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PROCEEDINGS OF THE

Forest Pest Management

FORUM

Shaw Centre, Ottawa | **December 2–4, 2014**

For more information:
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FOREST PEST MANAGEMENT FORUM
2014 PROCEEDINGS

SHAW CENTRE
DECEMBER 2-4, 2014

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.

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Canadian Food Inspection Agency
Natural Resources Canada

Invasive Species Centre

ACKNOWLEDGEMENTS

The 2014 Forest Pest Management Forum was a resounding success once again thanks to the contributions of many people. First of all, we wish to thank the presenters, who shared their knowledge of the issues discussed and who also provided summaries for these proceedings. Our thanks also go to the logistical support team. Last but not least, we wish to thank all the participants, who came from many different regions of Canada and the United States.

THE 2014 FORUM ORGANIZING COMMITTEE

FOREST PEST MANAGEMENT FORUM 2014

December 2 - 4, 2014
Shaw Centre

TUESDAY, DECEMBER 2

08:00 **Registration**

08:20 Welcome to the Forest Pest Management Forum
Glen Mason, Assistant Deputy Minister, Natural Resources Canada, Canadian Forest Service

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

Session I: GAPP Project Update

08:30 Protecting Canada's forests against invasive alien species by next generation biosurveillance: CFIA and partnerships
Cameron Duff, Canadian Food Inspection Agency

08:30 Protecting Canada's forests against invasive alien species by next generation biosurveillance: the science behind
Richard Hamelin, Natural Resources Canada, Canadian Forest Service

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

Session II: National Forest Pest Strategy Update

08:50 Canadian Council of Forest Ministers' Forest Pest Working Group update
Judi Beck, CCFM Forest Pest Working Group co-Chair, Natural Resources Canada, Canadian Forest Service

08:50 The NFPS risk analysis framework: successes and lessons learned
Janice Hodge, NFPS Technical Coordinator, JCH Forest Pest Management

09:30 Mountain pine beetle risk assessment: an update
Barry Cooke, Natural Resources Canada, Canadian Forest Service

09:50 The National Forestry Database: the relevance, use and impact of national data about Canada's forests and their management
Simon Bridge, Natural Resources Canada, Canadian Forest Service

10:10 **Break**

10:40 Invasive Species Centre: highlights and opportunities
Dilhari Fernando, Executive Director, Invasive Species Centre

Chair: *Tim Ebata, British Columbia Ministry of Forests, Lands and Natural Resource Operations*

Session III: Eastern Pest Management Issues

10:50 Newfoundland and Labrador Report
Dan Lavigne, Newfoundland and Labrador Department of Natural Resources

11:10 Nova Scotia Report
Gina Penny, Nova Scotia Department of Natural Resources

11:30 **Lunch (not included)**

Session IV: United States Report

13:00 Overview of forest pest conditions in the U.S.
Robert Rabaglia, United States Department of Agriculture, Forest Health Protection

Chair: *Gina Penny, Nova Scotia Department of Natural Resources*

Session V: Eastern Pest Management Issues (continued)

13:30 New Brunswick Report
Robert Johns, Natural Resources Canada, Canadian Forest Service on behalf of the New Brunswick Department of Natural Resources

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

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

Session VI: North of 60 Report

13:30 Northwest Territories Report
Jakub Olesinski, Government of the Northwest Territories, Environment and Natural Resources

14:50 **Break**

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

Session VII: Pesticide Regulations, Alternatives, Minor Use

15:30 Introduction
Michael Irvine, Ontario Ministry of Natural Resources and Forestry

15:35 When regulatory process and operational requirements conflict: how can we move this forward?
Dave Kreutzweiser, Natural Resources Canada, Canadian Forest Service

16:05 PMRA update
Terry Caunter, Pest Management Regulatory Agency

16:05 PMRA environmental assessment overview
Scott Kirby, Director, Pest Management Regulatory

17:00 **Adjourn**

WEDNESDAY, DECEMBER 3

08:00 **Registration**

Chair: *Jeremy Allison, Natural Resources Canada, Canadian Forest Service*

Session VIII: Insect Semiochemistry

08:30 Effect of pheromone-enhanced lures and trap height on the detection of Cerambycidae
Jon Sweeney, Natural Resources Canada, Canadian Forest Service Regulatory

08:30 The impact of trap design and distance among traps on the capture of Cerambycidae
Jeremy Allison, Natural Resources Canada, Canadian Forest Service

09:20 Early detection of non-native insects: U.S. perspective
Robert Rabaglia, United States Department of Agriculture, Forest Health Protection

09:20 The impact of landscape heterogeneity on the survey and detection of Cerambycidae
Brian Strom, United States Department of Agriculture, US Forest Service

10:10 **Break**

Session VIII: Insect Semiochemistry (continued)

10:40 CFIA priorities and needs re: forest invasive alien species detection and surveillance
Troy Kimoto, Canadian Food Inspection Agency

Session IX: Alien Invasives and Wood Packaging Updates

11:05 Solid wood packaging material interceptions: adding context to detections
Graham S. Thurston, Canadian Food Inspection Agency

11:25 **Lunch (not included)**

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

Session X: Western Pest Management Issues

13:00 Manitoba Report
Fiona Ross, Manitoba Conservation and Water Stewardship, Forestry Branch

13:20 Saskatchewan Report
Rory McIntosh, Saskatchewan Ministry of Environment, Forest Service Branch

13:40 Alberta Report
Erica Samis, Alberta Sustainable Resource Development, Forest Management Branch

14:00 British Columbia Report
Tim Ebata, British Columbia Ministry of Forests, Lands and Natural Resource Operations

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

Session XI: Forest Pathology

14:20 The root disease pathogen *Heterobasidion irregulare*: invader, proliferator, or just important?
Glenn Stanosz, University of Wisconsin-Madison

15:00 **Break**

Session XII: Urban Forestry

15:20 Canadian Forest Service urban forest engagement: science, policy and positioning
Ken Farr, Natural Resources Canada, Canadian Forest Service

Chair: *Cameron Duff, Canadian Food Inspection Agency*

Session XIII: CFIA Updates

15:40 CFIA plant health surveillance update
Mireille Marcotte, Canadian Food Inspection Agency

16:00 The importance of the International Plant Protection Convention and its standards
Cameron Duff, Forest, Canadian Food Inspection Agency

16:10 Protecting plant resources while facilitating trade in North America
Rebecca Lee, North American Plant Protection

16:20 Strategic approach to addressing animal and plant health issues
Mike Wood, Forest, Canadian Food Inspection Agency

16:20 Update on roles and responsibilities within the newly reorganized CFIA
Greg Wolff, Canadian Food Inspection Agency

17:00 **Adjourn**

THURSDAY, DECEMBER 4

08:00 **Registration**

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

Session XIV: Spruce budworm

08:20 CFS spruce budworm strategy and early intervention strategy top commitment: overview and funding received
Derek MacFarlane, Natural Resources Canada, Canadian Forest Service

Early Intervention Approach Testing

08:40 News from the frontlines: what we are learning about spruce budworm management approaches
Jacques Régnière, Natural Resources Canada, Canadian Forest Service

09:00 A bio-indicator of spruce budworm migratory flight
Johanne Delisle, Natural Resources Canada, Canadian Forest Service

09:20 Mating disruption trials against spruce budworm in Quebec: 2014
Johanne Delisle, Natural Resources Canada, Canadian Forest Service

09:40 Public engagement and partnership: developing a proactive approach to communicating issues surrounding spruce budworm management
Véronique Martel, Natural Resources Canada, Canadian Forest Service

10:00 **Break**

Provincial response to the outbreak

10:20 Spruce budworm 'early-intervention strategy' in Atlantic Canada: translating theory into practice
Robert Johns, Natural Resources Canada, Canadian Forest Service

10:40 Quebec
Louis Morneau, Ministère des Forêts, de la Faune et des Parcs du Québec

11:00 Climate change and pest management: U.S.-Canada research project collaborations
Barry Cooke, Natural Resources Canada, Canadian Forest Service

11:20 Panel discussion

12:00 **Adjourn**

PRESENTER ABSTRACTS

Session I: GAPP Project Update

(Unavailable)

Session II: National Forest Pest Strategy Update

Canadian Council of Forest Ministers' Forest Pest Working Group update

***Judi Beck*[1], *Rosalyn Lawrence*[2] *and Jean-Luc St-Germain*[3]**

[1]*Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, 506 West Burnside Road, Victoria, British Columbia V8Z 1M5*
[2]*Ontario Ministry of Natural Resources and Forestry, Policy Division, Whitney Block, 99 Wellesley Street West, Toronto, Ontario M7A 1W3*
[3]*Natural Resources Canada, Canadian Forest Service, Laurentian Forestry Centre, 1055 du P.E.P.S., P.O. Box 10380, Québec, Quebec G1V 4C7*

Federal, provincial and territorial governments are advancing the objectives of a National Forest Pest Strategy under the Canadian Council of Forest Ministers' leadership (CCFM). In 2014-2015, the CCFM Forest Pest Working Group has advanced an implementation strategy for a new five-year strategic plan aligned to CCFM priorities and jurisdictions' needs. Although the foundational NFPS components remain at the centre of this strategy, new work themes have emerged such as socio-economic analyses related to forest pest management, climate change impact and adaptation in a pest management context, and intergovernmental responses to invasive species. The presentation will provide an update on the outcomes of this process, and on the status of technical projects undertaken in 2014-2015.

National Forest Pest Strategy risk analysis framework: successes and lessons learned

Janice Hodge

JCH Forest Pest Management, 7700 DeJong Drive, Coldstream, British Columbia V1B 1P3

The National Forest Pest Strategy (NFPS) pest risk analysis (PRA) framework has been available to Canadian Council of Forest Ministers (CCFM) members across Canada for several years now. In that time period a number of PRAs, or modified PRAs, have been completed covering a number of invasive and native forest pests and spanning one or more jurisdictions. As part of the continuum of the learning process, feedback was sought from users to determine if the PRA met their needs and, more importantly, to determine what worked and what didn't work. This information will be used to inform a PRA user's guide and to evaluate the uptake of the framework by CCFM members and its impact on their decision-making processes – a performance measure identified in the 2008 NFPS Implementation Plan.

The National Forestry Database: the relevance, use and impact of national data about Canada's forests and their management

S.R.J. Bridge

Natural Resources Canada, Canadian Forest Service, 580 Booth Street, Ottawa, Ontario K1A 0E4

Since 1990, The National Forestry Database (NFD) has been providing reliable and timely information about forest management in Canada and its impact on the forest resource. This federal, provincial and territorial initiative aims to provide vital information to: help develop and improve sustainable forest management practices and policies; promote Canada's strong environmental credentials; and inform public debate about forest management in Canada. Readers of the NFD come from all sectors of society. They use the data to meet domestic and international reporting requirements, to inform and influence decision makers, to provide relevant and useful content to a paying audience, to influence markets and investors, and to support research. This presentation will provide an overview of information available in the database (such as information on area disturbed by insects, fires and harvesting) and its relevance, use and impact. The challenges of maintaining the database and the emerging opportunities will be addressed, including significant events in 2015 for reporting on Canada's forests and their management.

Session III: Eastern Pest Management Issues

Newfoundland and Labrador Report

Dan Lavigne

Newfoundland and Labrador Department of Natural Resources, 4 Herald Avenue, P.O. Box 2006 Corner Brook, Newfoundland A2H 6J8

The following is a brief summary of the status of forest pests and results of monitoring activities conducted in the province of Newfoundland and Labrador (NL) in 2014.

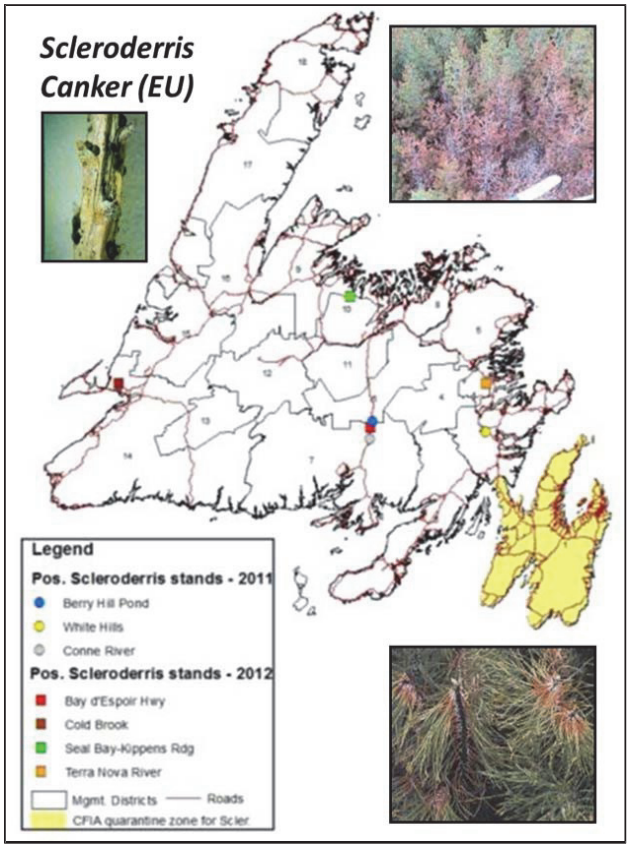
Please note – *These are only interim results. Final results will be made available in the provincial annual forest pest status report. This report will be available at: http://www.faa.gov.nl.ca/forestry/idc/monitoring_control.html.*

Invasive Forest Pests

In the province of Newfoundland and Labrador (NL) invasive forest pests are primarily monitored by the Canadian Food Inspection Agency (CFIA). Pests monitored by the CFIA in NL in 2014 included: gypsy moth, brown spruce longhorn beetle (BSLB), emerald ash borer, Asian long-horned beetle, Japanese beetle and monitoring of other wood boring insects through the IAS forest pest survey. Results of monitoring conducted for these invasive pests can be obtained from Ron Neville, Plant Health Survey Biologist, CFIA, Atlantic Canada (ron.neville@inspection.gc.ca).
Presently, the province only monitors European Scleroderris Canker and Balsam Woolly Adelgid - two invasive species established in the province.

European Scleroderris Canker

The European strain of Sclerroderris Canker was first found in the St. John's area in 1979. This introduced disease poses a threat to indigenous red pine of ecological significance and planted red pine on the island. Following its discovery, efforts were made to contain the disease through sanitation and the use of quarantines to restrict the movement of infected material. This was successful for ca. 25 years; however, in 2007 the disease was found 150 km outside the quarantine zone in the Berry Hill area. This site was sanitized in 2008. Despite these efforts an additional three sites were detected in 2011 (see map). One of these sites was only 3 km north of the site detected in 2007. In 2012, directed survey efforts detected an additional four sites outside the quarantine area (see map).

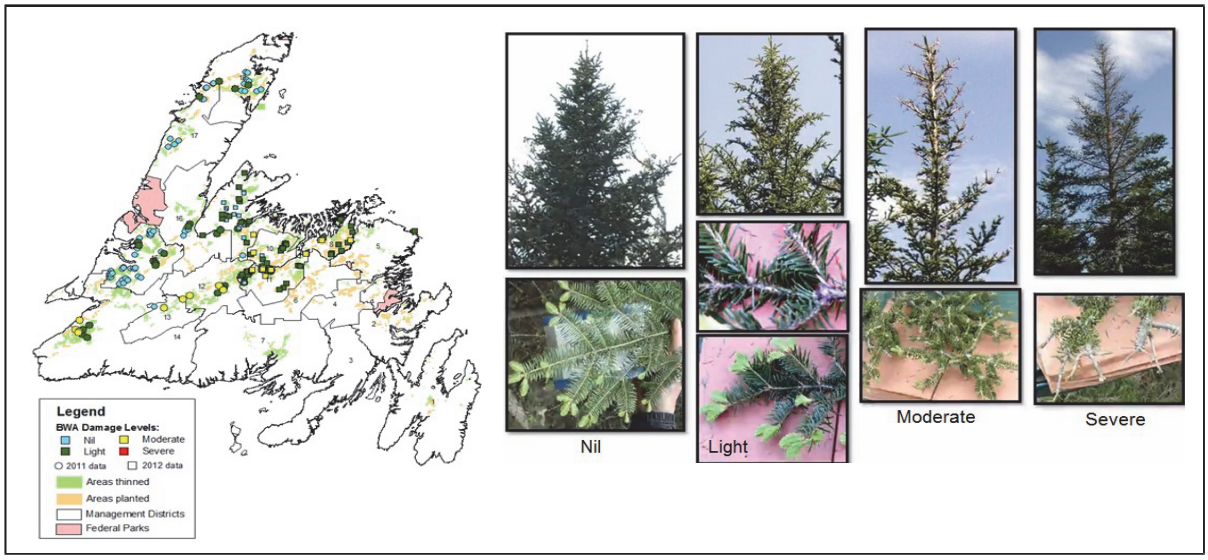


Prohibitions of movement were issued by the CFIA to restrict the movement of living pine at and within a 1 km radius of these sites. An application to sanitize these sites was also submitted under the province's Environmental Protection Act. Following the 45-day Environmental Assessment review process, the application was approved. To date, only one (Cold Brook) of the seven sites has been sanitized with sanitation still being proposed at the other sites.

Fortunately aerial surveys and general surveillance results have not detected any new sites since 2012. Within known sites, however, levels of infection and mortality have increased.

