detection, monitoring, and mapping of defoliation severity (Hall et al. 2006). There are many remote sensing issues pertaining to satellite acquisition and sensor characteristics, analysis method, and cost that govern how and which remote sensing satellites are most conducive for defoliation mapping. While programming certain satellite sensors increases the likelihood of acquiring an image, it comes at a cost compared to sensors such as Landsat that now operate under a free data policy. Within an operational and national monitoring context and under an environment of increasing fiscal constraint, future sensors operating with a cost-free or cost-reduced data policy will heavily influence the sensor selection for annual monitoring of pest defoliation.

In summary, a number of challenges exist across the spectrum of forest pest, host, and remote sensing perspectives. Research has addressed many of these challenges to varying degrees. The presentation was organized to identify these challenges, highlight research advances, and present a framework for a national monitoring system contingent upon integrating aerial survey and remote sensing data products as a potential approach for annual detection and monitoring of insect defoliation.

RÉSUMÉ DÉTAILLÉ

Un aperçu de l'application de la télédétection a été présenté lors de la séance thématique sur les progrès de la détection et de la surveillance des ravageurs forestiers. La défoliation par les insectes et le dépérissement terminal causé par la sécheresse constituent d'importants agents de perturbation naturelle dans les forêts canadiennes et leurs effets vont sans doute s'accroître en raison des changements climatiques (Volney et Fleming, 2000; Dale et coll., 2001; Allen et coll., 2010). À l'heure actuelle, on a surtout recours à des levés aériens et des levés de terrain menés à l'échelle provinciale et territoriale pour évaluer les perturbations causées par les insectes (Hodge et Westfall, 2009), et on ne connaît pas entièrement les caractéristiques spatiales et temporelles des infestations d'insectes (Hicke et coll., 2012) et du dépérissement terminal (Michaelian et coll., 2011). En intégrant des levés aériens provinciaux et territoriaux à des données de télédétection multiéchelles sur les changements, on pourrait obtenir de meilleures données de détection et de surveillance pour appuyer le Système national de surveillance, de comptabilisation et de production de rapports concernant le carbone des forêts (SNSCPRCF) du Canada (Kurz et Apps, 2006) et mettre à jour l'Inventaire forestier national (Gillis et coll., 2005). Ces deux programmes procurent au gouvernement canadien une motivation pour tabler sur les programmes actuels de surveillance des ravageurs et les intégrer pour en faire un ensemble national de données annuelles qui l'aidera à faire rapport de l'état et de la santé des forêts du Canada, comme il en a la mission.

Quels sont les progrès accomplis dans l'utilisation de la télédétection comme outil technologique pour compléter les méthodes de levé actuelles et quelles sont les difficultés à surmonter? Pour répondre à cette question, il faut intégrer nos connaissances au sujet des ravageurs forestiers, de leurs hôtes et des images de télédétection de manière à délimiter le cadre qui nous permettra d'aborder les difficultés à surmonter et les progrès accomplis.

On sait depuis longtemps que la défoliation par les insectes se répercute sur les caractéristiques morphologiques et physiologiques des arbres (Murtha, 1982). Selon le ravageur, les dommages morphologiques vont de la perte des feuilles au changement de coloration du feuillage. Le moment où surviennent les dommages et leur visibilité varient selon l'insecte et l'espèce hôte. Les effets physiologiques qui résultent de la perte de matière photosynthétique jouent sur la productivité de l'hôte, entraînent une vulnérabilité à des facteurs de mortalité secondaires comme les insectes et la maladie et peuvent donner lieu à l'apparition d'indicateurs morphologiques comme la mortalité des branches ou d'une partie de l'arbre. Dans le cas du peuplier faux-tremble, la perte de feuillage la plus manifeste est observée vers le moment où l'activité des larves culmine, mais avant la refoliation, et c'est le moment où les images de télédétection devraient être obtenues (Hall et coll., 2006). Les dommages causés par la tordeuse des bourgeons de l'épinette se caractérisent par une défoliation durant l'année courante, qui se manifeste par un feuillage rougeâtre au moment où les larves s'alimentent sur les pousses de l'année, et par une défoliation cumulative, c'est-à-dire la perte cumulative de feuillage sur plusieurs années consécutives. Pour parvenir à détecter et à surveiller les insectes ravageurs, il est essentiel de comprendre les différences dans le comportement alimentaire de leurs différentes espèces et les dommages que ces espèces causent. Plusieurs difficultés se présentent lorsqu'on surveille la défoliation causée par plusieurs espèces d'insectes; il faut notamment comprendre la façon dont les dommages se manifestent, connaître le rôle de la composition du peuplement sur les dommages causés, et consigner l'activité des ravageurs sur une aire géographique qui pourrait couvrir une grande partie Canada.

Les insectes ravageurs sont généralement spécifiques à un hôte, mais certains peuvent en défolier plus d'un. La livrée des forêts, par exemple, se nourrit surtout du peuplier faux-tremble mais, en raison de la vaste étendue de son habitat, elle se nourrit de plusieurs espèces de feuillus, surtout quand sa population est nombreuse (Ives et Wong, 1988). La tordeuse des bourgeons de l'épinette se nourrit de sapin baumier, d'épinette blanche et d'épinette noire, mais on a observé divers degrés de défoliation, ce qui est attribuable en partie aux différences entre les espèces (Nealis et Régnière, 2004). Il est de capital de comprendre ces préférences alimentaires (espèces hôtes et type de peuplement) pour pouvoir définir la relation entre les courbes de défoliation et le signal de télédétection. On a donc mis au point des modèles distincts de relation entre le pourcentage de défoliation et les changements dans la réponse spectrale, pour tenir compte des différences attribuables à la composition des peuplements.

Afin de pouvoir cartographier la défoliation de manière constante à partir des images de télédétection, les chercheurs ont concentré leurs efforts sur de nombreuses procédures de prétraitement des images, y compris les corrections géométriques, radiométriques et topographiques, de même que la normalisation des images selon qu'elles ont été prises avant ou après la défoliation. Ces procédures contribuent à la mise au point d'un modèle d'ampleur de la défoliation pour une région géographique donnée, mais qui peut ensuite être appliqué à un autre emplacement. Une idée fausse très courante est que la télédétection est un outil qui permet de déterminer le ravageur en cause. S'il est vrai qu'on peut détecter un changement dans la réponse spectrale qui pourrait être causé par la défoliation, le ravageur en cause est difficile à identifier. Le levé aérien de l'année précédente, la connaissance des espèces hôtes et le moment où surviennent les dommages et leur manifestation donnent des indices qui permettent d'identifier le ravageur probable.

Une grande difficulté est de faire un lien entre les estimations de l'ampleur de la défoliation faites sur le terrain ou à partir des levés aériens et les données de télédétection lorsque la classification repose sur les grandes catégories « légère », « moyenne » et « grave ». La difficulté consiste à attribuer une base spectrale aux limites des grandes catégories de défoliation. Il faut utiliser des estimations aussi précises que possible, réalisées sur le terrain, pour mettre au point des modèles d'images qui serviront à la détection, à la surveillance et à la cartographie de l'ampleur de la défoliation (Hall et coll., 2006). Il faut tenir compte de nombreux problèmes de télédétection associés à l'acquisition de données satellitaires et aux caractéristiques du capteur, à la méthode d'analyse et aux coûts pour déterminer quels satellites de télédétection sont les plus utiles pour cartographier la défoliation. Bien qu'on puisse accroître les chances d'obtenir une image en programmant certains capteurs satellitaires, cette programmation a un coût, comparativement aux capteurs comme Landsat qui fonctionnent maintenant en vertu d'une politique de gratuité des données. Dans un contexte opérationnel et national de surveillance et vu les réductions budgétaires de plus en plus contraignantes, la disponibilité à venir de capteurs exploités en vertu d'une politique de gratuité ou de coût réduit des données joueront grandement sur la sélection du capteur pour la surveillance annuelle de la défoliation par les insectes ravageurs.