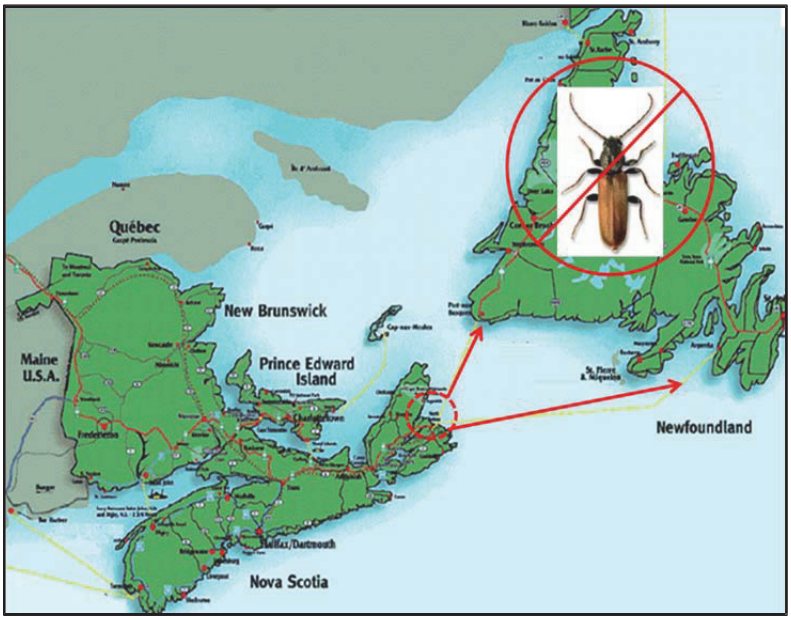
Balsam Woolly Adelgid

Unlike other jurisdictions, no annual monitoring of overwintering survival of balsam woolly adelgid (BWA) life stages is conducted Currently, the only information collected is the incidence and levels of BWA damage observed during surveillance of silvicultural areas (i.e. plantations and thinnings). To date, results have shown that the incidence and damage observed from BWA is higher in southwestern and central portions of the province (see map) with twig attack/damage (see images) the most common. Conversely, the incidence and levels of damage found at higher latitudes and higher elevation sites is lower or absent. This is most likely related to climate (i.e. colder winter temperatures). BWA damage is particularly evident in coastal areas, along road corridors and other open areas.



Special note regarding BSLB:

On the island over 85% of the growing stock is softwood with spruce representing ca. 35%. Spruce is an important species to the sawmilling industry and to the pulping process utilized by Corner Brook Pulp and Paper (i.e. certain composition of spruce required).



Concerns still exist over the potential deregulation of BSLB pest and its spread to the island. A discussion was held with senior CFIA and NLDNR officials regarding the potential use of measures at the Ferry Terminal in North Sydney to reduce the risk of spread of BSLB to the island.

Given the new BSLB detections in Kouchibouguac National Park, and the potential link to firewood movement by the public, the addition of traps in Gros Morne and Terra Nova National parks as part of CFIA BSLB detection efforts on the island should also be considered for 2015.

Native Forest Pests

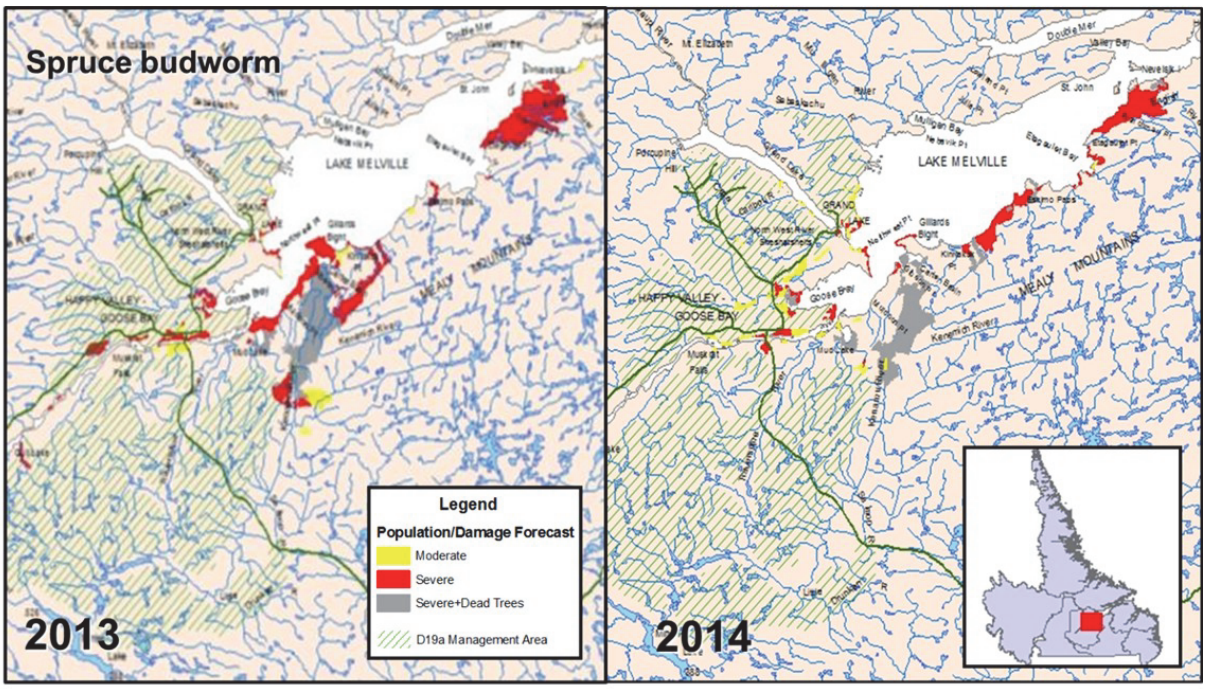
Major native forest insect pests are monitored annually by the Province. They include the eastern spruce budworm (SBW), eastern hemlock looper (HL), balsam fir sawfly (BFS), as well as other minor pests. Aerial control programs are also conducted as needed to protect the forest resources of the province.

Control in 2014

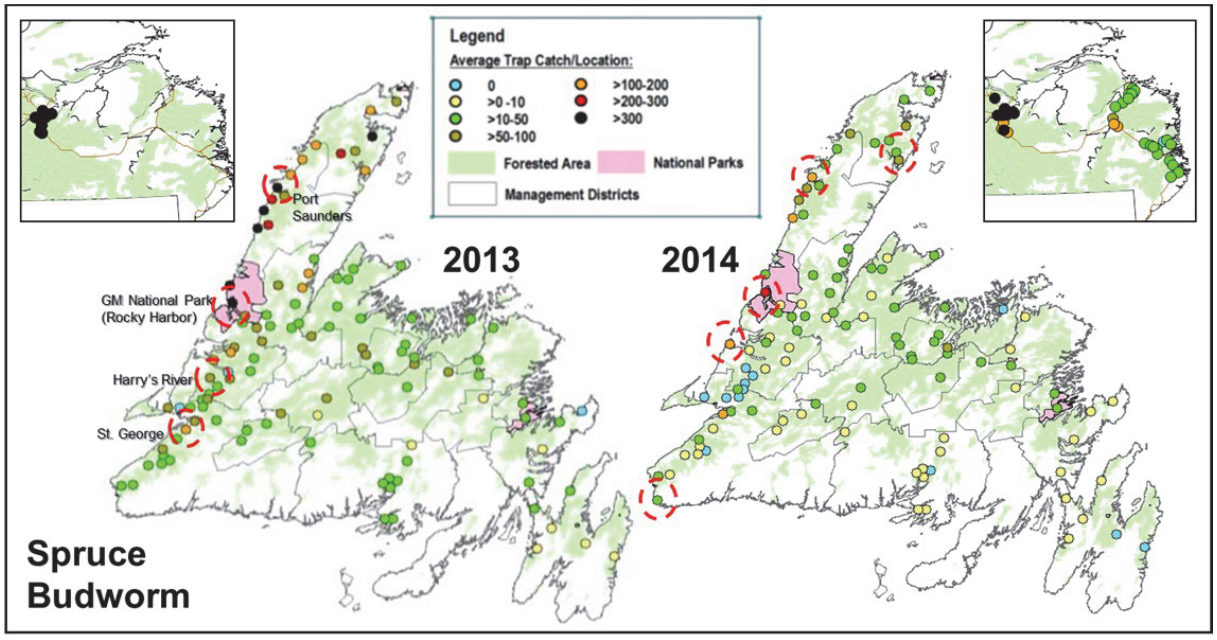
With populations of major forest insects forecasted to be at low levels across the island in 2014, no aerial control program was required. This is only the third time in the last 36 years that no aerial control program has been conducted in Newfoundland. In Labrador, SBW populations were forecast to be active again for the eighth straight year in the Goose Bay area; however, the absence or lack of a forest industry in the area precluded the need for any protection.

Eastern spruce budworm

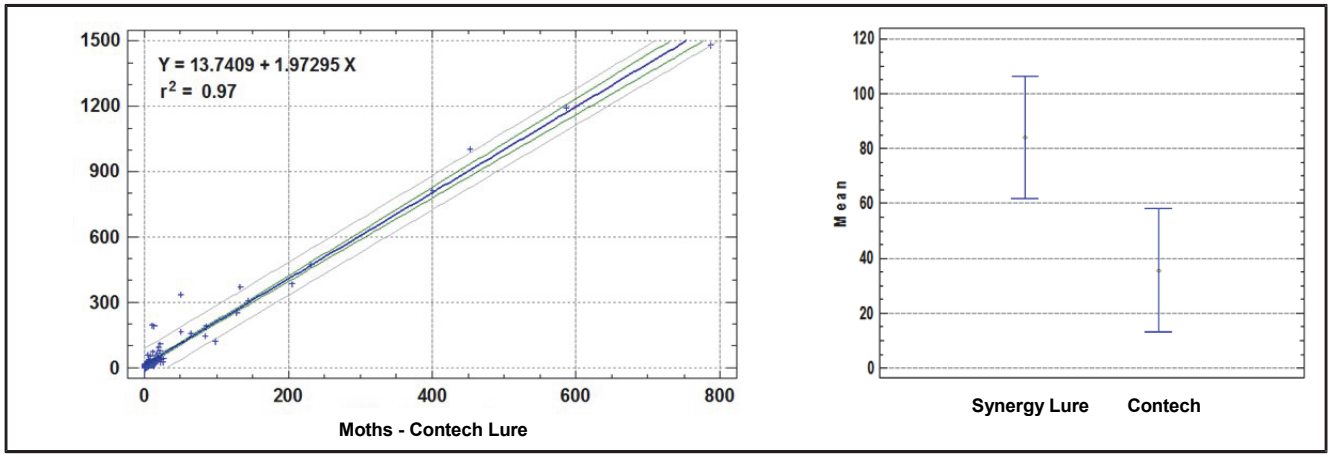
Aerial Defoliation Survey Results – As expected, moderate to severe (M-S) defoliation was observed again in the Goose Bay area in 2014. A total of 50,767 ha of defoliation were mapped. Mortality was observed within half of this area. The total area defoliated in 2014 was lower than the 82,230 ha of M-S defoliation observed in 2013 (see map below). On the island of Newfoundland, no SBW defoliation was observed in 2014.



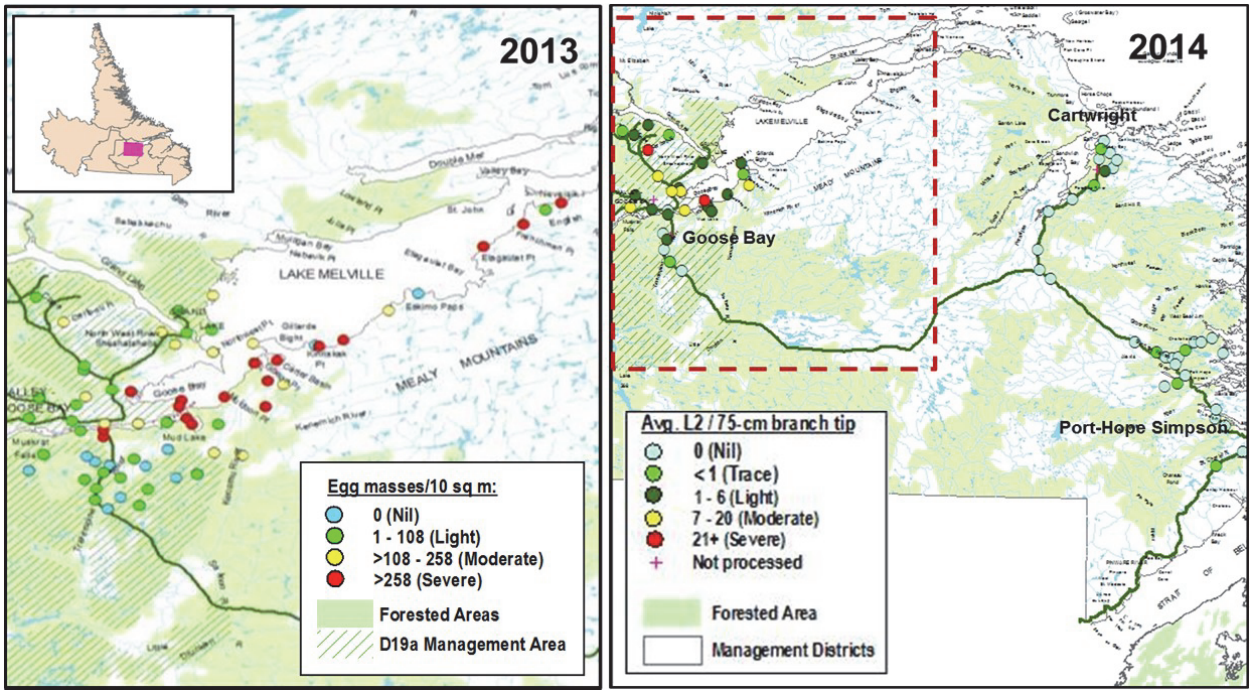
Pheromone Trapping Results – In response to rising SBW populations in the province of Quebec, NL increased its pheromone trapping network to ca. 100 locations on the island in 2012. Two Unitrap® non-saturating traps are placed 30-40 m apart at each location. Each trap contains one 330 µg SBW flex lure and one Vaportape killing strip. In 2014, based on differences in seasonal development traps were placed over the period of June 16 to July 4 in advance of the adult flight period. Unlike in 2013, where a 2-4x increase was noted in trap catches particularly on the northern Peninsula, trap catches dropped by the same order of magnitude in 2014. The overall provincial trap catch decreased from 86.3 moths per trap to 23.4 moths per trap. In a similar fashion, traps used on the west coast and northern peninsula for monitoring moth migration into the province detected little or no moth immigration in 2014 compared to 2013. In Labrador, the trapping network for monitoring SBW populations was expanded to include the Cartwright and Port Hope Simpson areas. Within the Goose Bay area, in Labrador, where SBW populations remained active, trap catches ranged from 158 to 1479 moths per trap.



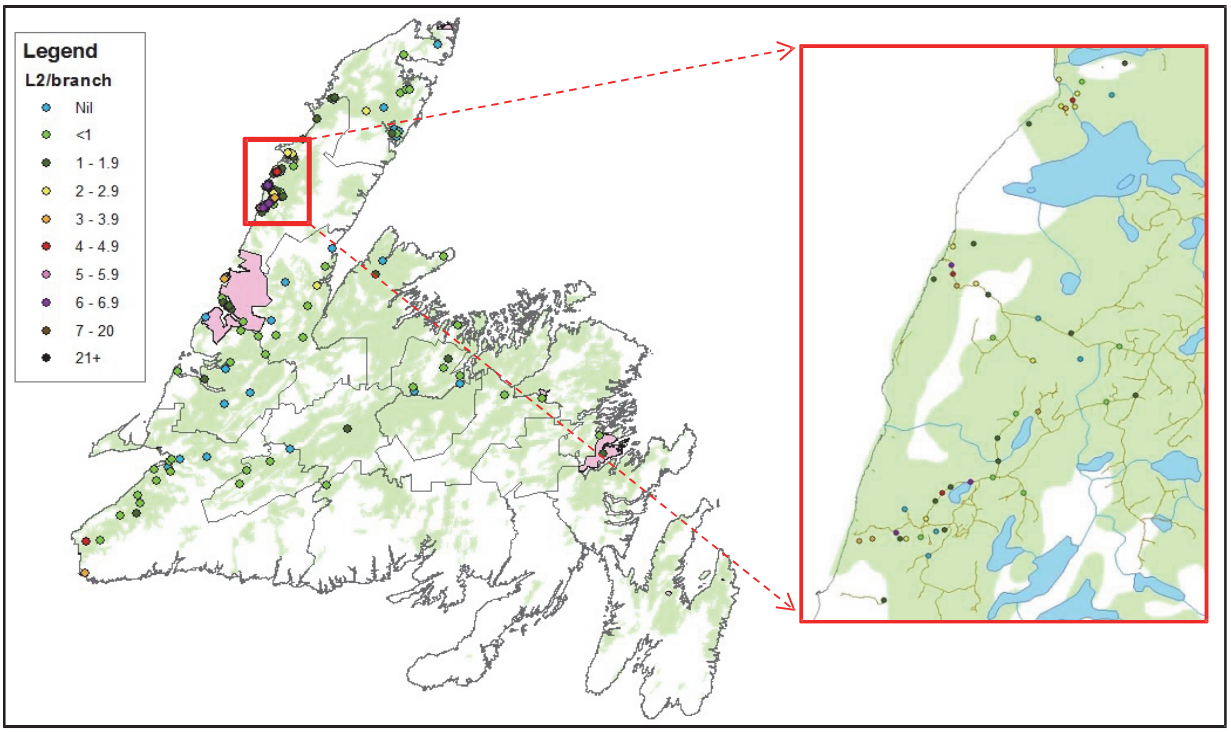
In 2014, SBW pheromone trapping activities also included a paired comparison of trap catches using 330 µg SBW flex lures supplied by two different suppliers (Contech and Synergy). The province of NL started using the SBW 330 µg flex lure from Synergy in 2012. Traps were paired at 116 locations and, surprisingly, trap catches were consistently 2x higher in the traps using the Synergy versus the Contech lure. Given both lures had the same pheromone load, the reason for these differences in trap catch was unknown. Lures from both suppliers were provided to Dr. Peter Silk of the CFS to examine the release rates. Regardless of exposure time he found the release rate of the Synergy lure to be roughly 2x higher. This difference in release rate and subsequent trap catches will obviously have implications when year to year trends or results between jurisdictions are examined.



Forecast/Outlook for 2015 – To forecast SBW population and damage levels expected in 2015, collection and processing of branch samples for overwintering second instar (L2) larvae was conducted. Sampling in Labrador was expanded in 2014 to also include the Cartwright and Port-Hope Simpson areas. L2 results from Labrador indicate that SBW populations capable of causing M-S defoliation will again be active in the Goose Bay area in 2015 – this will be ninth consecutive year that populations have been active in this area.



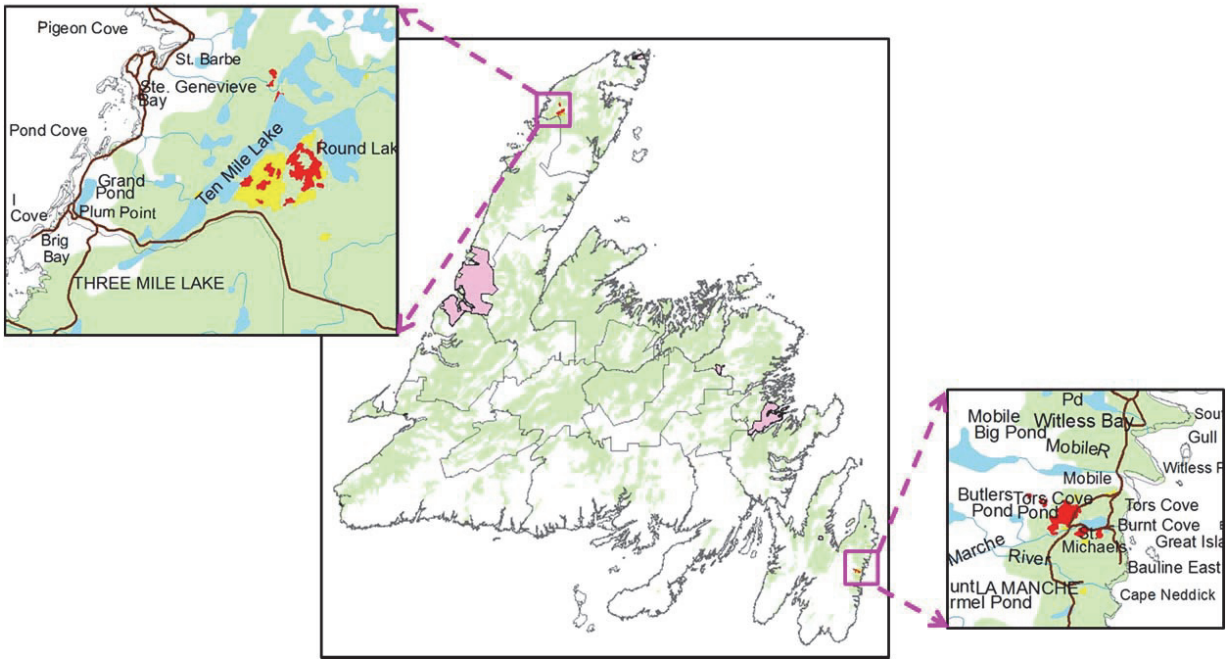
On the island, in 2014, 140 locations were assessed for L2s, with special attention given to areas on the northern and along the west coast (i.e. areas where evidence of moth immigration was observed in 2012 and 2013). Of the 140 locations assessed, 27 locations were NIL, 51 had trace populations with <1 L2/branch, and 62 locations had low populations (1-6 L2/branch) capable of causing light defoliation. The area where the highest low counts were observed was on the northern peninsula in an area north of Gros Morne National Park. This is the same area where evidence of moth immigration was observed in 2013 along with high pheromone trap catches. L2 populations at five locations within this area are above the threshold of four or more L2/branch suggested by Dr. Jacque Régnière for early intervention of SBW.



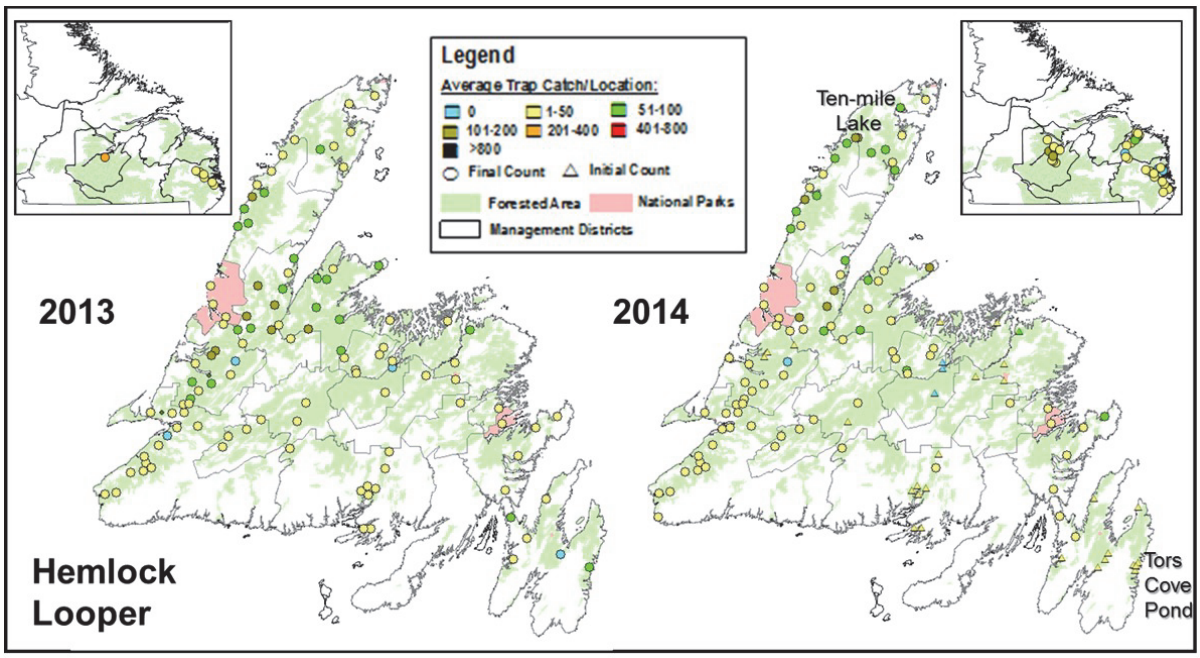
Additional supplementary L2 sampling is still being conducted in this area to determine if early intervention is needed in 2015. In the absence of any control, on-going monitoring of SBW populations is being considered.

Eastern Hemlock Looper

Aerial Defoliation Survey Results – In 2014, 2,506 ha of M-S defoliation caused was unexpectantly found on the Northern Peninsula. Another 577 ha of M-S defoliation was also observed on the Avalon Peninsula near Tors Cove Pond; however, this area of defoliation was expected based on forecasted population/damage levels for 2014.

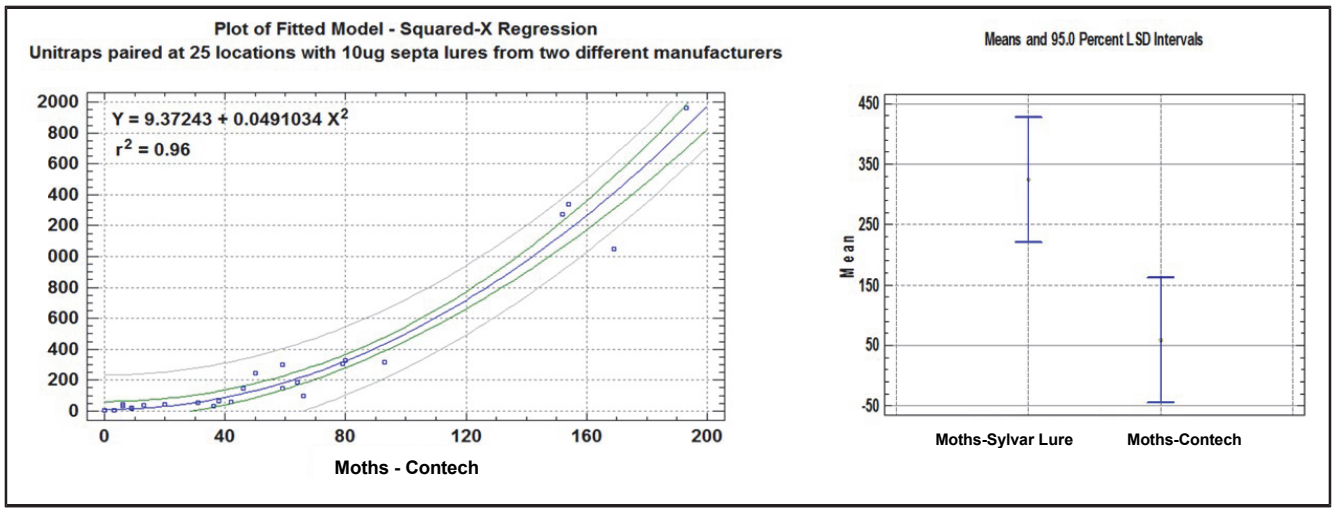


Pheromone Trapping Results – With the decline of HL in NL in recent years, a pheromone trapping network to monitor low density HL populations was established in 2011. This network of traps was increased in 2012 to ca. 100 locations. Two Unitrap ® non-saturating traps are placed 30-40 m apart at each location. Each trap contains one 10 µg HL septa lure and one Vaportape killing strip. Based on differences in seasonal development in 2014 traps were placed over the period of August 11–25 in advance of the adult flight period. On the island little change was observed in trap catches between 2013 and 2014. Even in areas with noticeable defoliation on the northern peninsula, only slight increases in trap catches were noted. Unlike in 2012, where trap catches of 300-500 moths were found in areas subsequently forecast to have M-S defoliation, trap catches in the last several years have been less responsive to increases in HL populations. The reasons for this are unknown.

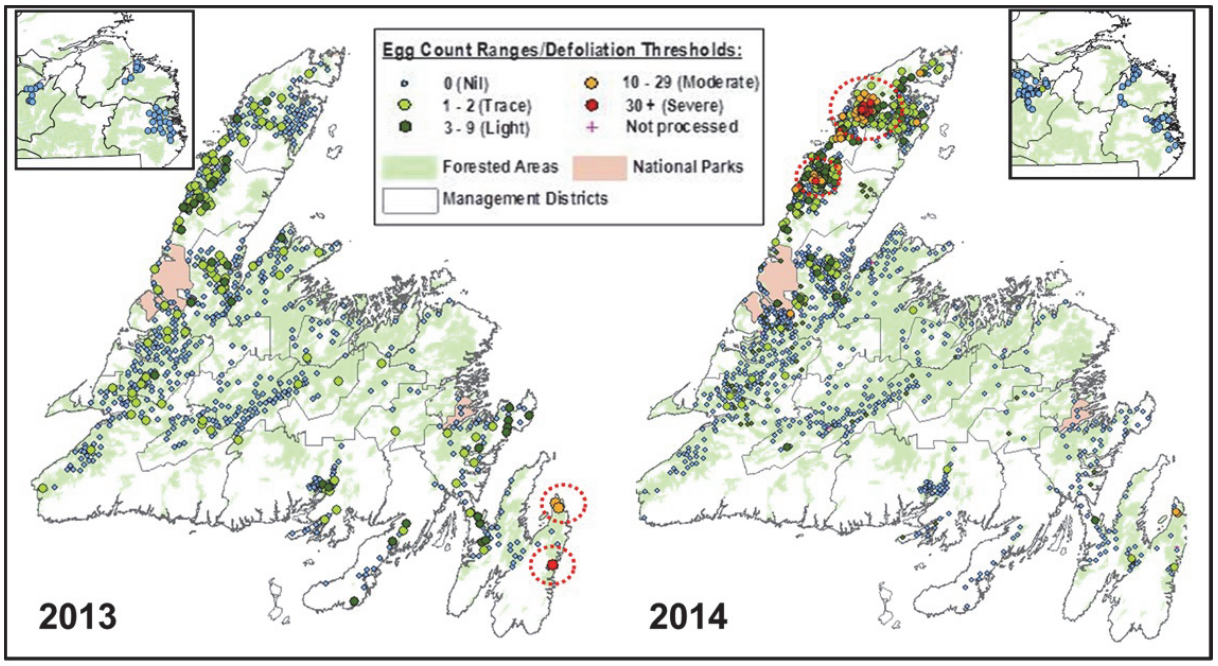


In 2014, the pheromone trapping network was expanded in Labrador to improve HL monitoring in the Goose Bay and Port-Hope Simpson areas, and conduct monitoring in the Cartwright area. Trapping results in Labrador indicate HL populations are present in all three areas at low levels.

In 2014, HL pheromone trapping also included a paired comparison of trap catches using 10 µg HL septa lures supplied by two different suppliers (Contech and Sylvar Technologies Inc.). The province of NL has been using the 10 µg HL flex lure from Contech since 2011. Traps were paired at 25 locations. Surprisingly trap catches were consistently higher in traps using the Sylvar Technologies Inc. lure. Given both lures had the same pheromone load, differences in the pheromone blend were likely responsible for differences in trap catches with the Sylvar Technologies Inc. lure more responsive to changes noted in HL population density.



Forecast/Outlook for 2015 – To forecast HL population and damage levels expected in 2015, collection and processing of branch samples for overwintering eggs was conducted. Sampling in Labrador was expanded in 2014 to also include the Cartwright and Port-Hope Simpson areas.



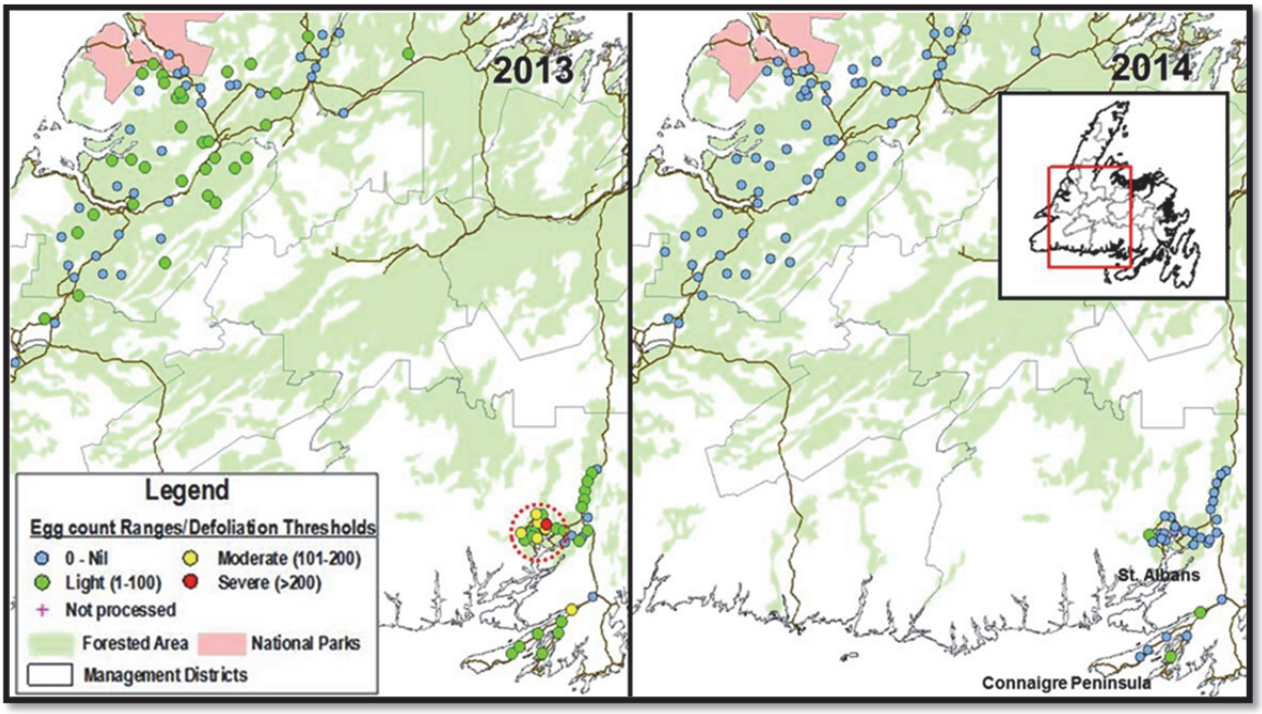
Sampling levels were increased from 735 plots in 2013 to 1139 plots in 2014 with increases primarily on the northern Peninsula. As indicated in the map above, HL populations capable of causing M-S defoliation in 2015 have erupted on the northern Peninsula in the Ten Mile Lake and Hawkes Bay area. The gross forecasted area is ca. 11,000 ha. Supplementary sampling is still being conducted to better define these areas in anticipation of a potential control program in 2015.

Balsam Fir Sawfly

Aerial Defoliation Survey Results – No balsam fir sawfly (BFS) defoliation was detected on the island in 2014.

Pheromone Trapping Results – In-kind support to help develop a pheromone lure for monitoring of BFS populations was provided to Dr. Gaetan Leclair in 2014 with results to be reported at SERG-I.

Forecast/Outlook for 2015 – To forecast BFS populations and damage levels expected in 2015, collection and processing of branch samples for overwintering eggs was conducted at 94 locations. Collapse of BFS populations on Connaigre Peninsula and St. Albans area continued as expected with only three locations found to have a light forecast. On the west coast, concerns over the start of an increasing trend in BFS populations based on results in 2013 were put to rest with no BFS eggs found at locations on the west coast in 2014.