Bref, il faut surmonter un certain nombre de difficultés relatives aux ravageurs forestiers, aux espèces hôtes et à la télédétection. La recherche en a aplani un bon nombre, à divers degrés. Notre communication a été organisée pour décrire ces difficultés, souligner les progrès réalisés grâce à la recherche et présenter un cadre pour créer un système national de surveillance reposant sur l'intégration des levés aériens et des données de télédétection comme méthode potentielle de détection et de surveillance annuelles de la défoliation par les insectes ravageurs.

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DEVELOPMENT OF DETECTION AND GENOTYPING TOOLS FOR PLANT PATHOGENS DETECTION (*PHYTOPHTHORA* AND FUNGI) USING GENOMIC DATA INFORMATION

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ABSTRACT

In the last decade, several genomes of plant pathogens have been made available. Knowing the genomes can help to better understand these organisms and are also valuable resources for the development of detection and genotyping tools, essential for detection and control of forest pathogens. *Phytophthora* for example, are well know for causing diseases in agriculture and forest ecosystems, as *Phytophthora ramorum*, the genome allowed us to select regions in the genome that allowed us to differentiate individual species and different genotypes within species. The molecular markers used in diagnostics, generally identify/detect only one specific species target and does not tell us if other species could be present (as other *Phytophthora*). To enhance specificity, the differences in the position of the primers annealing sites are based on differences on gene orders using comparisons of the mitochondrial genomes of *Phytophthora*, *Pythium* and plant for primer design. TaqMan probes for the genus *Phytophthora* and specific probes to different species could be amplified by real-time PCR in the same reaction. Other tools using the same principle are being developed for other organisms.

RÉSUMÉ

Au cours de la dernière décennie, plusieurs génomes d'agents pathogènes sont devenus disponibles. Non seulement ces génomes peuvent aider à mieux comprendre les organismes, mais ils sont également des ressources précieuses pour le développement d'outils de détection et de génotypage qui sont essentiels pour détecter et contrôler la propagation d'agents pathogènes. Par exemple, pour les espèces de *Phytophthora,* bien connues pour causer des maladies dans les écosystèmes forestiers et agricoles (p. ex., *Phytophthora ramorum*), leur génome a permis de sélectionner des régions permettant de différencier des espèces individuelles ainsi que différents génotypes au sein d'une même espèce. Pour le diagnostic, les marqueurs moléculaires utilisés n'identifient généralement qu'une seule espèce et ne permettent pas de dire si d'autres *Phytophthora* pourraient être présentes. Pour augmenter la spécificité, les différences dans la position des sites d'appariement des amorces sont comparées aux différences dans l'ordre des gènes en utilisant le génome mitochondrial de *Phytophthora*, de *Pythium* et de plantes pour la conception d'amorces.

Des sondes TaqMan pour le genre *Phytophthora* et des sondes spécifiques à différentes espèces peuvent être amplifiées par PCR en temps réel dans la même réaction. D'autres outils utilisant ces principes sont en cours de développement pour d'autres organismes.

DNA BARCODING AND FOREST BIOSECURITY: APPLYING MOLECULAR TOOLS TO THE IDENTIFICATION OF FOREST PESTS

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ABSTRACT

The detection of non-indigenous introductions is often hampered by the inability to separate introduced taxa from closely related native taxa as a consequence of the lack reference material and taxonomic keys or the inability to reliably identify immature life stages. The development of DNA libraries for the mitochondrial gene cytochrome C oxidase I and the associated analytical tools by the Barcode of Life Network show great promise in enabling the rapid recognition of non-indigenous introductions. We provide multiple examples of the application of DNA barcoding to the recognition of non-indigneous species.

RÉSUMÉ

En l'absence de matériel de référence et de clés taxinomiques permettant d'identifier de façon fiable les stades immatures et de distinguer les taxons introduits des taxons indigènes étroitement apparentés, de nombreuses introductions d'insectes non indigènes échappent à la détection. La constitution d'une banque de séquences du gène mitochondrial de la cytochrome C oxydase I et l'élaboration d'outils analytiques connexes par le *Barcode of Life Network* devraient accélérer considérablement l'identification des insectes non indigènes introduits. Nous présentons de nombreux exemples témoignant de l'utilité du barcoding moléculaire pour l'identification des espèces non indigènes.

PLANT-EATING BEETLES FROM THE ASIA PACIFIC REGION POSING A RISK TO CANADIAN PLANT RESOURCES: 2011 UPDATE

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ABSTRACT

We provide an update on CFIA research on phytophagous beetles from predominantly Asia Pacific Region posing a risk to Canadian plant resources. Our four main target plant-eating groups are Buprestidae (jewel beetles), Chrysomelidae (leaf beetles), Cerambycidae (longhorn beetles) and Curculionidae (including Scolytinae, weevils, bark and ambrosia beetles). Since 2007, we undertake annual fieldwork in the Asia Pacific Region, mainly in the Russian Far East and in China. There we sample and study beetles in their natural habitats, build morphological and genetic barcoding voucher collections and foster collaborative links with local entomologists. Resulting from this proactive approach, we were the first to detect and report on two of the most recent exotic beetle species for North America: a longhorn *Trichoferus campestris* in Montreal and a jewel-beetle *Agrilus sulcicollis* in Ontario. In 2011 we published two monographs: on the flea-beetle genus *Chaetocnema* and on *Agrilus* from East Asia; these works illustrate and identify 75 and 272 species, respectively. Our main current engagement is studying Asian *Agrilus* species most closely related to Emerald Ash Borer in a collaborative project with colleagues at the USDA, and in China and Russia.

RÉSUMÉ

Dans le présent article, nous faisons le point sur les travaux entrepris par l'Agence canadienne d'inspection des aliments (ACIA) sur les coléoptères phytophages originaires principalement de l'Asie-Pacifique qui représentent une menace pour les ressources végétales du Canada. Nos travaux portent principalement sur les buprestes (Buprestidae), les chrysomèles (Chrysomelidae), les longicornes (Cerambycidae) et les charançons (Curculionidae, incluant les Scolytinae et les Platyponinae). Depuis 2007, nous effectuons annuellement des inventaires dans la région de l'Asie-Pacifique, principalement dans l'Extrême-Orient russe et en Chine. Nous capturons et étudions les coléoptères dans leur milieu naturel, constituons des collections de spécimens de référence à des fins de codage moléculaire et d'analyses morphologiques et établissons des liens de collaboration avec les entomologistes locaux. Grâce à cette approche proactive, nous avons été les premiers à détecter et à signaler la présence de deux des plus récentes introductions de

coléoptères exotiques en Amérique du Nord : un longicorne, le *Trichoferus campestris*, à Montréal, et un bupreste, l'*Agrilus sulcicollis*, en Ontario. En 2011, nous avons publié deux monographies, une sur les altises du genre *Chaetocnema* et l'autre sur les buprestes du genre *Agrilus* de l'Asie de l'Est; ces ouvrages illustrent et permettent d'identifier 75 et 272 espèces, respectivement. Actuellement, nous nous consacrons principalement à l'étude des espèces asiatiques du genre *Agrilus* étroitement apparentées à l'agrile du frêne, en collaboration avec des collègues des États-Unis (USDA), de la Chine et de la Russie.

INFERRING INTRODUCTION PATHWAYS FOR RECENTLY DETECTED NON-INDIGENOUS SPECIES

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ABSTRACT

Recent establishments of invasive insect pests such as the emerald ash borer, Asian long-horned beetle and brown spruce longhorn beetle in Canada have highlighted the threat that such incursions pose to the urban and natural forests of the country. The impacts of non-indigenous introductions generally first occur in urban environs, as a direct consequence of the importation of a wide range of commodities. Once established in the urban environments, pest populations can expand into the adjacent natural forests.