Other Forest Pests

Other forest pests and damage observed in the province of NL in 2014 included: i) Poplar sawfly in the St. Anthony area on the northern Peninsula, ii) Serpentine leafminer damage on aspen in portions of Labrador, iii) Spruce needle rust in areas on the northern Peninsula, iv) Maple tar spot on maples in central/eastern portion of the island, v) reddish-brown discoloration in upper crowns of balsam fir trees over wide-spread areas of island caused by heavy cone crops 2-3 years ago; and vi) moose browse damage on conifers in National Parks and silvicultural areas on island.


Poplar sawfly
Serpentine leafminer
Spruce Needle Rust
Maple Tar Spot
Discoloration of crowns on balsam fir caused by heavy cone crop
Moose Browse

Nova Scotia Report

Gina Penny

Nova Scotia Department of Natural Resources, Risk Services Unit P.O. Box 130, Shubenacadie, Nova Scotia B0N 2H0

The last **Eastern blackheaded budworm (*Acleris variana*)** outbreak erupted in 2004, covering approximately 114,000 hectares, in the Cape Breton Highlands. In 2014, an overwintering egg survey was conducted at 68 sites in the Eastern Region. Eggs were detected at 74% of sites surveyed down from 82% in 2013. A pheromone trial was initiated in 2013, using a pheromone synthesized by researchers at the Canadian Forest Service. It was deployed in 40 multipher traps throughout the Cape Breton Highlands. The trial was repeated in 2014 and there was a substantial increase in both the average and maximum trap catches as compared to the previous year. Average moths per trap rose from 39 to 161 and the maximum number of moths captured increased from 144 to 884.

The **spruce budworm (*Choristoneura fumiferana*)** has caused more damage to Nova Scotian softwood forests than any other insect. In 2014, Forest Health staff monitored 144 pheromone traps province wide of which 60% were positive, down from 92% recorded in 2013. Average moths per trap and maximum trap catch were also down with two moths per trap and 23 moths respectively as compared to 19 moths per trap and 206 moths the year previous. The number of sites sampled for overwintering second instar larvae (L2s) was increased from 287 in 2013 to 299 in 2014. One percent of these sites were positive, with three L2s being detected in Victoria County, Cape Breton. This is half the number detected in 2013. However, it is still noteworthy as this is the second year in a row that L2s have been found. Prior to 2013, no L2s had been detected in Nova Scotia since 1994.

Jack pine budworm (*Choristoneura pinus pinus*) defoliation was first detected in 2005 within a mature white pine stand in the Western Region. In 2014, Forest Health staff monitored 40 pheromone traps in the Central and Western regions. Both the percentage of positive traps and average trap catch were down with 63% of traps positive and three moths per trap respectively as compared to 88% positive and six moths per trap in 2013. Three sites were surveyed for overwintering second instar larvae (L2s) in 2014. Of the sites surveyed, 33% were positive, up from 10% in 2013. Whereas the mean L2/m^2 bark is down from 23 in 2013 to two in 2014.

Since 1961, the **hemlock looper (*Lambdina fiscellaria fiscellaria*)** has defoliated approximately 135,000 hectares in Nova Scotia. Control programs were conducted in portions of Victoria and Inverness counties 1996 and 1997. Forest Health staff monitored 143 pheromone traps province wide in 2014. As in 2013, 96% of these traps were positive. However, both the average and the maximum trap catches have risen. In 2014, the average moths per trap was 63 with a maximum trap catch of 375 moths as compared to 42 moths per trap and a maximum of 332 moths in 2013. Overwintering egg surveys were conducted at 40 sites in the eastern region. Eggs were detected at 7.5% of sites sampled, down from 15% in 2013 and 24% in 2012.

Recorded outbreaks of the **balsam fir sawfly (*Neodiprion abietis*)** in Nova Scotia date back to 1942. In 2014, our overwintering egg survey included 152 sites in the Eastern and Central Regions. The percentage of positive sites has steadily decreased over time from a high of 59% in 2011 to 22% in 2014. Mean egg niches per 100 cm branch have followed the same path, dropping from a high of 36.6 in 2010 to 0.59 in 2014.

The last **whitemarked tussock moth (*Orgyia leucostigma*)** outbreak occurred in 1998 covering 1.4 million hectares in central and northern Nova Scotia. Since that time two mini population eruptions have occurred: Cape Breton in 2005 and Guysborough in 2007. In 2014, 319 sites were sampled province wide for overwintering egg masses. The percentage of sites where egg masses were detected has dropped by half from 10% in 2013 to 5% in 2014.

Forest Health staff monitor **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 the 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 gall midge damage. Of the 152 sites surveyed in 2014, 13% had balsam twig aphid damage and seven percent had balsam gall midge damage.

Balsam woolly adelgid (***Adelges piceae*)** overwintering was surveyed at 18 permanent monitoring plots province wide in the spring of 2014. Increased populations were detected at five plots, seven plots had decreased populations and no change was detected in the remaining six plots. One of the most important natural factors limiting adelgid populations is temperature. Mortality of overwintering nymphs increases as temperatures dip below -20°C and temperatures of -30°C or lower are fatal. Late spring frosts will also kill exposed feeding nymphs. When the minimum temperatures recorded at each of these plots during the winter of 2013-14 were examined, on average, plots where populations increased recorded four days at or below -20°C while plots where populations decreased recorded eight days at or below -20°C. These extra cold days may have been sufficient to result in some of the observed mortality. Forest Health staff also monitor balsam woolly adelgid populations in a more general way. Balsam fir branches collected for the balsam fir sawfly survey are visually inspected for adelgid damage. Three live buds per branch are also examined for the presence of overwintering adelgid nymphs. In 2014, overwintering nymphs were found at 12% of the 152 sites surveyed, down from 24% in 2013 while none of the sites surveyed had gouted branches; down from 2% in 2013.

Forest Health staff, in cooperation with the Canadian Food Inspection Agency, conduct detection surveys for the **hemlock woolly adelgid (*Adelges tsugae*)**. A native of Asia this insect is a threat to eastern hemlock forests. In 2014, 11 remote hemlock stands were surveyed in the western region and no hemlock woolly adelgids were detected.

Forest Health staff collaborate with the Canadian Food Inspection Agency when conducting pheromone surveys for the **gypsy moth (*Lymantria dispar*)**. Our portion of the survey is conducted in two parts. Individual multipher traps are deployed at designated sites province wide to monitor population trends, while delta traps are placed in towns outside of the Canadian Food Inspection Agency's regulated zone to determine if the population is spreading into new areas. In 2014, 21 multipher traps were deployed province wide; 76% of these were positive, up from 67% in 2013. Average moths per trap are up with 231 moths captured in 2014 versus 220 in 2013. Delta traps were deployed throughout nine towns (10 traps/town) outside of the Canadian Food Inspection Agencies regulated zone. Average trap catches in all of these towns were less than one moth per trap. Since 2000, with the exception of a large increase in the town of Cheticamp in 2002, average trap catches in towns outside of the regulated zone have consistently remained below two moths per trap.

The **beech leaf-mining weevil (O*rchestes fagiis*)** is a common and widespread pest of beech in its native Europe. In 2012, surveys conducted by the Canadian Forest Service and the Canadian Food Inspection Agency, found it to be well established in Nova Scotia (primarily within a 20-km radius of Halifax, but also near Sydney and Chester). This is the first record of this pest in North America. Currently the Canadian Forest Service and the Canadian Food Inspection Agency are collaborating on surveys to determine the weevil's distribution and risk to beech in North America. During the summer of 2014, a detection survey was completed by the Canadian Food Inspection Agency in the Maritime Provinces. Beech stands in both forested and urban environments were targeted. Visual surveys for symptoms of attack were conducted and branches were beaten for adults. In Nova Scotia three new positive locations, all located in Cape Breton County, were detected.

The **brown spruce longhorn beetle (*Tetropium fuscum*)**, native to northern and central Europe, arrived in Halifax in the 1990s. As part of a joint effort, the Forest Health unit works with the Canadian Food Inspection Agency and the Canadian Forest Service to monitor the beetle's spread within the province. The 2014 detection survey included extensive pheromone trapping in Eastern Canada. In Nova Scotia, there were five new positive sites detected outside of the brown spruce longhorn beetle regulated area in the counties of Colchester (2), Pictou (1), and Guysborough (2). In New Brunswick there were two new positive locations. One within the South Kouchibouguac Campground at the Kouchibouguac National Park and one in Memramcook, Westmorland County. These new finds brings the total number of positive sites outside of the brown spruce longhorn beetle regulated area to 109. All of the traps deployed in Newfoundland and Labrador, Prince Edward Island, and Quebec were negative for brown spruce longhorn beetle.

Post tropical storm Arthur made landfall in Nova Scotia on July 5, 2014, reaching maximum sustained wind speeds of 110 km/h. During the provincial aerial overview survey, low - extensive wind damage was recorded over a 64,040 hectare area. Damage was more profound in coastal areas due to the salt spray associated with the storm surge. Pockets of damage were also recorded province wide as a result of spruce beetle (*Dendroctonus rufipennis*) mortality (534 ha), Sirococcus shoot blight (*Sirococcus conigenis*) damage (2098 ha), and flooding (3906 ha).

Session IV: United States Report

(Unavailable)

Session V: Eastern Pest Management Issues

New Brunswick Report

Forest Pest Management Group

New Brunswick Department of Natural Resources, 1350 Regent St. P. O. Box 6000, Fredericton New Brunswick E3B 5H1

This summary provides an overview of the status of forest insect and pest conditions in New Brunswick (NB) in 2014, and highlights many of the pest management activities of the NB Department of Natural Resources' Forest Pest Management Group (FPMG). If required, the reader can contact FPMG for further information.

From the 1950s to the 1990s, **spruce budworm** was the most serious forest pest in NB, and across many jurisdictions in eastern North America. No defoliation has been detected in NB since 1995. Since 1997, there has been an irregular though gradually increasing trend of populations as indicated by annual changes in moth catches in a pheromone trapping survey, particularly in the northern part of the province. This trend has gained more attention in light of the increasing outbreak in Québec, with defoliation mapped approximately 15-25 km from the NB border in each of the last three years. FPMG significantly increased its monitoring effort of spruce budworm in 2012. This was further increased in 2013 with a collaborative overwintering (L2) larval sampling program between FPMG and forest industry. This cooperative L2 survey was continued in 2014 with 1543 plots being sampled. This enhanced sampling effort was conducted throughout New Brunswick, regardless of land ownership but was concentrated in the northern half of the province. A further 279 locations were sampled by the Canadian Forest Service as part of their research effort under the Healthy Forest Partnership's Early Intervention Strategy research project in the winter of 2015. No defoliation was observed from aerial and ground surveys and spruce budworm overwintering larvae were detected at 20% of the 1543 cooperative L2 survey plots. Positives, mostly trace to very low counts, were primarily concentrated in northern New Brunswick. However, two pockets of moderate populations were detected; one in an area south of Campbellton and the other in north-western NB adjacent to the Quebec border. These areas have been selected as locations for early intervention research in 2015. In light of the proximity of the outbreak in Québec, and based on rising L2 counts, there is a high probability that the first pockets of light defoliation will be detected in northern NB in 2015, the first time since the collapse of the last outbreak in 1995.

In 2011, a single **brown spruce longhorn beetle** was found in Kouchibouguac National Park, most likely transported to the park in a piece of firewood from Nova Scotia. In the fall of 2011, the Canadian Food Inspection Agency (CFIA) in collaboration with Parks Canada and the Canadian Forest Service collected logs from sixteen trees with symptoms of brown spruce longhorned beetle (BSLB) attack and placed them in facilities where scientists observed for beetles emerging from the logs. No BSLB were detected in these. In 2012 and 2013 approximately 100 pheromone-based traps hung by federal agencies within Kouchibouguac National Park also failed to catch a single beetle. In 2012, FPMG conducted visual assessments of spruce trees at 282 locations throughout the province looking for signs and symptoms of BSLB attack (in conjunction with other operational surveys). In 2013 and 2014, assessments were again conducted by FPMG, this time at 259 and 363 locations, respectively, throughout the summer months. No suspect trees were found either year.

However, that was not the case from surveys conducted in 2014 by the CFIA, with the aid of Parks Canada in Kouchibouguac National Park. From trapping conducted throughout New Brunswick, two

sites were found positive, one in Memramcook and one in Kouchibouguac National Park. For the Memramcook detection, CFIA placed more traps in the area around the original find, but no additional beetles were caught. The property on which this beetle was detected is now under a federal Prohibition of Movement order. A Prohibition of Movement order has been in place for Kouchibouguac National Park since the first beetle find in 2011, so the new beetle detection does not require a new order.

Balsam fir sawfly is a native insect that feeds mainly on balsam fir. The larvae feed on older needles leading to reduced volume increment, weakened trees and sometimes tree mortality. Since the population collapse observed in 2012, no forecast surveys have been required.

Hemlock looper populations remain at endemic levels, with pheromone trap catches declining from those levels found the previous year.

Sirococcus shoot blight is a fungal disease affecting primarily red pine. Years with wet weather in May and June often result in intensification of disease symptoms (branch dieback and, after successive attacks, tree mortality). In 2012, appropriate methodology was developed to evaluate the severity and distribution of the disease in red pine stands. Assessments by FPMG and Regional Pest Detection Officers revealed that Sirococcus is widespread and a large portion of assessed stands are at a high risk of experiencing tree mortality within the next five years. In 2013, further assessments were conducted, with an increased proportion assessed from the northern half of the province. Between 2012 and 2013, 455 red pine stands totaling 2819 ha have been assessed. Of this area, 656 ha (23%) were classed as at high risk. Red pine stands with significant damage continued to be found in 2014.

Balsam gall midge has been in an outbreak phase in the province for the last eight years. In 2012, 91% of locations assessed for balsam gall midge injury had detectable levels of damage. This declined to 58% in 2013 and then to 6% in 2014, indicating this insect is now at or near the trough in its population cycle. Populations and damage typically remain very low for several years following the collapse of an outbreak cycle.

In 2014 many **other forest health problems** were monitored through targeted and/or general surveillance surveys. While a wet spring and summer led to a higher than normal incidence of foliar diseases such as needle casts and needle rusts in 2013, disease symptoms once again dropped to more typical background levels in 2014. Forest tent caterpillar defoliation was mapped from aerial and ground-based surveys over an area of ~3400 ha in north-east New Brunswick. Birch skeletonizer and fall webworm was widely observed throughout parts of the province. On July 5, post-tropical storm Arthur caused significant property damage and impacts on urban trees, but no catastrophic losses were observed at the larger forest scale. Very limited and localized damage caused by balsam fir tip blight (*Delphinella balsameae*), balsam woolly adelgid, birch leafminer, white pine weevil, and pitch nodule makers was also observed in 2014.

Quebec Report
(Available in French only)

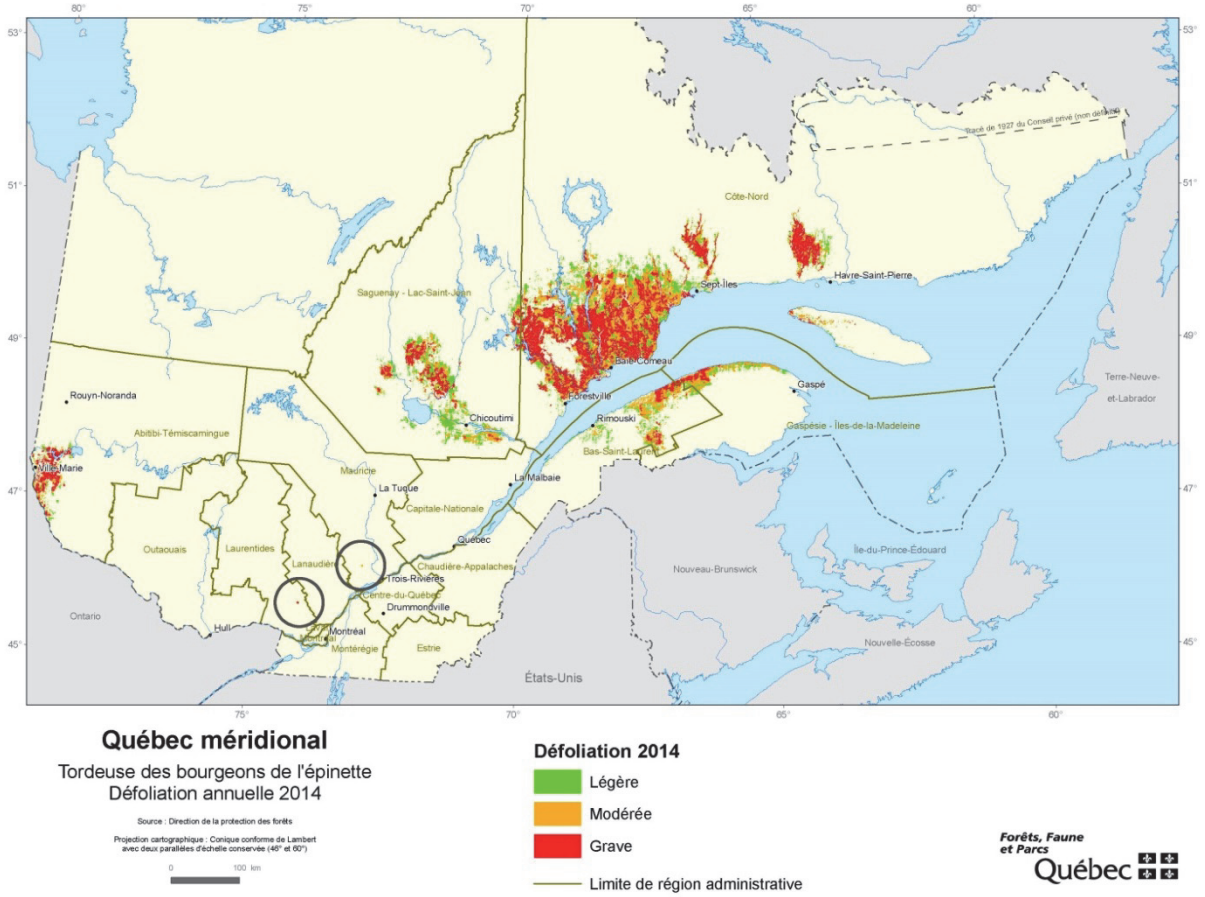
Louis Morneau*, *Cédric Fournier, Julie Bouchard, Pierre Therrien, Danièle Pouliot and Sébastien Bélanger

Ministère des Forêts, de la Faune et des Parcs du Québec, Ministère des Ressources naturelles du Québec, 2700 Einstein Street, Suite D.2.370A, Québec, Quebec G1P 3W8

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

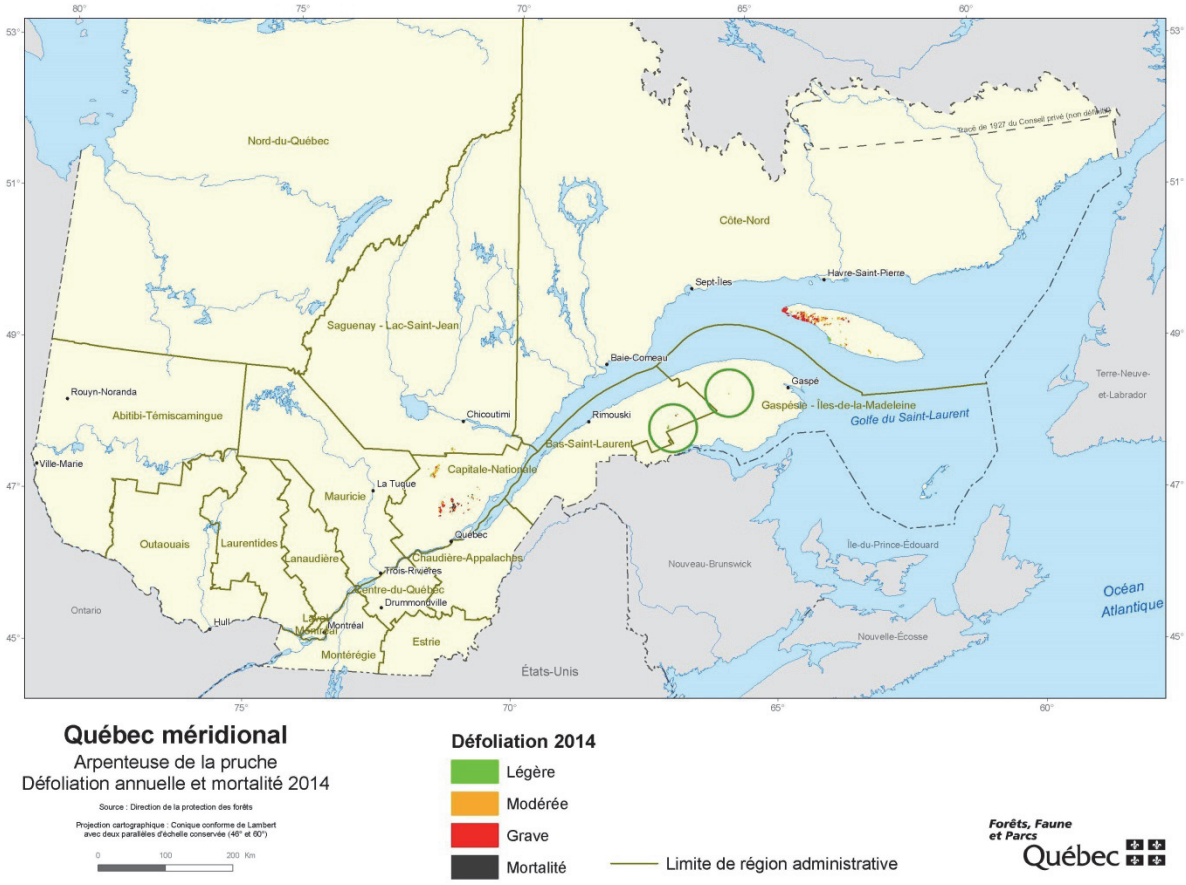
Le mandat de détection des insectes et maladies dans les forêts québécoises est assumé chaque année par la Direction de la protection des forêts (DPF) du ministère des Forêts, de la Faune et des Parcs (MFFP). Cette activité permet notamment d'identifier et de localiser les infestations d'insectes forestiers 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 15 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 2014, les techniciens en protection des forêts ont visité 2 593 sites d'observation, dont 539 plantations de pins, d'épinettes, de mélèzes et de feuillus. De plus, le personnel a effectué des relevés aériens afin de détecter et de circonscrire les dégâts causés par la tordeuse des bourgeons de l'épinette, l'arpenteuse de la pruche, le diprion de Swaine et des chablis, ce qui a requis environ 390 heures de vol. Enfin, 20 pépinières publiques et privées ont fait l'objet d'inspections phytosanitaires. Des lots totalisant quelque 138,8 millions de plants ont été examinés lors des inspections de certification et quelque 9,7 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 2014 totalisent 4 275 065 hectares (carte 1) comparativement à 3 206 024 hectares en 2013 et à 2 226 095 hectares en 2012. Les régions les plus touchées sont la Côte-Nord, le Saguenay–Lac-Saint-Jean, le Bas Saint Laurent, l'Abitibi-Témiscamingue et la Gaspésie–Îles-de-la-Madeleine. La répartition des dommages dans ces régions est, respectivement, de 69 %, 15 %, 7 %, 5 % et 4 % du total provincial. Les infestations relevées dans la région de la Mauricie et celle des Laurentides sont minimes. Ailleurs au Québec, aucune aire défoliée n'a été détectée par le survol aérien. Un plan d'intervention contre la TBE a été mis en œuvre pour une première année dans la région du Bas-Saint-Laurent en 2014. Dans la région de la Côte Nord et celle du Saguenay–Lac Saint Jean, des interventions de lutte directe sont menées depuis 6 et 5 ans, respectivement. L'objectif est de limiter la défoliation par l'insecte dans des peuplements forestiers ciblés afin de maintenir les arbres en vie. La Société de protection des forêts contre les insectes et maladies (SOPFIM) est l'organisme délégué pour la mise en application de ce plan. Des pulvérisations aériennes avec un insecticide biologique, le *Bacillus thuringiensis* var. *kurstaki* (Btk), ont été réalisées du 1er au 28 juin sur une superficie totale de 148 006 hectares comparativement à 120 310 hectares en 2013. Le site Web de la SOPFIM (www.sopfim.qc.ca) contient de plus amples renseignements sur les résultats du plan d'intervention 2014.



Carte 1. Défoliations causées par la tordeuse des bourgeons de l'épinette au Québec en 2014.

Les superficies touchées par l'arpenteuse de la pruche, *Lambdina f. fiscellaria*, ont diminué en 2014 dans la région de la Capitale-Nationale comparativement à 2013 (carte 2). De la mortalité a été observée dans des sapinières sur 680 hectares. De nouveaux foyers sont apparus plus au nord et jusque dans la région du Saguenay–Lac-Saint-Jean (353 hectares). Les défoliations causées par l'arpenteuse de la pruche sur l'île d'Anticosti depuis 2012, dans la région de la Côte-Nord, ont diminué pour totaliser 11 273 hectares en 2014 dans l'ouest de l'île. De plus, une partie des dommages est attribuable à la tordeuse des bourgeons de l'épinette qui est aussi en période épidémique dans la région. On trouve quelques foyers de défoliation dans la région du Bas-Saint-Laurent et dans celle de la Gaspésie–Îles-de-la-Madeleine. Aucun dommage significatif important n'a été observé ailleurs dans la province.



Carte 2. Défoliations causées par l'arpenteuse de la pruche au Québec en 2014.

Aucune défoliation par la tordeuse du pin gris, *Choristoneura p. pinus*, n'a été détectée par le relevé aérien des dommages en 2014 et les captures de papillons dans les pièges à phéromones demeurent faibles. Le déclin des dommages causés par la cochenille-tortue du pin, *Toumeyella parvicornis*, s'est poursuivi en 2014 dans l'ouest de la province.

La livrée des forêts, *Malacosoma disstria*, cause depuis 3 ans des dommages localisés dans l'ouest de la province. En 2014, quelques milliers d'hectares sont touchés près de Matagami, Rouyn-Noranda et Duparquet.

L'Agence canadienne d'inspection des aliments (ACIA) a confirmé la présence de l'agrile du frêne, *Agrilus planipennis*, dans la région de la Montérégie en juin 2008. La progression de l'insecte est en constante évolution depuis au Québec. En 2014, la DPF a installé 20 pièges afin de détecter cet insecte en dehors de la zone réglementée de Gatineau. Un piège s'est révélé positif au nord de Notre Dame du Laus. L'ACIA a consolidé cette année les zones réglementées en une seule zone pour le Québec et l'Ontario.

En 2014, des maladies du feuillage et des pousses ont été détectées dans plusieurs régions du Québec. La rouille des aiguilles de l'épinette causée par *Chrysomyxa spp*. a été très abondante sur l'épinette blanche, l'épinette noire et l'épinette bleue du Colorado dans certaines régions, telle celle du Saguenay-Lac-Saint-Jean. La brûlure en bandes brunes, *Lecanosticta acicola*, sur le pin blanc et la

brûlure en bandes rouges, *Dothistroma pini*, sur le pin rouge engendrent annuellement des chutes d'aiguilles importantes et sont rapportées beaucoup plus fréquemment depuis les cinq dernières années. Il arrive souvent qu'on observe uniquement la pousse annuelle sur les arbres atteints. Les pins affaiblis montrent par la suite des symptômes de dépérissement.

Les brûlures des pousses ont été présentes à de très nombreuses occasions sur les feuillus et les résineux de plusieurs régions du Québec. Le peuplier faux-tremble a été affecté par *Fusicladium elegans* et *F. radiosum var. lethiferum*. Sur le sapin, la brûlure de pousses et la brûlure des aiguilles causées par *Delphinella balsameae* se trouvent à grande échelle mais sont concentrées sur de petites superficies sur le territoire des régions du Bas-Saint-Laurent, de la Gaspésie–Îles-de-la-Madeleine, de la Capitale-Nationale, de la Chaudière-Appalaches et de l'Estrie. Le champignon *Sirococcus conigenus* a endommagé les pousses de plusieurs espèces d'épinettes dans plusieurs régions du Québec.

Le chancre diplodien, causé par *Diplodia pinea* et à l'occasion par *D. scrobiculata*, est de plus en plus souvent rapporté sur le pin rouge et le pin noir d'Autriche. Ces champignons seraient présents naturellement à l'intérieur des tissus de l'hôte (endophytes) et deviendraient actifs lorsque leurs hôtes sont affaiblis. Les conditions climatiques ou édaphiques défavorables telles la sécheresse estivale de 2012, des conditions printanières humides telles celles de 2014 ou encore l'état des sites où les arbres sont établis, sont toutes des causes qui portent atteinte à la santé des arbres.

Un autre fléau est le dépérissement et la mort de nombreux arbres tels les chênes dans des régions où la sécheresse de 2012 a été particulièrement importante. Ces arbres étaient souvent établis sur des sols minces ou argileux. Le dépérissement des arbres est une maladie résultant de l'effet combiné de plusieurs facteurs néfastes d'origines vivante et non vivante. La sécheresse prolongée de l'été 2012, les froids extrêmes de l'hiver 2013-2014, le type de sol non adéquat à l'établissement de l'espèce, les blessures au tronc et aux racines, la chute prématurée du feuillage atteint d'une maladie foliaire et la pollution sont tous en partie responsables de ces dépérissements.

Pour finir, d'importants chablis dans l'est de la province et quelques-uns situés en Outaouais ont été répertoriés en 2014. C'est la tempête Arthur qui a fait le plus de dégâts dans la Baie-des-Chaleurs en Gaspésie. Au total, un peu moins de 10 000 hectares ont été affectés, principalement en forêt privée. Les dommages en forêt ont été considérables, car les vents violents dépassant une vitesse de 100 km/h ont couché des peuplements forestiers feuillus sur les flancs de montagne.

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

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

Status of Important Insects, Diseases, and Abiotic Events Affecting Forest Health in Ontario 2014

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Introduction

Forest health monitoring has been conducted in Ontario since the 1930s under a partnership arrangement between the Ontario Ministry of Natural Resources (OMNRF) and Natural Resources Canada – Canadian Forest Service (CFS). Since 2008 the field program has been designed and led by OMNRF, with CFS providing scientific advice, and leading research projects relevant to monitoring, detection, control, and impact assessment.

In 2014 the scientific and program direction was provided by OMNRF's Forest Health and Silviculture Section. The program implementation and coordination was done by OMNRF's Biodiversity and Monitoring Section. The province was divided into work areas, with 11 Forest Health Technical Specialists (Figure 1) conducting the surveys and monitoring, and participating in several research projects with CFS.

Figure 1. Forest Health Monitoring work areas, 2014.

Insect diagnostics was done through a three-way partnership with OMNRF, CFS, and the Invasive Species Centre. Samples collected by the program were identified by Lena van Seggelen of the Invasive Species Centre. CFS supported insect diagnostics by providing verification of the original insect identification, and access to the Great Lakes Forestry Centre laboratory and insect collection. Results of the insect collections were entered into the national database managed by CFS.

Disease samples were identified by Sylvia Greifenhagen at the Ontario Forest Research Institute. The aerial mapping results of major forest disturbances were collated into maps and graphical reports by OMNRF's Biodiversity and Monitoring Section.

The annual forest health monitoring program has five components:

- Aerial mapping of major forest disturbances (e.g., insect outbreaks, weather events, decline, and disease damage) to quantify their extent and severity.
- Biomonitoring through the collection of insect and disease samples to track occurrence, changes in range or host species attacked, or changes in abundance.
- Special surveys for pests of interests, particularly invasive species, or pests affecting high value trees such as plantations or seed orchards.
- Conducting or supporting research projects in forest entomology, pathology, or weather impacts.
- Temporary and permanent sample plots to monitor health of forest ecosystems.

All forested land in the province, regardless of ownership (e.g., Crown land, private land, county forests, First Nations reserves, provincial parks, federal parks) is monitored each year. The forest pests which are surveyed include native and introduced species. Abiotic events include extreme occurrences such as drought, pollution, frost, freezing, snow, ice, and scorch. Decline events reported by the program can be caused by biotic (e.g., insects or diseases) or abiotic (e.g. drought or pollution) factors, or a combination of these factors.

Weather patterns

Weather affects the growth, phenology (timing of the different life cycle stages), dispersal, and survival of forest insects. Forest pathogens, especially leaf diseases and needle cast fungi, can become much more common during periods of wet or humid weather. Also, extreme weather events such as drought, snowfall, flooding, tornadoes, microbursts, frost, freezing, scorch, and rapid fluctuations in temperature can affect tree health, causing foliage or twig death, or tree decline or mortality.

Spring of 2014 continued the colder than average temperatures of the 2013-14 winter, with snow continuing to fall from March to April, especially in Northeast Region extending into Southern Region. May temperatures were in the normal range throughout most of the province. Temperatures then dropped to below normal in June and July with above normal rainfall occurring most notably in Southern and Northeast regions. The remaining summer and fall months were within average conditions with some high and low spikes in temperature.

The 2014 weather conditions generally favoured tree growth and hence healthy forests. The cooler to normal temperatures were less favourable to insect growth and survival. Fungi likely benefited from the cool wet weather, but did not result in abundant major forest disturbances. An exception was widespread occurrence in early fall of tar spot on maples, especially Norway maples, from Sault Ste. Marie to Sudbury and south.

Extreme weather and abiotic events

Similar to 2013, there were no new drought effects mapped in 2014. Stands affected by the drought of 2012 did however continue to show signs the effects, with standing dead conifer and hardwood trees still detectable.

An ice storm that began December 21 and continued until December 23, 2013 caused extensive damage in southern Ontario. Top, stem, and branch breakage, plus uprooted and bent over trees occurred from north of London through Kitchener into the Golden Horseshoe, then east along the north shore of Lake Ontario, and up the St. Lawrence to Cornwall. Thousands of trees in landscaped areas, riparian zones and other wooded areas were damaged by ice buildup. Trees were affected in urban forests, landscaped areas, riparian zones and other wooded areas. Aerial mapping of the damage was not conducted because of the logistical challenge of conducting low level flights over metropolitan areas. Furthermore, although the damage was extensive it was also inconsistent across the landscape. Severely damaged trees were often adjacent to unaffected trees, making it difficult to delineate and classify the damage. Nonetheless, ground assessments did show that green and white ash trees were the most affected species, whether or not they were infested with emerald ash borer.

In June of 2014, high winds and large hail occurred in the town of South Porcupine (city of Timmins), Timmins District. Hail broke, split and tore away branches and caused damage to main stems on a variety of tree species including white birch, trembling aspen, balsam fir, black and white ash and white and black spruce.

Tornados and high wind events caused 3,415 ha of blowdown across the province in 2014. The majority of damage was recorded in Thunder Bay District (1,867 ha), Northwest Region, with areas affected in Northeast (168 ha) and Southern (136 ha) regions (Figure 2).

Several tornados occurred in Southern Region resulting in severe damage to scattered, open grown trees and woodlot edges. A total of six tornadoes were reported from June 17 to July 30 occurring between Barrie and Orangeville, northwest of Huntsville on Bear Lake, and along the northern boundary of Pinery Provincial Park to Grand Bend. Damage was mostly to wind rows and forest edges.