More than twenty-five non-indigenous herbivores have been discovered in British Columbia during inventories of the fauna of urban parks and street trees or during the construction of DNA reference libraries for species identification. They include: eight species of Lepidoptera; seven sawflies (Hymenoptera: Symphyta); ten beetles (Coleoptera: Cuculionidae & Cerambycidae) and one gall midge (Diptera: Cecidomyiidae). The hosts and the feeding guilds, overwintering biology, life histories, and native and introduced ranges of these introductions are examined and a preliminary analysis of the probable pathways for their introduction is presented. Evidence for the expansion into natural forest habitats are presented for some species. Canadian and international strategies to prevent the influx of alien invasive species are discussed.

RÉSUMÉ

L'établissement récent de l'agrile du frêne, du longicorne étoilé et du longicorne brun de l'épinette rappelle de façon éloquente la menace que pose l'introduction d'insectes ravageurs envahissants pour les forêts urbaines et naturelles du pays. En général, les impacts des introductions d'espèces non indigènes sont d'abord observés en milieu urbain, point d'entrée au pays d'un grand nombre de produits importés. Une fois établis en milieu urbain, les ravageurs peuvent se disperser dans les forêts naturelles adjacentes.

Plus de 25 espèces d'insectes herbivores non indigènes (8 lépidoptères, 7 hyménoptères symphites ou mouches à scie, 10 coléoptères [curculionidés et cérambycidés] et 1 diptère [cécidomyiidés]) ont été découvertes en Colombie-Britannique durant des inventaires de la faune associée aux parcs urbains et aux arbres d'avenue ou durant la construction de banques de gènes à des fins d'identification des espèces. Nous examinons les hôtes et les guildes trophiques, la biologie hivernale, le cycle vital et les aires de répartition de ces espèces dans leurs contrées d'origine et d'adoption et nous présentons une analyse préliminaire de leurs voies d'introduction probables. Nous présentons également des données qui témoignent de la dispersion d'un certain nombre de ces espèces dans les milieux forestiers indigènes. Enfin, nous passons en revue les stratégies adoptées par le Canada et d'autres pays pour prévenir l'introduction d'espèces exotiques envahissantes à l'échelle de leur territoire respectif.

BSLB UPDATE: ECOLOGY AND NON-REGULATORY CONTROL METHODS

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ABSTRACT

The brown spruce longhorn beetle (BSLB), *Tetropium fuscum* (F.), has been established in Nova Scotia since at least 1990 and is spreading slowly westward. We present recent research on the influence of tree condition and natural enemies on BSLB fitness as well as tools and methods for suppressing BSLB populations and slowing its spread. Tree condition appears to have a direct impact on the success of BSLB, influencing survival, development time, and adult size, and may mediate the impact of natural enemies and competitors. Deployment of 100 pheromone-baited traps per ha reduced the percentage of spruce bait logs infested with BSLB and the mean number of larvae per m^2; densities of 25 traps per ha were tested in 2011. Aerial broadcast applications of the beetle's aggregation pheromone, fuscumol, in Hercon Bioflakes® significantly reduced the percentage of females that were mated as well as the percentage of bait logs infested and the density of larvae per m^2. Trials were repeated in 2011 using a higher dose of flakes. An auto-contamination fungal chamber attached to a pheromone-baited trap device successfully infected BSLB adults with *Beauveria bassiana*; rate of horizontal transmission and effects of the fungus on fecundity will be determined this winter.

RÉSUMÉ

Le longicorne brun de l'épinette (*Tetropium fuscum* [F.]) est établi en Nouvelle-Écosse (Canada) depuis au moins 1990 et se disperse lentement vers l'ouest. Nous présentons ici les résultats de travaux récents sur l'incidence de l'état de santé des arbres et de la présence d'ennemis naturels sur la valeur adaptative ou fitness du ravageur. Nous décrivons également des outils et des méthodes élaborés récemment pour réprimer les populations du ravageur et ralentir leur dispersion. L'état de santé des arbres semble influer directement sur la valeur adaptative du longicorne brun de l'épinette en agissant sur sa survie, la durée de son développement et la taille des adultes, et peut-être indirectement, en agissant sur l'impact des ennemis naturels et des espèces compétitrices. Le déploiement de 100 pièges à phéromone par ha a permis de réduire le pourcentage de billons d'appât infestés et le nombre moyen de larves par m^2. De nouveaux essais

utilisant 25 pièges par ha ont été effectués en 2011. Des applications aériennes d'une formulation en microflocons (Hercon Bioflakes®) de fuscumol, phéromone d'agrégation du ravageur, ont entraîné une réduction significative des pourcentages de femelles accouplées et de billons d'appât infestés et du nombre de larves par m^2. De nouveaux essais utilisant une plus forte dose de microflocons ont été effectués en 2011. Dans le cadre d'essais d'auto-contamination fongique effectués à l'aide d'une chambre jumelée à un piège à phéromone, des adultes ont été infectés par le champignon *Beauveria bassiana*; les taux de transmission horizontale et les effets du champignon sur la fécondité du ravageur seront déterminés cet hiver.

BSLB IMPACTS, SPREAD, AND BEST MANAGEMENT PRACTICES

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ABSTRACT

The brown spruce longhorn beetle, *Tetropium fuscum* (F.) (BSLB) became established in Nova Scotia around 1990 and has been attacking and killing spruce trees in the Halifax area. Measurements from 64 impact plots in spruce stands near the site of introduction showed that BSLB has infested/killed approximately 30% of the stand basal area to date. Based on trap catch data from 2008-10, the rate of spread of BSLB over the last 20 years has been relatively slow with a rapid decline in populations outward from the site of introduction to a point of about 80 km where populations are rare and hard to find. Maintaining a healthy forest through best management practices and increased public awareness are very useful activities to help mitigate the risk of spread and establishment of BSLB.

RÉSUMÉ

Le longicorne brun de l'épinette, *Tetropium fuscum* (F.), s'est établi en Nouvelle-Écosse aux alentours de 1990 et, depuis, il attaque et tue des épinettes dans la région d'Halifax. Selon les données recueillies dans 64 parcelles établies dans des peuplements d'épinette situés près du lieu d'introduction, les épinettes infestées ou tuées jusqu'à maintenant par le longicorne brun de l'épinette représentent environ 30 % de la surface terrière de ces peuplements. Selon les données de piégeage recueillies de 2008 à 2010, la propagation de l'insecte a été relativement lente au cours des 20 dernières années. De plus, les populations déclinent rapidement à mesure que l'on s'éloigne du lieu d'introduction, jusqu'à une distance de 80 km, où elles sont peu nombreuses et difficiles à trouver. Afin d'atténuer le risque de propagation et d'établissement du longicorne brun de l'épinette, il est très important de mettre en œuvre des mesures de lutte et de sensibilisation permettant de maintenir la santé des forêts.

Overview of research efforts on Asian longhorned beetle in Canada

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Abstract

In 2003, a breeding population of the Asian longhorned beetle, *Anoplophora glabripennis* (Motschulsky), a native species in China and the Korean Peninsula, was discovered in Ontario. This polyphagous beetle had the potential to alter the composition and structure of natural deciduous forests in eastern North America. To gain knowledge on the arrival, establishment and spread of this beetle, we studied the infested trees removed during the implementation of a programme designed to eradicate this species. Our studies revealed that: i) founding beetles arrived in the mid 1990s; ii) signs and symptoms of injury were observed on several tree genera, yet most were found on maple (*Acer* spp.); iii) trees were attacked repeatedly over many years and a few were dead at the time of removal; iv) the number of new trees infested typically doubled each year; v) the area infested, defined as 400 m around an infested tree, exceeded 2000 ha in 2007, when the last infested tree was found; vi) the farthest beetle had spread 5 km away from the origin of the infestation. This knowledge was used to develop site-specific management options for this pest and is serving as a basis for more in-depth analyses of the invasion.

Résumé

Une population établie du longicorne étoilé, *Anoplophora glabripennis* (Motschulsky), une espèce originaire de la Chine et de la péninsule coréenne, a été découverte en Ontario en 2003. Cet insecte polyphage avait le potentiel de modifier la composition et la structure des forêts naturelles de feuillus en Amérique du Nord. Dans le but d'acquérir des connaissances sur l'arrivée, l'établissement et la dispersion de cet insecte, nous avons étudié les arbres attaqués qui ont été abattus lors de la mise en œuvre du programme conçu pour éradiquer cet insecte. Nos études ont montré que i) cette espèce est arrivée en Ontario au milieu des années 1990; ii) des signes et symptômes d'attaques ont été observés sur plusieurs genres de feuillus, toutefois la majorité étaient sur les érables (*Acer* spp.); iii) les arbres ont été attaqués pendant plusieurs années consécutives et certains étaient morts au moment de l'abattage; iv) le nombre d'arbres attaqués doublait à chaque année; v) la superficie de l'attaque, définie comme étant l'aire couvrant

400 m autour de chaque arbre attaqué, dépassait 2000 ha lorsque le dernier arbre attaqué a été abattu en 2007; vi) le longicorne le plus éloigné de l'origine de l'infestation a été trouvé à 5 km de l'épicentre. Cette information a été utilisée pour développer des options de lutte antiparasitaire propre au site affecté et servira de base à des analyses plus complexes sur cette invasion.

POSTER SESSION

SÉANCE D'AFFICHES

Tools for the molecular detection of forest pests developed at the Laurentian Forestry Centre

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Early detection of exotic and invasive forest pathogens should help to prevent and mitigate their detrimental impacts on Canadian economy and ecosystems. At the Laurentian Forestry Centre of Natural Resources Canada, we are designing molecular detection tools for fast, reliable and high-throughput detection of tree pathogens. Molecular detection is based on DNA. The sequencing of particular regions of an organism's genome reveals unique nucleic acid sequences that allow us to identify it and differentiate it from its related species. This species-specific genetic fingerprint serves as a DNA barcode and is used to design detection assays targeting different hierarchical taxonomic groups. This makes it possible to detect newly introduced target pathogens and has the potential to detect cryptic.species.

Les outils développés au Centre de foresterie des Laurentides pour la détection moléculaire des ravageurs forestiers

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Pour prévenir et limiter les impacts négatifs de certaines maladies sur nos forêts, il faut disposer d'outils d'identification performants permettant une détection précoce des agents pathogènes en cause. Au Centre de foresterie des Laurentides de Ressources naturelles Canada, nous développons des outils de détection moléculaire qui permettent d'identifier rapidement, efficacement et à grande échelle plusieurs agents phytopathogènes. L'ADN est à la base de la détection moléculaire. À partir de certaines régions du génome d'un organisme, il est possible d'identifier des séquences en acides nucléiques qui lui sont propres, permettant ainsi de le différencier des autres organismes apparentés. Cette empreinte génétique qui caractérise chaque organisme vivant sert alors de code à barres et elle est utilisée pour développer des tests de détection moléculaire à divers niveaux taxonomiques. Cette approche permet non seulement d'identifier des espèces nouvellement introduites au pays, mais elle a aussi le potentiel de détecter des espèces encore non décrites.

CanFIAS: historical records of invasive alien species in Canada's forests

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Forest stewardship for sustainability requires scientific information to assess past and project future impacts to forest ecosystems resulting from forest invasive alien species (FIAS). Primary information is required for analysis and synthesis, for rapid display and for policy assessment. We provide primary and synthesized information and tools for investigation and communication for several levels of inquiry from the long-term data legacy of forest survey and research in Canada. We have built a web-based database application composed of 3 sources of primary historical scientific data on invasive species: 1) voucher specimen labels, 2) survey collections, and 3) a searchable document library. System functionality includes capabilities for sorting, mapping, exporting and reporting.

EEEFCan : les données historiques des espèces exotiques envahissantes dans les forêts du Canada

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Pour assurer la gérance et la durabilité des forêts, il faut disposer des données scientifiques nécessaires pour évaluer et prévoir les impacts futurs des espèces exotiques envahissantes forestières (EEEF) sur les écosystèmes forestiers. Il faut disposer de données primaires à des fins d'analyse et de synthèse, de divulgation rapide et d'évaluation stratégique. Nous puisons à même les données amassées au fil des ans dans le cadre de relevés et de projets de recherche sur les forêts du Canada pour fournir, en réponse à divers types de requêtes, des outils et des données primaires et de synthèse à des fins d'étude et de communication. Nous avons construit une base de données Web intégrant trois grandes sources de données scientifiques historiques sur les espèces envahissantes : 1) étiquettes des spécimens de référence; 2) collections constituées lors des relevés; 3) bibliothèque de documents interrogeables. Le système sera doté de fonctionnalités permettant le tri, la cartographie, l'exportation et l'établissement de rapports.

Defining priorities in forest pathology research at the CFS

Forest pathology working group

CFS has more than 50 employees working in forest pathology, mainly at the Laurentian and Pacific Forestry Centres. In the context of research studies and in order to link CFS expertise to partners' needs, we have planned various meetings and consultations with CFS researchers in pathology and federal and provincial partners working in forest protection. Following various meetings organised in 2010, a joint working group with CFIA and PMRA has been formed, with the mandate to establish a list of ca. 10 priority diseases from a preliminary list of 90 noteworthy forest diseases. We have taken into account the available knowledge on national and international risks, the extent of damages and the number of Canadian host trees, the possibility or not to detect and control these diseases and their sensitivity to climate. The list should provide guidance for CFS research work in the forthcoming years. This poster displays the results of this consensus building and consultation process and provides some information on the selected diseases.

Déterminer les priorités de recherche en pathologie forestière au SCF

Groupe de travail en pathologie forestière

Le SCF compte plus de 50 employés travaillant en pathologie forestière, principalement au Centre de foresterie des Laurentides et au Centre de foresterie du Pacifique. Dans un contexte de recherche et afin d'arrimer l'expertise du SCF aux besoins de ses partenaires, nous avons planifié une série de rencontres et de consultations avec les chercheurs en pathologie du SCF ainsi que nos partenaires fédéraux et provinciaux en protection des forêts. À la suite de diverses rencontres réalisées en 2010, un groupe de travail a été formé conjointement avec l'ACIA et l'ARLA afin d'établir une liste identifiant une dizaine de maladies prioritaires à partir d'une liste initialement composée de 90 maladies forestières importantes. Nous avons tenu compte des connaissances disponibles sur les risques à l'échelle nationale et internationale, l'étendue des dommages et des hôtes canadiens connus, la possibilité ou non de détecter et de contrôler ces maladies et leur sensibilité au climat. Cette liste devrait orienter les travaux de recherche du SCF dans les prochaines années. Cette affiche présente les résultats de ces concertations et consultations et quelques informations sur les maladies retenues.

Scratching the surface: Mountain pine beetle entomogenous parasites/pathogens

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The mountain pine beetle (MPB) *Dendroctonus ponderosae* is the most destructive native pest to lodgepole pine forests in Canada. Currently, western Canada is experiencing the largest epidemic in recorded history, and is suffering devastating economic and environmental losses, from the attack of over 15 million ha of lodgepole pine forests. Control options to date have relied on cultural methods and the use of old chemistry but with mixed results and in some cases very ineffective. There is therefore an urgent need to search for effective biological control agents to complement any multi-tactic approach for managing MPB. To date, there are no biological control alternatives for the management of MPB infestations (see Safranyik et al. 2002). In spite of this, very little is known about native or endemic entomogenous pathogens/parasites that attack mountain pine beetle. We report the occurrence of indigenous entomopathogens/parasites; a microsporidia species and an entomopathogenic fungus, *Beauveria bassiana* in populations of mountain pine beetle obtained from Princeton, British Columbia and Grand Prairie, Alberta. Implications for the presence of these microbial organisms in MPB populations and their exploitation for the management of this destructive pest will be discussed.