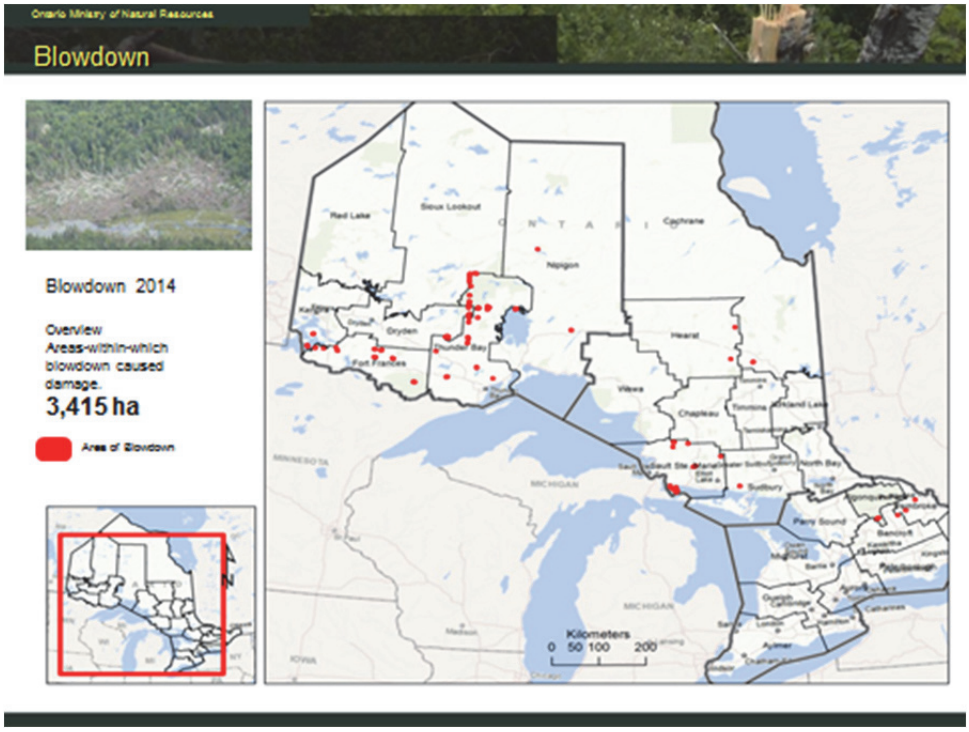

Figure 2. Blowdown and tornado damage in Ontario, 2014.

Insect infestations

The jack pine budworm (*Choristoneura pinus pinus* Freeman) outbreak which had been steadily declining from its peak of 740,116 ha 2006, but increased in 2012 and 2013, returned to a trend of decreasing infestation with 22,010 ha of defoliation in 2014, compared from 83,075 ha in 2013. As in 2012 and 2013, jack pine budworm defoliation in 2014 was restricted to an esker area in Sioux Lookout District, northwest of the town of Sioux Lookout (Figure 3). Relative to its historical levels, jack pine budworm remains at low levels provincially (Figure 4).

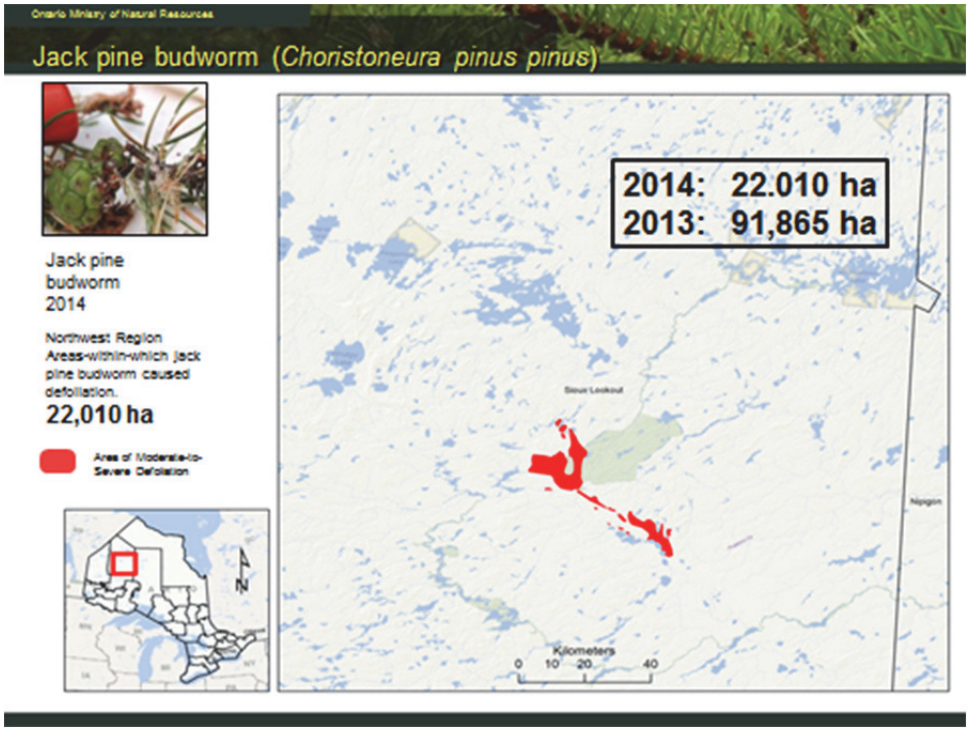

Figure 3. Area-within-which jack pine budworm caused moderate-to-severe defoliation and tree mortality in 2014.

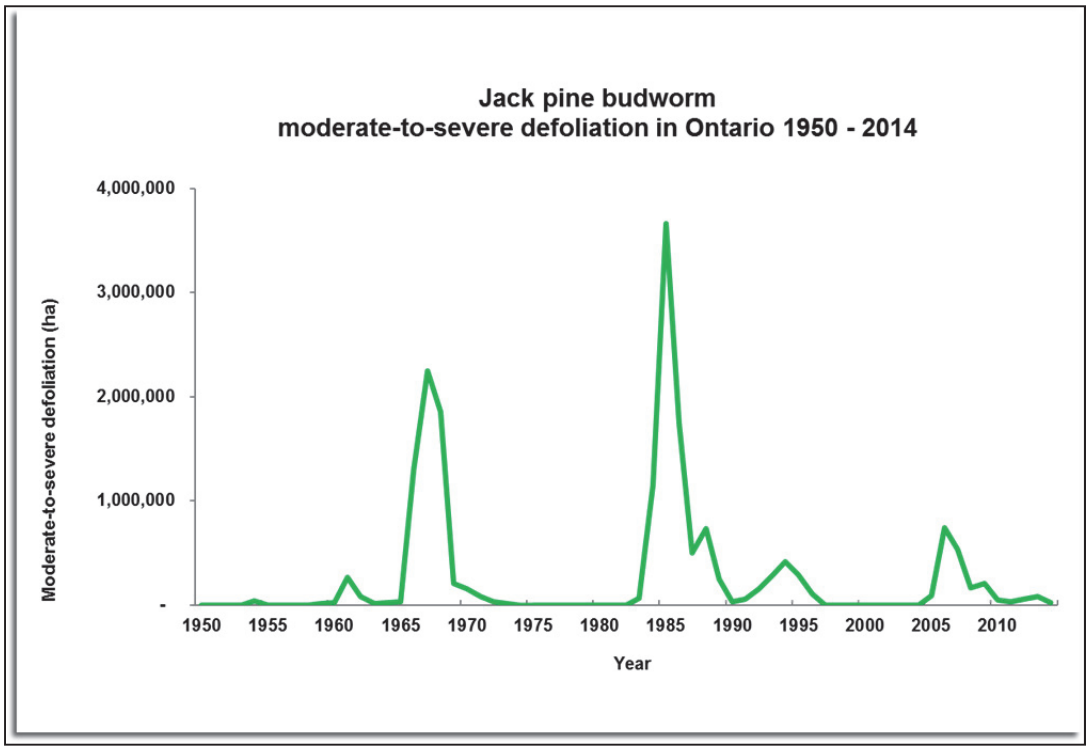

Figure 4. Area of moderate-to-severe defoliation by jack pine budworm in Ontario, 1950-2014.

There is limited forest management or timber harvesting in the area currently being defoliated by jack pine budworm. Thus at this time, no insect management programs are expected to be undertaken. Although pheromone trapping for this insect show populations are expected to remain low, a slight rise in moth captures in northeastern Ontario suggest populations may be increasing there (Figure 5). The jack pine budworm situation will continue to be monitored to determine whether the infestation continues to increase, or returns to endemic levels.

Plot	Reg	District	Twp/Location	Z	Easting	Northing	Avg moths/trap		
							2014	2013	2012
62	NE	Sudbury	Ulster	17	453000	5186000	47.5	0	
	NE	Sudbury	MERRITT	17	440207	5121496	45.5	15.5	18
	NE	Sudbury	Moncreif	17	462299	516868	41	2	2
	NE	Sudbury	Hart	17	455432	5170409	33	1	0
	NE	Sault Ste. Marie	SAGARD	17	361495	5169372	30	1	12
	NE	Sudbury	NAIRN	17	452026	5130131	25	8.5	7
	NE	Sudbury	Norman	17	505643	5181512	25	0	0
40	NE	Sudbury	MONESTIME	17	401300	5178534	23.5	0	0
60	NE	Sudbury	TEASDALE	17	406762	5161956	19		
50	NE	Sudbury	Rhodes	17	468199	5197071	18.5		
	NE	Sudbury	MANDAMIN	17	409548	5146417	18	0	7
	NE	Sudbury	Scadding	17	528855	5168596	15.5	0.5	
20	NE	Sudbury	Allen	17	520551	5098553	15	0	
	NE	Sudbury	MONESTIME	17	404045	5177149	14	2	3
	NE	Sudbury	Cartier	17	605514	5134207	14	2	
11	NE	Sault Ste. Marie	SAGARD	17	362874	5170460	13.5	1	5
	NE	Sudbury	Solski	17	431286	5172850	13	0	3
47	NE	Sudbury	Olinyk	17	411170	5178038	12	0	1
3	NE	Sault Ste. Marie	LANE	17	337517	5220967	11.5	1	5
48	NE	Sudbury	PRESCOTT	17	403966	5171572	11	0	3.5
21	NE	Sudbury	Antrim	17	451435	5196721	10.5	1	

Figure 5. Results of jack pine budworm pheromone trapping in northeastern Ontario, 2014.

The ongoing spruce budworm (*Choristoneura fumiferana* Clemens) outbreak rebounded in 2014 to 30,317 ha (Figure 6), compared to the collapse of 2013 when defoliation was limited to a mere 253 ha. This compared to 99,797 ha in 2012. A new infestation developed in 2014 in the boundary area between Chapleau and Hearst districts. Trapping results from 2014 also show an increase in male moth captures in Northeast Region. Tree mortality increased modestly in 2014, reaching a cumulative total of 240,326 ha since 1997 in Sudbury and North Bay districts. Susceptible forests of spruce and balsam fir across much of northern Ontario are beginning to reach age classes (i.e. > 40 years) preferred by spruce budworm.

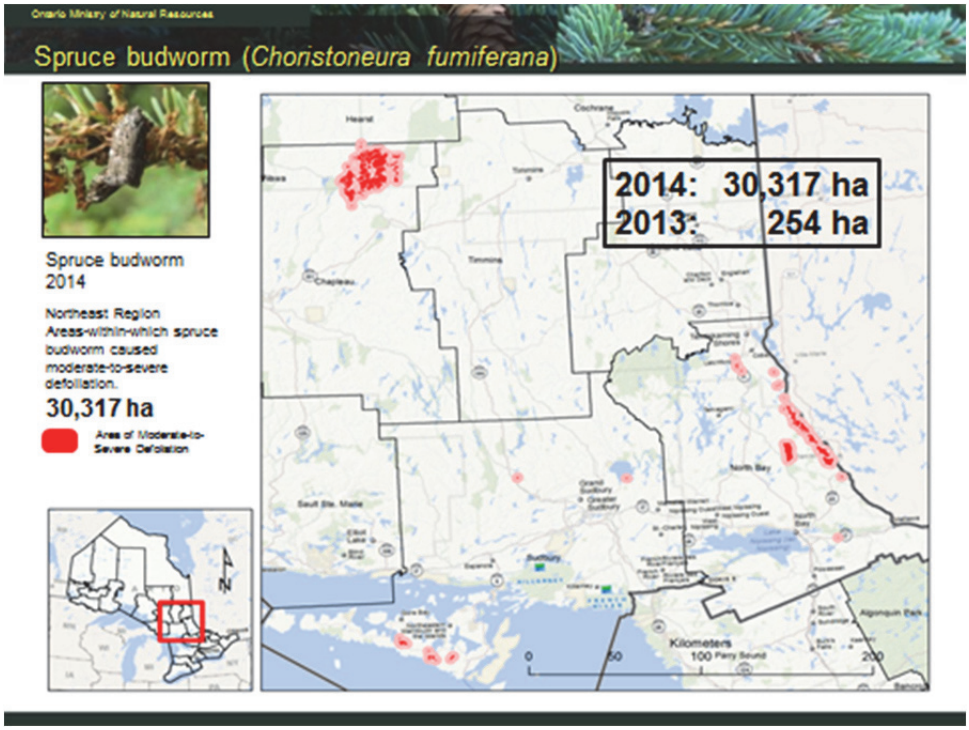

Figure 6. Area-within-which spruce budworm caused moderate-to-severe defoliation in Ontario, 2014.

The spruce budworm outbreak is still at low levels compared to its potential to reach several million hectares (Figure 7). Significant increased moth captures from pheromone trapping in 2014 showed spruce budworm can be expected to increase in abundance in 2015 in northeastern Ontario (Figure 8).

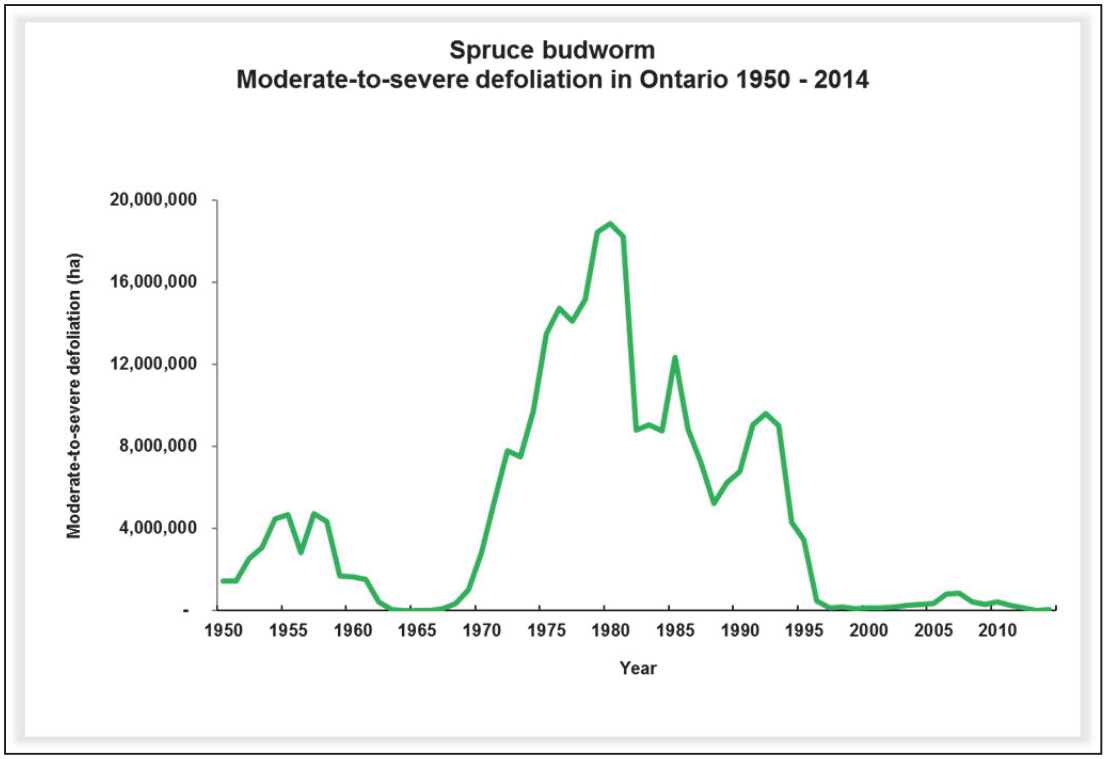

Figure 7. Area of moderate-to-severe defoliation by spruce budworm in Ontario, 1950-2014.

Plot	Reg	District	Twp/Location	Z	Easting	Northing	Avg moths/trap		
							2014	2013	2012
A	NE	North Bay	Blyth Twp.	17	612054	5152898	425.3		111.4
32	NE	Wawa	Peever Twp	16	684493	5238337	377.7	43.5	34.5
33	NE	Sault Ste. Marie	Shields Twp	16	718221	5191688	310.7	NA	NA
46	NE	North Bay	Strathcona Twp.	17	590280	5211792	236.3	276.7	407.3
24	NE	Wawa	Asselin Twp	16	663961	5272560	227.0	25.3	7.3
56	NE	Chapleau	Shipley	17	374533	5270874	119.3	18.0	20.7
95	NE	Timmins	Eldorado Twp.	17	492777	5348746	116.7	30.0	36.7
34	NE	Sault Ste. Marie	Villeneuve Twp	17	322781	5189023	102.5	24.0	24.0
26	NE	Sault Ste. Marie	Bridgeland Twp	17	302183	5142292	101.0	19.3	69.5
104	NE	Wawa	Dumas	16	670427	5355493	100.0	13.7	6.7
97	NE	Timmins	Hazen Twp.	17	454503	5304172	99.3	39.3	57.3
11	NE	North Bay	Hugel Twp (blown down)	17	556098	5150830	97.3	67.5	
31	NE	Sault Ste. Marie	Lewis Twp	17	379314	5122851	97.0	34.7	18.0
57	NE	Cochrane	Dempsey	17	525504	5446905	88.3	32.3	1.0
59	NE	Cochrane	Homuth	17	462361	5497055	80.0	5.7	4.0
51	NE	Chapleau	Ivanhoe	17	381011	5334123	75.0	10.3	10.0
102	NE	Timmins	Sewell Twp	17	428394	5442142	72.0	36.3	109.7

Figure 8. Results of spruce budworm pheromone trapping in northeastern Ontario, 2014.