Cherchons sous la carapace : parasites et agents pathogènes entomogènes s'attaquant au dendroctone du pin ponderosa

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Le dendroctone du pin ponderosa (*Dendroctonus ponderosae*) est l'insecte indigène causant le plus de dommages aux forêts de pins tordus au Canada. L'Ouest canadien connaît la plus grande infestation jamais enregistrée : à l'heure actuelle, l'insecte s'attaque à plus de 15 millions d'hectares de forêt de pin tordu, entraînant des pertes économiques et environnementales dévastatrices. Jusqu'à maintenant, la lutte contre le dendroctone du pin ponderosa a fait appel à des méthodes culturales et à des produits chimiques conçus il y a longtemps, qui donnent des résultats variables et qui sont dans certains cas inefficaces. Il est donc essentiel de mettre au point des agents de lutte biologique efficaces qui pourront constituer un complément à toute approche multistratégique. Toutefois, de tels agents de lutte biologique n'existent pas encore. En outre, nous possédons très peu de connaissances sur les parasites et agents pathogènes entomogènes indigènes s'attaquant au dendroctone du pin ponderosa. Dans le présent article, nous faisons état de la découverte d'une espèce de microsporidie entomogène et d'un champignon entomopathogène, le *Beauveria bassiana*, tous deux indigènes au Canada, chez des populations de dendroctone de Princeton, en Colombie-Britannique, et de Grande Prairie, en Alberta. Nous analyserons les implications de la présence de ces microorganismes dans les populations de dendroctone du pin ponderosa et traiterons de leur utilisation comme agents de lutte contre cet organisme nuisible destructeur.

Spread of *Heterobasidion irregulare* in eastern Canada towards northern natural forests of *Pinus banksiana*

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In eastern Canada, the forest pathogen *Heterobasidion irregulare*, known until recently under the name *H. annosum*, was first detected in Canada in 1955 on red pine (*Pinus resinosa*) at St. Williams in southern Ontario. The diseased plantation had been thinned 26 years before. Further north in Rockland, near Ottawa, one of the oldest plantations of red pine in Ontario (planted in 1914) was thinned in 1938, 1951, 1961 and 1971; until age 67, mortality was confined to small suppressed trees. Thus the disease was not present in the Rockland area when it was first detected at St. Williams. But in 1968, the root disease was found in the Rockland region for the first time in this part of Ontario, at Larose forest. As that location was near the Ontario-Quebec border, we selected on the Quebec side thinned red pine plantations in 1983 for annual inspection. The disease was found in 1989 for the first time in Quebec; the diseased plantation had been thinned in 1981. The disease has recently spread to Drummondville, northeast of the previous infection centres, as well as to the nearby Eastern Townships. *H. irregulare* is also progressing northward, with two infection centres in red pine plantations at Saint-Jean-de-Matha in 2009. This locality is not far from large natural stands of *Pinus banksiana* which extend from eastern Canada up to Yukon. Preliminary data from inoculation trials with *H. irregulare* show that fresh *P. banksiana* stumps can be colonized by *H. irregulare*. In short, this pathogen colonized red pine stumps at St. Williams in 1929. Eighty years later, it was found at Saint-Jean-de-Matha, 800 km north of St. Williams. At this rate, the risk of seeing an extension of this root disease in natural *P. banksiana* stands is very high. This extension of *H. irregulare* is related to forest activities.

Progression de *Heterobasidion irregulare* dans l'est du Canada vers les forêts naturelles de *Pinus banksiana* plus au nord

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Dans l'est du Canada, le champignon pathogène *Heterobasidion irregulare*, mieux connu sous le nom de *H. annosum*, a été détecté pour la première fois au Canada en 1955 sur le pin rouge (*Pinus resinosa*) à St. Williams, dans le sud de l'Ontario. La plantation affectée avait été éclaircie 26 ans auparavant. Plus au nord, à Rockland, près d'Ottawa, une des plus vieilles plantations de pin rouge en Ontario (plantée en 1914) a été éclaircie en

1938, 1951, 1961 et 1971. Jusqu'à l'âge de 67 ans, la mortalité était confinée aux petits arbres supprimés. Ainsi, la maladie n'était pas présente dans la région de Rockland quand elle a été détectée à St. Williams. Toutefois, en 1968, la maladie a été trouvée pour la première fois dans cette partie de l'Ontario, plus précisément à la forêt Larose, dans la région de Rockland. Comme cette plantation était près de la frontière entre l'Ontario et le Québec, des plantations de pin rouge récemment éclaircies ont été sélectionnées au Québec en 1983 pour des inspections annuelles. La maladie a été trouvée pour la première fois au Québec en 1989; la plantation affectée avait été éclaircie en 1981. La maladie a récemment été détectée près de Drummondville, au nord-est des précédents centres d'infection, et aussi dans l'Estrie, qui est tout près. La détection de deux nouveaux centres d'infection dans des plantations de pin rouge à Saint-Jean-de-Matha en 2009 indique que *H. irregulare* progresse vers le nord. Cette localité n'est pas très loin des grands peuplements de *Pinus banksiana* qui s'étendent de l'est du Canada jusqu'au Yukon. Des données préliminaires obtenues à la suite d'essais d'inoculation avec *H. irregulare* montrent que des souches fraîches de *P. banksiana* peuvent être colonisées par cette maladie. En résumé, le champignon pathogène a probablement colonisé les souches de pins rouges à St. Williams en 1929. Quelque 80 ans plus tard, le champignon a été trouvé 800 km plus au nord, à Saint-Jean-de-Matha. À ce rythme, le risque de voir cette maladie s'étendre dans les peuplements naturels de *P. banksiana* est très élevé. Cette extension de *H. irregulare* est reliée à l'activité forestière.

Estimates of the potential cost of emerald ash borer (*Agrilus planipennis* Fairmaire) in Canadian municipalities

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We estimate the economic costs associated with EAB-related mortality of street and backyard trees in Canadian municipalities over a 30-year time horizon. Our approach employs a simple spread model to approximate EAB arrival times at each community based on 3 'maximum spread rates': slow (~10 km/year), medium (~30 km/year), and fast (~50 km/year). Costs are estimated for four discount rates (0, 2, 4, and 10%) and three treatment rates (0, 10, and 50% of trees treated with an insecticide). Ash density along urban roads was estimated from a variety of sources, including a recently developed survey that allows rapid assessments of street tree composition. Based on the 30 km/year spread rate, a 4% discount rate, and 10% treatment rate, the present value of the costs is estimated to be ~$524 million; this value increases to roughly $890 million when costs associated with backyard trees are included. Our estimates are conservative because they focus only on damage to street (and backyard) trees; nonetheless, their magnitude suggests considerable justification for investments to slow the spread of EAB in Canada.

Estimations des coûts potentiels associés à l'agrile du frêne (*Agrilus planipennis* Fairmaire) dans les municipalités canadiennes

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Nous estimons les coûts économiques associés à la mortalité des arbres de rue et d'arrière-cour attribuable à l'agrile du frêne dans les municipalités canadiennes sur un horizon de 30 ans. Notre méthode est fondée sur un simple modèle de propagation qui sert à calculer le moment de l'arrivée de l'agrile du frêne dans chaque collectivité selon trois taux de propagation maximale : faible (~10 km/année), moyen (~30 km/année) et élevé (~50 km/année). Les coûts sont estimés pour quatre taux d'actualisation (0, 2, 4 et 10 %) et trois taux de traitement (0, 10 et 50 % des arbres traités avec un insecticide). La densité des frênes le long des routes en milieu urbain a été estimée à partir de diverses sources, y compris un relevé mis au point récemment qui permet d'évaluer rapidement la composition des arbres de rue. Si on considère un taux de propagation de 30 km/année, un taux d'actualisation de 4 % et un taux de traitement de 10 %, la valeur actuelle des coûts est estimée à environ 524 millions de dollars; cette valeur augmente à environ 890 millions de dollars lorsqu'on inclut les coûts associés aux arbres d'arrière-cour. Nos estimations sont prudentes parce qu'elles ne portent que sur les

dommages causés aux arbres de rue (et d'arrière-cour); l'importance de ces dommages donne néanmoins à penser qu'il est grandement justifié d'investir pour ralentir la propagation de l'agrile du frêne au Canada.

To treat or remove: An economic model to assist in deciding the fate of ash trees threatened by emerald ash borer

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Should you protect your ash (*Fraxinus* spp.)? We present a model to assist homeowners in deciding the fate of ash trees threatened by the recent arrival of emerald ash borer (EAB; *Agrilus planipennis* Fairmaire) in North America. For basic analyses, the model tracks the ongoing cost of treatment versus the one-time costs associated with removal and replacement; all future values are discounted following standard economic practice. For each year over the period of interest, the net treatment gain/loss is calculated and plotted, indicating the period of time over which the homeowner would be financially ahead/behind by using the treatment approach. For a medium-sized ash tree with average treatment, removal, and replacement costs, positive treatment gain values persist for about 7 years. Optionally, model features can be utilized that incorporate other benefits and costs that have been attributed to urban trees, including: property value premiums, energy savings, runoff and pollution benefits, and ongoing maintenance costs. When all the optional benefits and costs are included in the model, positive treatment gains for the same medium ash tree persist for about 17 years. An interactive version of the model is available at: https://glfcstg.cfsnet.nfis.org/mapserver/apm/index.php.

Traiter ou enlever? Un modèle économique pour aider à décider du sort des frênes menacés par l'agrile du frêne

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Devez-vous protéger votre frêne (*Fraxinus* spp.)? Nous présentons un modèle pour aider les propriétaires à décider du sort de leurs frênes menacés par l'arrivée récente de l'agrile du frêne (*Agrilus planipennis* Fairmaire) en Amérique du Nord. Le modèle fournit essentiellement un suivi comparatif des coûts récurrents du traitement insecticide d'un arbre et des coûts non récurrents de son enlèvement et de son remplacement; les valeurs futures sont actualisées selon les pratiques économiques courantes. Le système calcule et pointe sur un graphique, pour chaque année de la période visée, les gains ou les pertes nets associés au traitement insecticide, ce qui permet d'établir pendant combien de temps le propriétaire ayant opté pour le traitement en sortira gagnant ou perdant sur le plan financier. Si on considère un frêne de taille moyenne, un taux de traitement moyen ainsi que les coûts d'enlèvement et de remplacement, les gains associés au traitement insecticide persistent durant environ 7 ans. Vous pouvez choisir d'inclure dans le modèle divers coûts et bénéfices additionnels associés aux arbres urbains, comme la valeur ajoutée à la propriété, les économies d'énergie, la réduction du ruissellement et de la pollution ainsi que les coûts d'entretien récurrents. Lorsque tous les bénéfices et coûts optionnels sont inclus dans le modèle, les gains associés au traitement insecticide pour le même frêne de taille moyenne persistent durant environ 17 ans. On peut consulter une version interactive du modèle à l'adresse suivante : https://glfcstg.cfsnet.nfis.org/mapserver/apm/index.php?&NEK=f.

Sudden oak death (*Phytophthora ramorum*): Research contribution at the Canadian Forest Service

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Phytophthora ramorum (*Pr*) is mainly known as the causal agent of sudden oak death (= ramorum bleeding canker) in North America and ramorum blight in Europe. It can infect over 120 hosts, several of which are present in Canadian forested and urban areas. Movement of infected nursery stock is probably the highest risk pathway for reaching Canadian forests and indeed the disease has been detected and eradicated several times from nurseries in British Columbia since it was first observed in 2003. Our research activities have been mainly carried out to better understand the biology, population genetics, and mitigation measures to help assess the risk associated with *Pr* in Canada. Our studies deal with the: 1) evaluation of susceptibility of nursery plants, forest vegetation and tree species common to eastern and western Canada; 2) development of DNA markers to identify the three *Pr* lineages; 3) assessment of the aggressiveness of these lineages; 4) efficacy of biocontrol products and commercial fungicides; and 5) research to determine resistance mechanisms in trees.

L'encre de chênes rouges (*Phytophthora ramorum*) : contribution aux recherches menées au Service canadien des forêts

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Phytophthora ramorum (*Pr*) est surtout connu comme l'agent pathogène causant l'encre des chênes rouges (= *sudden oak death*) en Amérique du Nord et la brûlure des pousses (= *ramorum blight*) en Europe. Il peut infecter plus de 120 hôtes, dont plusieurs sont présents dans les forêts et les milieux urbains canadiens. L'expédition de matériel de pépinière infecté constitue la filière la plus à risque pour les forêts canadiennes et le *Pr* a d'ailleurs été détecté et éradiqué dans plusieurs pépinières de la Colombie-Britannique depuis sa première introduction en 2003. Pour mieux évaluer le risque associé au *Pr*, nos recherches visent à améliorer notre connaissance de la biologie, de la génétique et des mesures d'atténuation de cet agent pathogène. Nos études portent sur : 1) l'évaluation de la sensibilité d'espèces de plantes forestières communes dans l'Est et l'Ouest canadiens; 2) le développement de marqueurs moléculaires pour identifier les trois lignées du *Pr*; 3) l'évaluation de l'agressivité de ces trois lignées; 4) l'efficacité de produits antiparasitaires biologiques et de fongicides commerciaux; et 5) la recherche de mécanismes de résistance au *Pr* chez les arbres.

Emerging *Phytophthora* diseases: Is there a threat to Canadian forests?

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Forests and landscape areas throughout the world are under serious threat from an increasing number of *Phytophthora* species. Diseases such as jarrah (*Eucalyptus marginata*) dieback (*P. cinnamomi*) in western Australia, needle blight (*P. pinifolia*) of *Pinus radiata* planted in Chile, root rot (*P. lateralis*) of *Chamaecyparis lawsoniana* in western North America and chestnut ink disease (*P. cambivora* & *P. cinnamomi*) in Europe cause severe tree damage. In addition, European alders have recently been affected by a lethal root and collar rot (*P. alni*). Diseases caused by *P. ramorum* and *P. kernoviae* have also drawn the attention of several regulating agencies worldwide. For instance, in 2009, *P. ramorum*, which usually affects broadleaf species, was found on *Larix kaempferi* in the United Kingdom, and so far 2 million trees have been killed or felled in an attempt to control the disease. In Canada, the threat from several *Phytophthora* spp. is real and there are significant gaps in our understanding of these pathogens. We will soon have to address questions such as: What are the environmental conditions promoting the virulence of *Phytophthora* spp.? How can these diseases be rapidly and accurately diagnosed? What can be done to improve risk assessments and control measures of these pathogens?

Est-ce que les maladies émergentes causées par les *Phytophthora* spp. sont une menace pour les forêts canadiennes?