The forest tent caterpillar (*Malacosoma disstria* Hubner) outbreak more than doubled in size in 2014 reaching 468,866 ha of moderate-to-severe defoliation (Figure 9). The majority of this (459,197 ha) was recorded in Northwest Region where all but Fort Frances District was aerially mapped with defoliation. Forest tent caterpillar defoliation continued to occur in Southern Region with 8,638 ha occurring in woodlots and forested areas near the southern part of Georgian Bay. A new area of infestation was recorded in Northeast Region in 2014 where 1,031 ha of moderate-to-severe defoliation were aerially mapped in Hearst District. This outbreak, particularly in Northwest Region has the potential to reach millions of hectares in size over the next few years. Forest tent caterpillar egg-band forecasting and aerial surveys will continue to be carried out to help predict expansion and possible declines.

The southern Ontario defoliation is not expected to increase substantially in 2015. However, as the outbreak spreads in the northwest, and moves into northeastern Ontario, it can also be expected to include the central parts of Southern Region over the next several years. As of 2014, however, the outbreak of this insect has yet to reach its potential for affecting several millions hectares of Ontario's forests (Figure 10).

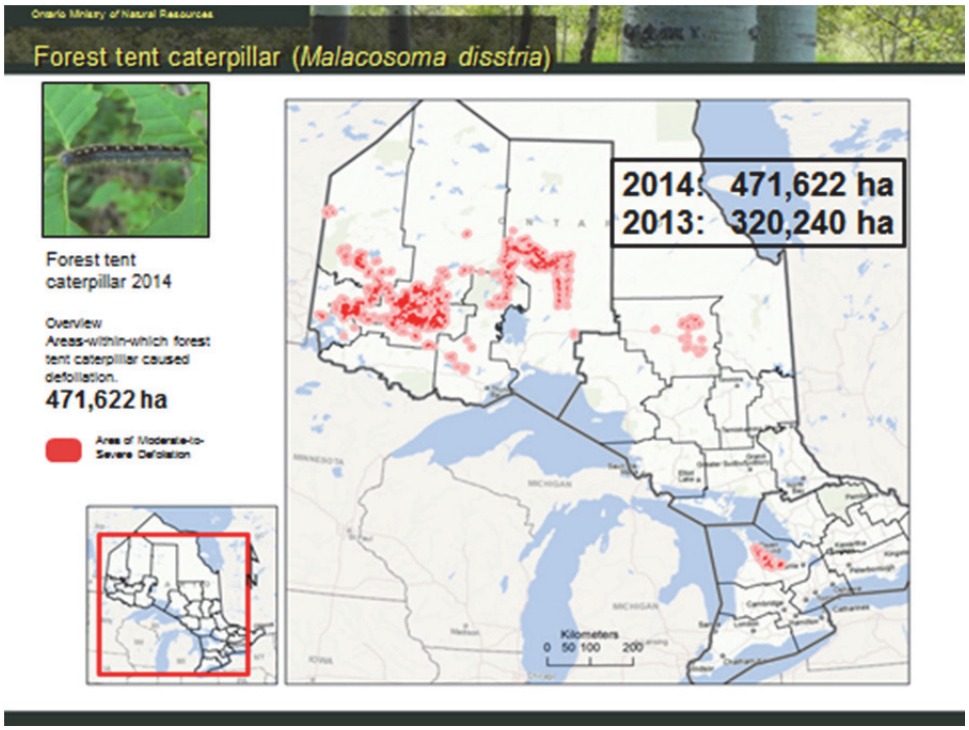

Figure 9. Area-within-which forest tent caterpillar caused defoliation in Ontario 2014.

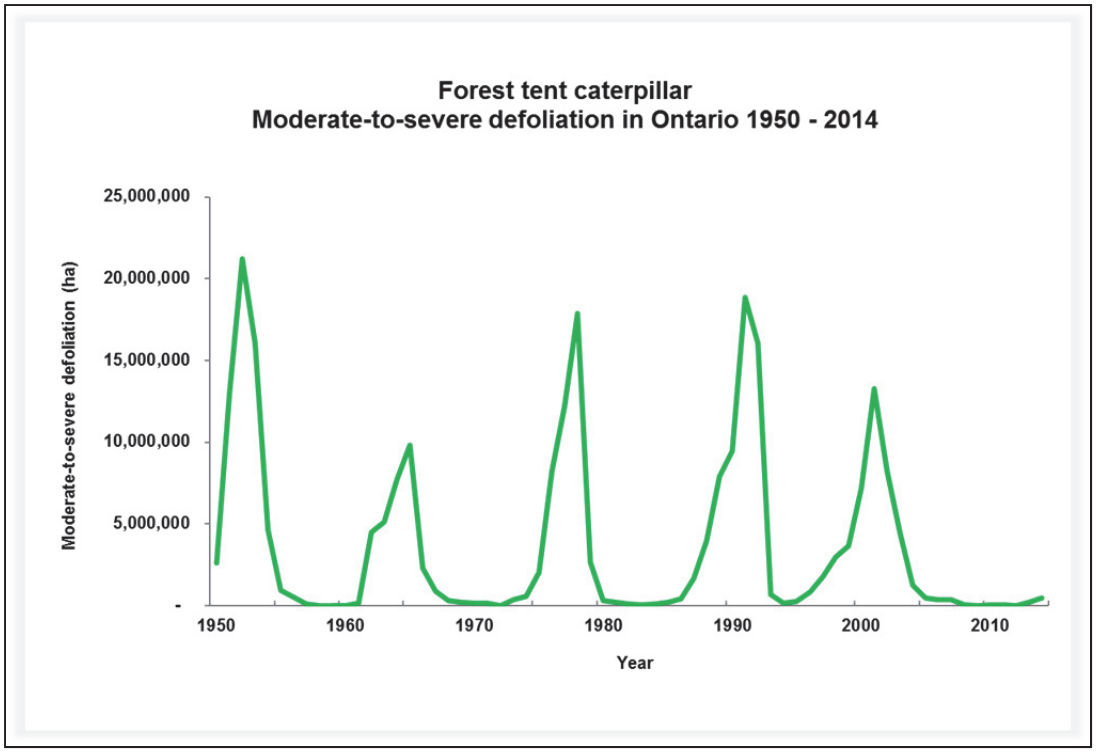

Figure 10. Area of moderate-to-severe defoliation by forest tent caterpillar in Ontario, 1950-2014.

For the third year in a row, gypsy moth (*Lymantria dispar* (L.)) caused moderate-to-severe defoliation on white birch trees, other hardwoods, and understory blueberry bushes growing on thin soils on rocky sites in and around Sudbury. Defoliation in 2014 reached 22,335 ha (Figure 11), a considerable increase over the 9,118 ha affected in 2013. In addition to the defoliation in Sudbury, pockets of gypsy moth defoliation persisted in the Sarnia area (Aylmer District) in southwestern Ontario. Despite three visible peaks in defoliation since the arrival and spread of this insect in Ontario, there is no pattern visible in the periodicity of high populations on the province (Figure 12).

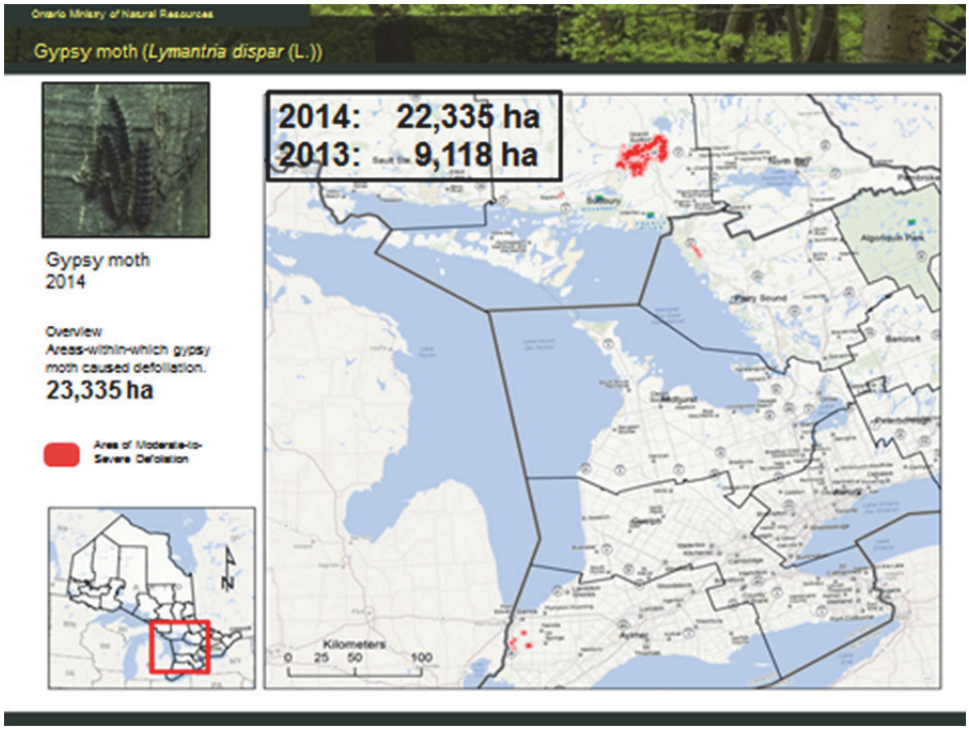

Figure 11. Area-within-which gypsy moth cause moderate-to-severe defoliation in Ontario, 2014.

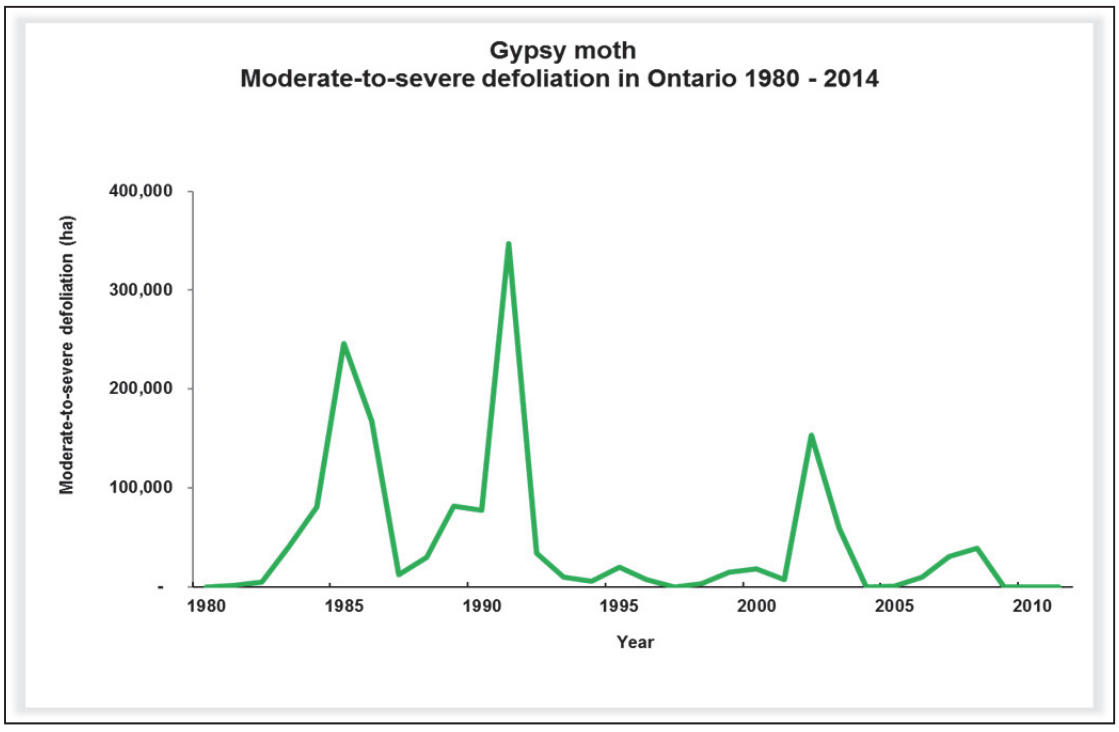

Figure 12. Area of moderate-to-severe defoliation by gypsy moth in Ontario, 1950-2014.

Larch case bearer (*Coleophora laricella* (Hubner)), which has been a chronic defoliator in Ontario since 1998, continued to cause defoliation of tamarack trees in pockets scattered across southern Ontario. A total of 9,631 ha were affected in 2014, compared to 5,486 in 2013 (Figure 13). For the first time since 1998, defoliation occurred in northeastern Ontario along Highway 11 in Hearst District.

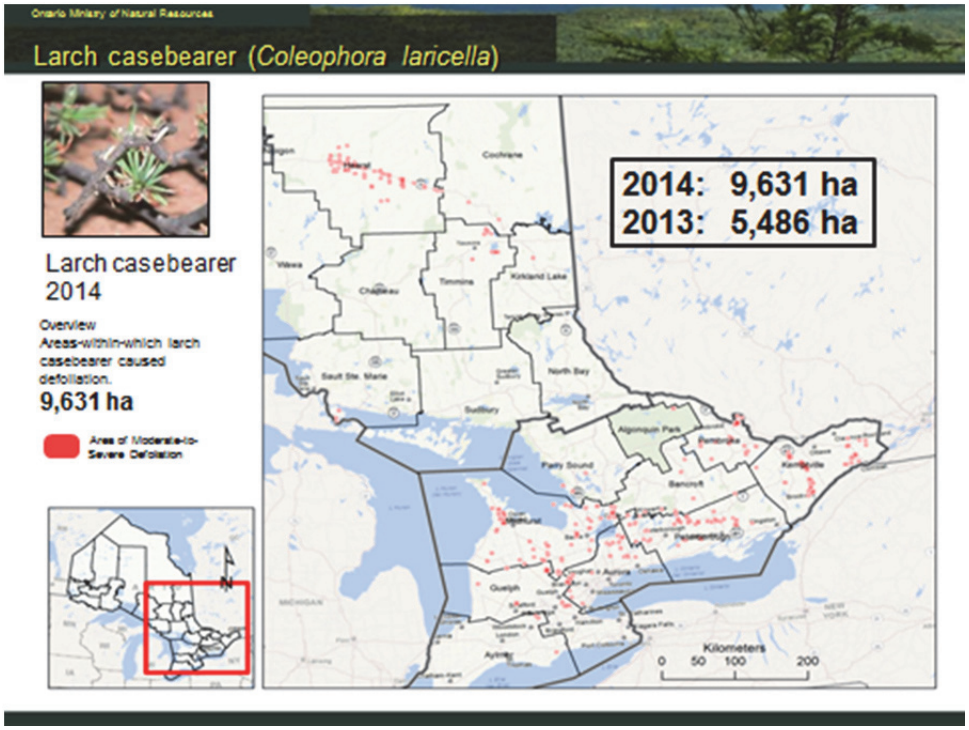

Figure 13. Area-within-which larch casebearer caused moderate-to-severe defoliation in Ontario, 2014.

There were several other insect infestations worth noting in 2014:

- For the third consecutive year, birch skeletonizer (*Bucculatrix canadensisella* Chambers) and the fungus septoria leaf spot (*Septoria betulae* Pass.) caused late-season browning and early leaf-drop across much of northern Ontario. The two species often co-occurred on the same trees, and on the same leaves. The affected area was not aerially mapped, but ground observations found the event occurring from Kenora east to North Bay. The severity of this event (i.e., amount of leaves affected, and the proportion of trees affected in a stand), appeared to be much less than in 2012 or 2013.

- For the third year in a row, cedar leaf miners (*Argyesthia* spp. and *Coleotechnites thujaella* (Kft.)) caused severe browning on eastern white cedar, affecting 10,780 ha in south central Ontario. Although this is a significant increase over the 6,209 ha affected in 2013, it is only 1/3 of the 30,486 ha affected in 2012.

- Aspen two-leaf tier (*Enargia decolor* Walker) caused only limited continued to cause defoliation in 2014, with 749 ha of trembling aspen affected in Sault Ste. Marie, Wawa, and Chapleau districts. This is down considerably from the 22,450 ha of defoliation in the same districts in 2013.

- Eastern larch beetle (*Dendroctonus simplex* Leconte) continued to cause mortality to tamarack trees in northwestern Ontario, affecting 759 ha in scattered pockets in Fort Frances District. This was very similar to the 779 ha affected in 2013. This event appears to be an extension of a much more significant area of tree mortality that has been occurring in adjacent areas in Minnesota, USA.

Forest pathogens and tree decline

Most tree pathogens do not cause symptoms over large geographic areas to the point where they can be aerially mapped. Nonetheless, leaf diseases occasionally can be mapped when the damage is exceptionally severe. Despite the relatively cool wet weather of 2014, foliar diseases were not common. There were a few exceptions, such as tar spot (Rhytisma spp.) on maples, especially Norway maple in much of Ontario. This phenomenon also occurred in Quebec.

Invasive species

Emerald ash borer (*Agrilus planipennis* Fairmaire) is regulated by the Canadian Food Inspection Agency (CFIA). There were several new finds of this insect in Ontario in 2013 by CFIA and OMNRF. New areas included St. Joseph's Island (Sault Ste. Marie District) and Guelph, Midhurst, Aurora, and Kemptville districts (Figure 14).

CFIA significantly expanded the regulated area in 2014 to include the southern portions of the judicial districts of Algoma, Sudbury, and Nipissing, and all parts of Ontario south of these districts (Figure 15).