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Les forêts et les milieux paysagés à travers le monde sont menacés par le nombre croissant de *Phytophthora* spp. Des maladies telles que le dépérissement terminal (*P. cinnamomi*) du jarrah (*Eucalyptus marginata*) dans l'ouest de Australie, la brûlure des aiguilles (*P. pinifolia*) du *Pinus radiata* planté au Chili, la pourriture racinaire (*P. laterallis*) du *Chamaecyparis lawsoniana* dans l'ouest de l'Amérique du Nord et l'encre (*P. cambivora* & *P. cinnamomi*) du châtaigner en Europe causent des dommages sérieux aux arbres. De plus, les aulnes européens ont récemment été affligés d'une pourriture létale des racines et du collet (*P. alni*). Des maladies causées par les *P. ramorum* et *P. kernoviae* ont aussi retenu l'attention de plusieurs agences de réglementation à l'échelle mondiale. Par exemple, en 2009, le *P. ramorum*, qui affecte habituellement les espèces feuillues, a été détecté chez le *Larix kaempferi* au Royaume-Uni et, jusqu'à maintenant, 2 millions d'arbres ont été tués ou abattus pour combattre la maladie. Au Canada, la menace que représentent plusieurs *Phytophthora* spp. est réelle et il y a des lacunes flagrantes dans notre compréhension de ces agents pathogènes. Nous devrons incessamment répondre à des questions telles : Quelles sont les conditions environnementales favorisant la virulence des *Phytophthora* spp.? Comment peut-on diagnostiquer ces maladies plus rapidement et efficacement? Que peut-on faire pour améliorer les évaluations de risques et les moyens de lutte face à ces agents pathogènes?

Phylogenetic analyses of North American populations of *Heterobasidion irregulare* and *Heterobasidion occidentale*

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Heterobasidion annosum (Fr.) Bref. *sensu lato* causes one of the most destructive diseases of conifers. *Heterobasidion* is a species complex consisting of 5 species. The North American intersterility groups (ISG), *H. irregulare* (P) and *H. occidentale* (S), were recently named. The other 3 spp., *H. annosum sensu stricto* (*s.s.*)- (P*)*, *H. parviporum* (S) and *H. abietinum* (F), are European. Development of molecular diagnostics for detection and identification of *Heterobasidion* spp. in wood products for international trade is needed by CFIA. Eight housekeeping genes were selected for genetic analysis of the 26 isolates of *Heterobasidion* from BC and Ontario. Phylogenetic analyses of sequences from the 26 isolates and other 226 isolates from Europe, Asia, and North America, revealed that isolates from BC resembles *H. occidentale*, and shares sequence homology with isolates from California and Idaho. Another 16 isolates from eastern Rocky Mountains exhibited degrees of variation, and shared a close phylogenetic with *H. irregulare* isolates from Quebec, Ontario, Montana, Georgia, and Alabama.

Analyse phylogénétique des populations nord-américaines de l'*Heterobasidion irregulare* et de l'*Heterobasidion occidentale*

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L'*Heterobasidion annosum* (Fr.) Bref. *sensu lato* est l'agent d'une des maladies les plus destructives des conifères. Cette espèce est en fait constituée d'un complexe composé de cinq espèces du genre *Heterobasidion*. Deux de celles-ci, l'*H. irregulare* et l'*H. occidentale*, sont des entités interstériles d'Amérique du Nord récemment décrites à titre d'espèces distinctes, tandis que les trois autres, l'*H. annosum sensu stricto*, l'*H. parviporum* et l'*H. abietinum*, sont des espèces européennes. L'ACIA a besoin de méthodes moléculaires pour pouvoir détecter et identifier les espèces d'*Heterobasidion* présentes dans les produits du bois faisant l'objet d'un commerce international. Nous avons donc soumis 26 isolats d'*Heterobasidion* de Colombie-Britannique et d'Ontario à une analyse génétique fondée sur huit gènes constitutifs. L'analyse phylogénétique des séquences de ces 26 isolats ainsi que de 226 isolats provenant d'Europe, d'Asie et d'autres régions d'Amérique du Nord a révélé que les isolats de Colombie-Britannique ressemblent à l'*H. occidentale* et présentent une homologie de séquence avec les isolats de Californie et d'Idaho. Seize autres isolats, provenant de l'est des Rocheuses, sont étroitement apparentés aux isolats d'*H. irregulare* du Québec, de l'Ontario, du Montana, de Georgie et d'Alabama.

Mass trapping for population suppression of an invasive longhorn beetle, *Tetropium fuscum* (F.) (Coleoptera: Cerambycidae)

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Mass trapping is a potential way of suppressing populations of brown spruce longhorn beetle, *Tetropium fuscum* (F.), at sites established outside of the generally infested area. We present results of Nova Scotia field trials testing mass trapping for *T. fuscum* population suppression in 2008 and 2009, and preliminary results from additional trials in 2011. Black panel intercept traps baited with the aggregation pheromone, fuscumol, and host volatiles were deployed at 100 traps per ha and replicated in four 1 ha plots in 2008 and 2009. Each mass trapping plot was paired with a 1 ha untreated plot located 200-100 m away. Three decks of spruce bait logs were set out in each treated and control plot along a diagonal transect. The percentage of spruce bait logs infested with *T. fuscum* and the mean number of *T. fuscum* larvae per m^2 were significantly lower in mass-trapped plots than untreated control plots. Lower densities of 25 traps per ha (20 m x 20 m grid) were tested in 2011 and preliminary results will be known in January 2012.

Piégeage de masse pour la suppression des populations d'un longicorne envahissant, le *Tetropium fuscum* (F.) (Coleoptera : Cerambycidae)

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Le piégeage de masse est une méthode qui pourrait être utilisée à des fins de suppression des populations du longicorne brun de l'épinette (*Tetropium fuscum* [F.]) à l'extérieur de la région généralement infestée par le ravageur. Nous présentons les résultats d'essais de piégeage de masse réalisés sur le terrain en 2008 et 2009, en Nouvelle-Écosse, à des fins de suppression des populations du ravageur, ainsi que les résultats préliminaires d'essais additionnels effectués en 2011. Des pièges intercepteurs (panneaux noirs) appâtés avec du fuscumol (phéromone d'agrégation du ravageur) et des composés volatils de l'hôte ont été déployés en 2008 et 2009 dans quatre parcelles de 1 ha, à raison de 100 pièges par ha. Chaque parcelle de piégeage (traitée) était appariée à une parcelle de 1 ha non traitée (témoin) située à une distance de 100 à 200 m. Trois empilements de billons d'appât d'épinette ont été disposés dans chaque parcelle traitée et non traitée le long d'un transect diagonal. Le pourcentage de billons d'appât infestés par le ravageur et le nombre moyen de larves par m^2 étaient significativement plus faibles dans les parcelles traitées que dans les parcelles témoins. De nouveaux essais utilisant une plus forte densité de pièges (25 pièges par ha disposés selon une grille de 20 m x 20 m) ont été effectués en 2011. Les résultats de ces essais seront connus en janvier 2012.

Population suppression of *Tetropium fuscum* (F.) by pheromone-mediated mating disruption

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The brown spruce longhorn beetle, *Tetropium fuscum* (F.) has been established in Nova Scotia, Canada, since at least 1990 and has now been detected in nine counties of Nova Scotia, as well as Kouchibouguac Park, NB. Practical means of population suppression are needed to slow the beetle's spread in North America. We present results of field trials testing broadcast applications of the beetle's aggregation pheromone, fuscumol, in Hercon Bioflakes® for mating disruption and population suppression. Fuscumol was formulated at 10% concentration and applied twice per season at 2.75 kg/ha in to 4 ha plots. There were two replicates in 2008 and four reps in 2009 and 2010; equal numbers of untreated plots served as controls. Flakes were applied from the ground in 2008 and from a helicopter in 2009 and 2010. Broadcast application of fuscumol significantly reduced the percentage of females that were mated in both 2009 and 2010, the percentage of bait logs infested with *T. fuscum* in 2008 and 2009, and the density of *T. fuscum* larvae per m^2 in bait logs in 2008 and 2009. Trials were repeated in 2011 using a higher dose of flakes (4.5 kg/ha) and results will be known in January 2012.

Suppression des populations du *Tetropium fuscum* (F.) par confusion sexuelle induite par des phéromones

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Le longicorne brun de l'épinette (*Tetropium fuscum* [F.]) est établi en Nouvelle-Écosse (Canada) depuis au moins 1990 et sa présence a récemment été détectée dans neuf comtés de cette province ainsi que dans le parc national Kouchibouguac, au Nouveau-Brunswick. La mise au point de mesures pratiques de suppression des populations s'impose pour ralentir sa dispersion en Amérique du Nord. Nous présentons ici les résultats d'essais sur le terrain d'applications généralisées d'une formulation en microflocons (Hercon Bioflakes®) de fuscumol, une phéromone d'agrégation produite par le ravageur, à des fins de confusion sexuelle et de suppression des populations. Les microflocons ont été appliqués deux fois par saison dans des parcelles de 4 ha en formulation renfermant 10 % de fuscumol, à raison de 2,75 kg/ha. Deux répétitions par essai ont été réalisées en 2008 et quatre répétitions par essai ont été réalisées en 2009 et 2010; un nombre équivalent de parcelles non traitées ont été utilisées comme témoins. Les applications ont été effectuées à partir du sol en 2008 et par hélicoptère en 2009 et 2010. Les traitements ont entraîné une réduction significative du pourcentage de femelles accouplées en

2009 et 2010, du pourcentage de billons d'appât infestés par le ravageur en 2008 et 2009, et du nombre de larves par m^2 dans les billons d'appât en 2008 et 2009. De nouveaux essais utilisant une plus forte dose de microflocons (4,5 kg/ha) ont été réalisés en 2011. Les résultats de ces essais seront connus en janvier 2012.

New era in detection tools: The Genomics-Based Forest Health Diagnostics and Monitoring project

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This project aims to increase Canada's capacity in forest pathogen detection and monitoring by designing high-throughput DNA-based diagnostic assays. End-users involved in the project have already emphasized the importance of such tools in pathogen detection and monitoring, and phytosanitary certification. Our team will work with end-users and partners to prepare a list of the 50 'most unwanted' forest pathogens for assay development. The list will include pathogens regulated by quarantines in Canada or in key export nations, or that have been identified as a threat to Canada's forests. The output of this research will be fully validated diagnostic tests for on-site use, or as a high-throughput service offered to end-users and partners. This diagnostic tool will not only help end-users to prevent introduction of exotic and invasive pathogens, it will also assist the forest and nursery industries with phytosanitary certification. The project will also uncover and address risks associated with assay commercialization and adoption.

Une ère nouvelle dans les outils de détection : Le projet « Diagnostic et surveillance de la santé des forêts au moyen de la génomique »

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Ce projet propose d'accroître la capacité du Canada dans la détection et le suivi des pathogènes forestiers par la conception de tests permettant une détection moléculaire à haut débit. Les utilisateurs impliqués ont déjà soulevé l'importance de tels outils pour la détection et le monitoring des agents phytopathogènes, ainsi que pour la certification phytosanitaire. Pour développer cet outil, notre équipe travaillera avec les utilisateurs et les partenaires afin de dresser la liste des 50 pathogènes forestiers « les plus indésirables ». La liste ciblera les agents phytopathogènes réglementés à l'importation et à l'exportation, ainsi que tous les autres champignons ravageurs identifiés comme une menace pour les forêts canadiennes. Le produit final de ce projet sera un ensemble de tests de diagnostic entièrement validés qui seront accessibles ou offerts comme service aux utilisateurs et aux partenaires. Cet outil de diagnostic servira non seulement à prévenir l'introduction d'agents pathogènes exotiques et envahissants, mais il aidera aussi l'industrie forestière et les pépinières pour la certification phytosanitaire. Le projet permettra également d'identifier et de gérer les risques associés à la commercialisation et à l'adoption du produit.

Reverse Pathway Analysis: A new tool for rapid assessments of pest invasion risk

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Long-distance introductions of new invasive species are often driven by socioeconomic factors, such that traditional "biological" invasion models may not be capable of estimating spread fully and reliably. In this study, we present a new methodology to uncover primary human-mediated vectors and origins of new pest establishments that may be caused by trade, transportation and/or other economic activities. A reverse pathway analysis answers the question "Where did the species come from before it arrived at the location of interest?" and shows the suspected infestation sources for the location, such as previously infested sites, urban areas, campgrounds or ports of entry).

The analysis is undertaken in three steps. First, we use existing data sources on movement of pest-associated commodities and other economic activities to build a probabilistic pathway model. The model is formulated as a Markovian pathway matrix, and allows for quantitative characterization of likelihoods and vectors of new pest introductions from already or likely-to-be infested locations. We then run the pathway model to generate multiple sets of probabilistic predictions of establishment vectors from every potential point of introduction in the transportation network (one point at a time). At the last step, pathway simulations from individual locations of origin are aggregated to a database application that summarizes the locations and likelihoods of the potential origins of an infestation in a given target location of interest. Because the analysis evaluates every possible location as a potential infestation "source", the data can be aggregated into a dynamic web application to help communicate the results of the reverse pathway analysis to pest risk professionals and provide real-time decision support for rapid assessments of the potential vectors of human-assisted introductions of invasive pests in North America.

La rétro-analyse des voies d'introduction, un nouvel outil d'évaluation rapide des risques posés par les espèces envahissantes

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L'introduction de nouvelles espèces envahissantes provenant de régions éloignées est souvent favorisée par des facteurs socio-économiques. En conséquence, il est souvent difficile, voire impossible, d'estimer de façon précise et fiable la dispersion de ces espèces dans leur nouvel environnement avec les modèles classiques d'invasion « biologique ». Nous avons élaboré une nouvelle méthode permettant de déterminer les principaux vecteurs anthropiques et les origines des nouvelles introductions d'espèces nuisibles potentiellement favorisées par le commerce, le transport de marchandises et/ou d'autres activités économiques. La rétro-analyse des voies d'introduction permet de retracer le trajet suivi par une espèce donnée avant qu'elle n'atteigne sa nouvelle contrée d'adoption et de déterminer les sources probables de l'infestation dans cette région (p. ex., sites déjà infestés, zones urbaines, terrains de camping, ports d'entrée, etc.).

L'analyse se déroule en trois étapes. Dans un premier temps, il faut examiner les sources de données existantes sur les déplacements des denrées et autres activités économiques associées au ravageur pour construire un modèle probabiliste des voies d'introduction. Ce modèle, qui se présente sous la forme d'une matrice de Markov, permet une caractérisation quantitative des vraisemblances et des vecteurs potentiels des nouvelles introductions d'espèces nuisibles à partir de régions déjà infestées ou soupçonnées de l'être. L'exécution du modèle permet ensuite de générer des ensembles multiples de prévisions probabilistes des vecteurs d'établissement pour chaque point d'introduction potentiel compris dans le réseau de transport (un point à la fois). Enfin, dans un troisième temps, les simulations des voies d'introduction à partir de chaque point d'origine sont agrégées à une application de base de données qui résume les emplacements et les vraisemblances des origines potentielles d'une infestation dans une région donnée. Puisque l'analyse évalue chaque emplacement possible comme une « source » d'infestation potentielle, les données peuvent être agrégées dans une application Web dynamique pour communiquer les résultats de la rétro-analyse des voies d'introduction aux spécialistes de l'évaluation des risques associés aux ravageurs et offrir un outil d'aide à la décision en temps réel permettant d'évaluer rapidement les vecteurs potentiels des introductions de ravageurs envahissants favorisées par les humains en Amérique du Nord.