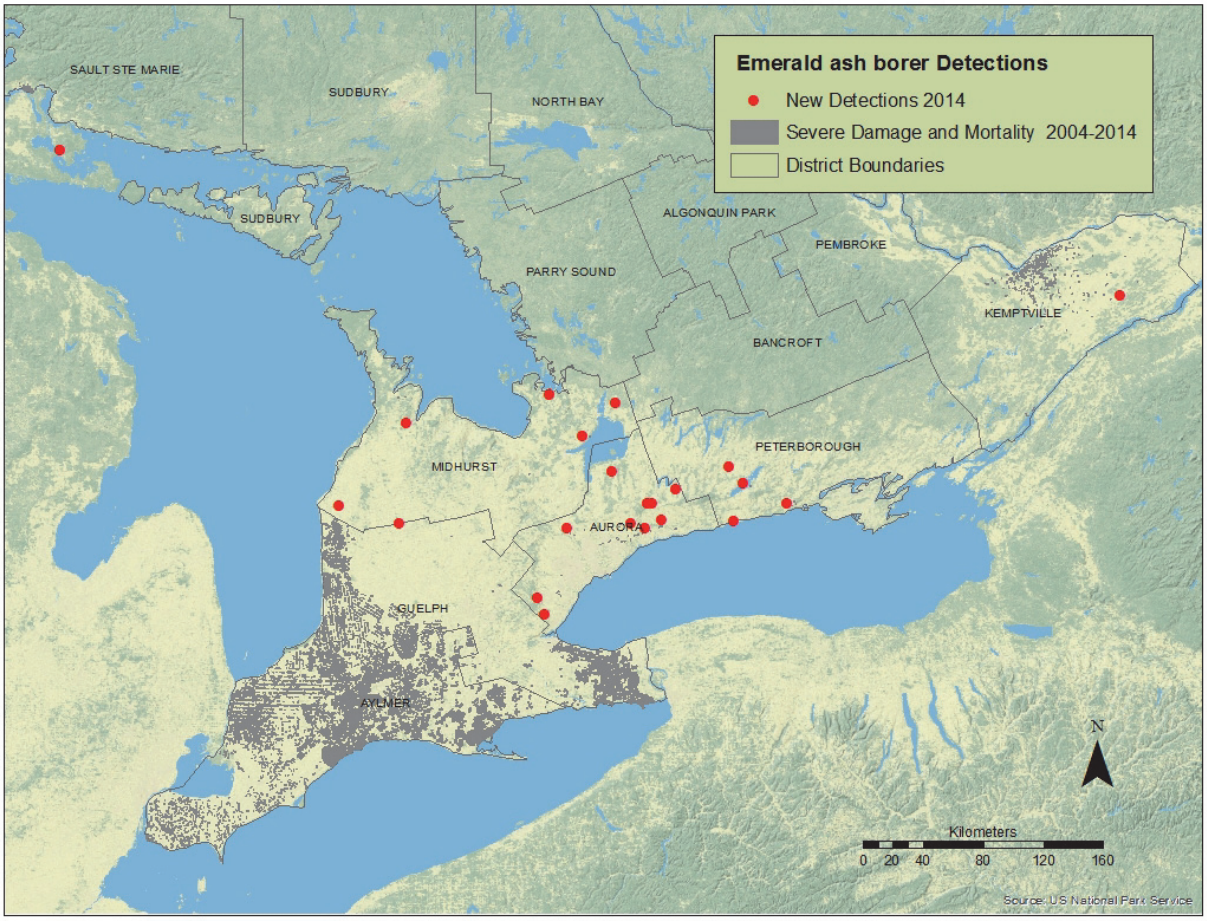

Figure 14. Locations where emerald ash borer infestations were discovered in 2014.

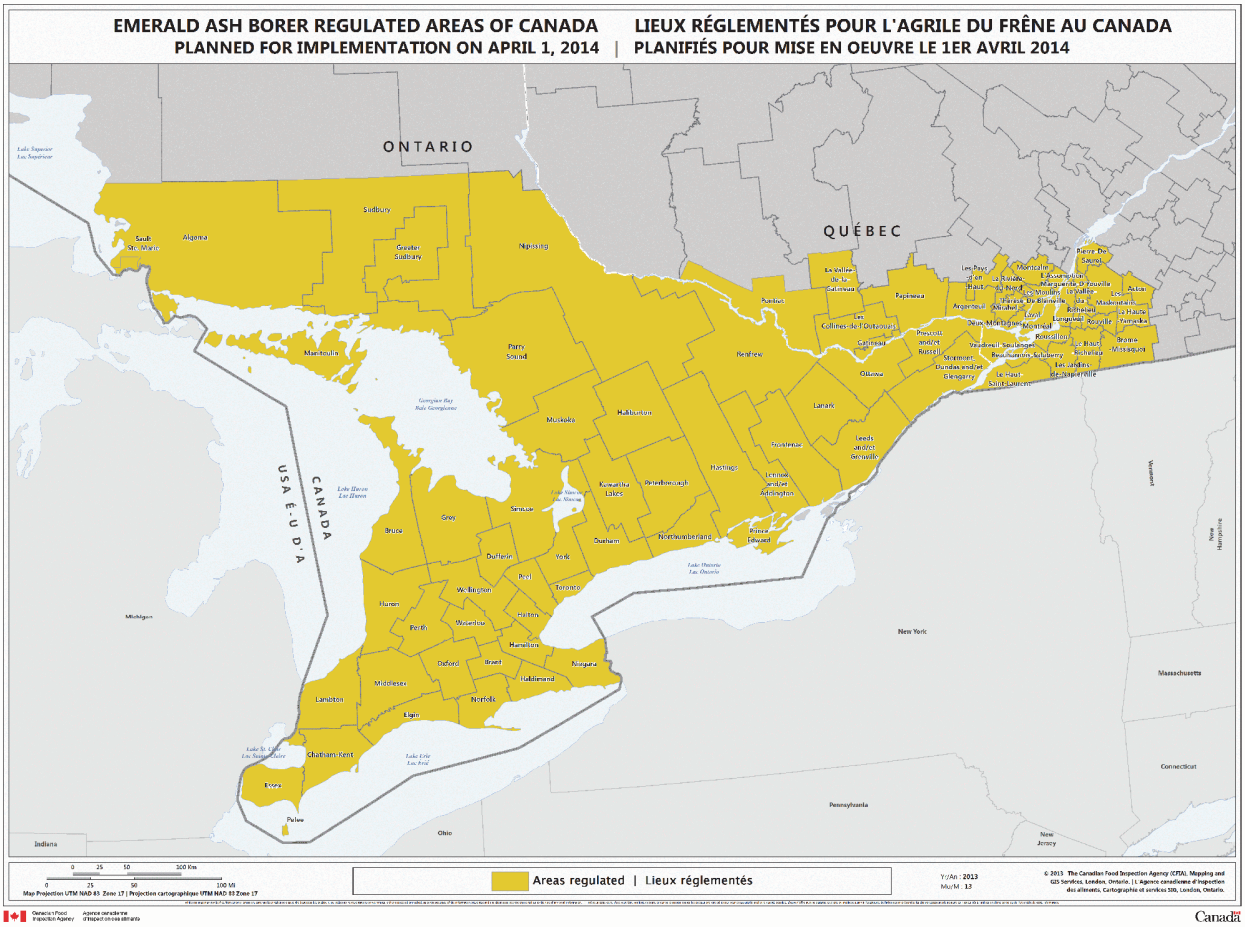

Figure 15. Area regulated by CFIA to reduce the risk of human-assisted spread of emerald ash borer.

Tree mortality from emerald ash borer usually exceeds 99% of the ash trees in an area. Aerial surveys in 2014 showed new decline and mortality of 43,338 ha (Figure 16). Together with the cumulative mortality of 153,052 ha from 2004 to 2013, the total area affected by emerald ash borer has reached 196,390 ha (Figures 16 and 17).

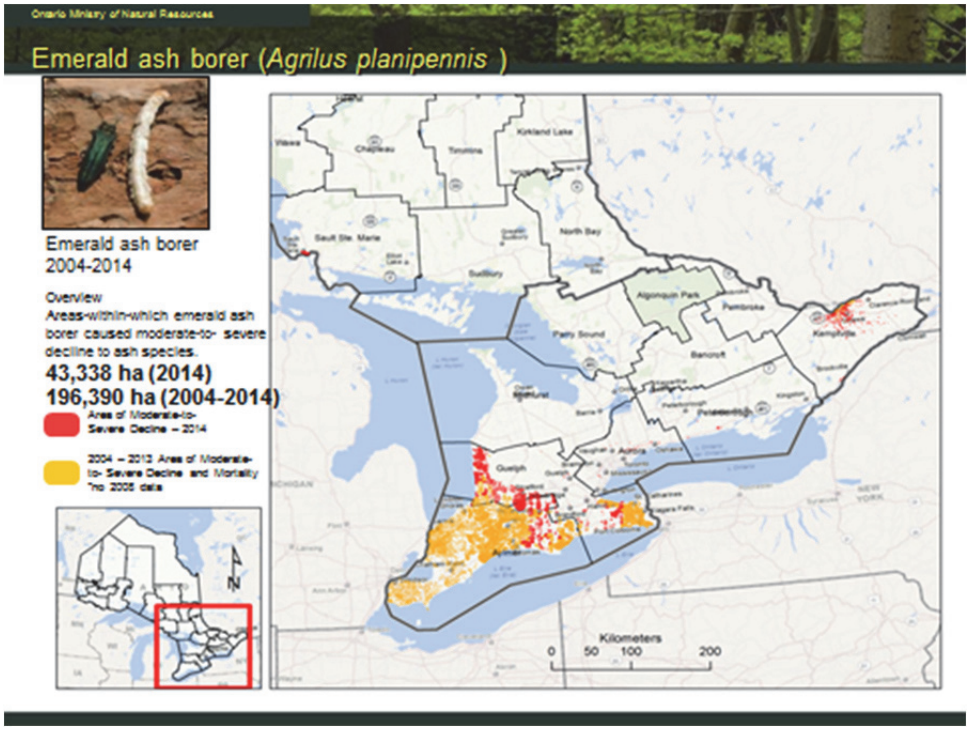

Figure 16. Area-within-which emerald ash borer caused tree decline and mortality in Ontario in 2014 (red) and cumulatively from 2004-2013 (yellow).

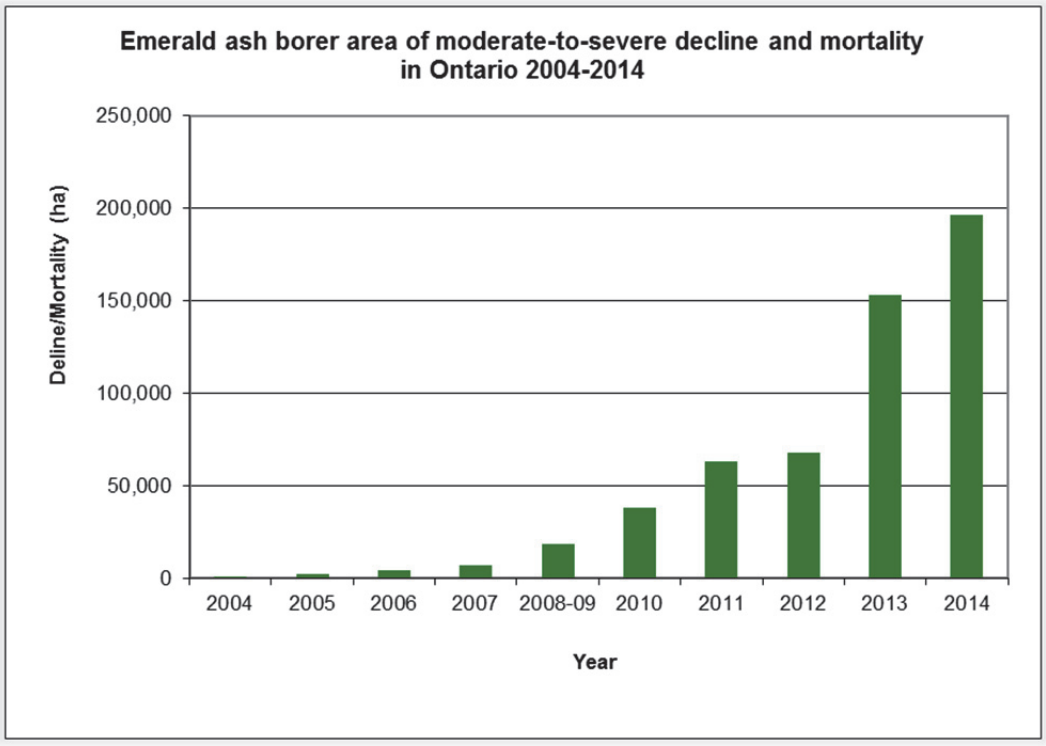

Figure 17. Annual cumulative tree decline and mortality caused by emerald ash borer in Ontario, 2004-2014.

2014 was the second year for the first release of a biocontrol agent for emerald ash borer were made by the Canadian Forest Service as part of a long term strategy to reduce impacts caused by emerald ash borer. The larval parasitoid *Tetrastichus planipennisi* Yang, native to China, was released at six sites in southern Ontario. Follow-up assessments will be done in future years to determine establishment, and impacts on emerald ash borer populations.

On April 5, 2013, CFIA declared Asian long-horned beetle (*Anoplohora glabripennis* Motschulsky) eradicated from Toronto and Vaughan. The declaration was based on a program to cut and chip infested trees and host trees within 400 m, followed by five years of surveys which found no beetles or infested trees. In August 2013, a new infestation was found in Mississauga following the discovery of a beetle on a car. Subsequent surveys by CFIA, the cities of Toronto, Mississauga, and Brampton, and MNR found approximately 25 infested Norway and Manitoba maple trees. Infested trees were in the Mississauga area around Lester B. Pearson International Airport, with the exception of one tree found in an adjacent area within the city of Toronto. In February and March 2014, CFIA led a multi-agency eradication program to eliminate this insect from Mississauga and Toronto. All known infested trees, plus any of the four primary host genera (maples (*Acer* spp.), poplars (*Populus* spp.), willows (*Salix* spp.) and birches (*Betul*a spp.)) within 800 m of infested tree, were cut and chipped. Follow up surveys in 2014 did not find any additional infested trees. Surveys will continue for 5 years to ensure all infested trees have been found and cut. Collaborators on this eradication effort include CFIA, Natural Resources Canada – Canadian Forest Service, Ontario Ministry of Natural Resources, and the cities of Mississauga and Toronto.

Hemlock woolly adelgid (*Adelges tsugae* Annand) was found by CFIA in 2013 infesting a single eastern hemlock tree in the Niagara River gorge. A second infested tree was found in the gorge by CFIA in 2014. As in 2013, the infested tree was cut and burned on-site by the Niagara Parks Commission. A second infestation of this insect in a group of five trees in Etobicoke was made in 2012. Two additional infested trees were found nearby by CFIA in 2013. All of these infested trees were removed and incinerated by CFIA.

Beech bark disease, which is a combination of an invasive insect (beech scale, C*ryptococcus fagisuga* Linding) and an invasive stem fungus (*Nectria faginata* (Lohman et al.) Castl.) continued to spread in Ontario in 2014. Damage continues to accelerate in several locations. After several years of presence of beech scale, the disease was found for the first time in 2014 on St. Joseph's Island, Sault Ste. Marie District.

For the third year in a row, a pheromone trapping survey was done for walnut twig beetle (*Pityophthorus juglandis* Blackman), the vector for thousand canker disease (*Geosmithia morbida* sp. nov.). As in 2012 and 2013, no walnut twig beetles were found in the Ontario traps.

Session VI: North of 60 Report

Northwest Territories Report

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Summary

The Government of the Northwest Territories' Department of Environment and Natural Resources (ENR) delivers forest health monitoring across the NWT. The 2014 surveys were conducted on July 8-9 and July 22-26 with assistance from the Canadian Forest Service. The aerial survey flight routes encompassed over 6000 km (Figure 1) focusing on areas identified as high risk, i.e. along major rivers and waterways or uplands and hill slopes. Some areas between the Great Bear and Great Slave Lake, and along the Mackenzie River valley between Hay River and Fort Providence could not be surveyed because of limited visibility due to smoke. Overall, 405,206 hectares were mapped as affected by four major insect pests (Figure 2): Aspen Serpentine Leafminer (*Phyllocnistis populiella*) – 320,193 ha, Eastern Spruce Budworm (*Choristoneura fumiferana*) – 79,152 ha, Willow Blotch Leafminer (*Micrurapteryx salicifoliella*) – 4636 ha, and Forest Tent Caterpillar (*Malacosoma disstria*) – 1224 ha, while 1,600 ha were affected by abiotic factors. Overall, there was over a threefold increase in total area affected by various forest heath agents compared to the previous year.

Tree mortality

Mortality caused by abiotic factors

June and July saw the extremely dry conditions across the whole Territories. These two months combined received only 30% of typical precipitation as per Canadian Climate Normals 1981-2010 which may have contributed to higher susceptibility of trees for pest attacks, and consequently to an overall increase in total area affected by insect pests compared to the previous year (141,268 ha in 2013). However, only 433 ha of aspen dieback along the Mackenzie River Valley near Fort Simpson and Tulita were identified as caused directly by climate related factors, i.e. drought or unstable water table (Figure 2). It should be noted that these changes did not occur as a result of the current year weather conditions but rather as a consequence of long term climate shifts in certain areas.

Red belt (or winter desiccation) was mapped in the mountainous regions of the Nahanni National Park, totaling 1,200 ha.

Mortality caused by insect agents

Approximately 1,500 ha of spruce mortality caused by repeated severe defoliation by spruce budworm over the last 4-5 years were mapped along Mackenzie River near Tulita in Sahtu region (Figure 3). These areas contain >30% of the stand mortality and are observed in mature timber along major rivers and waterways.

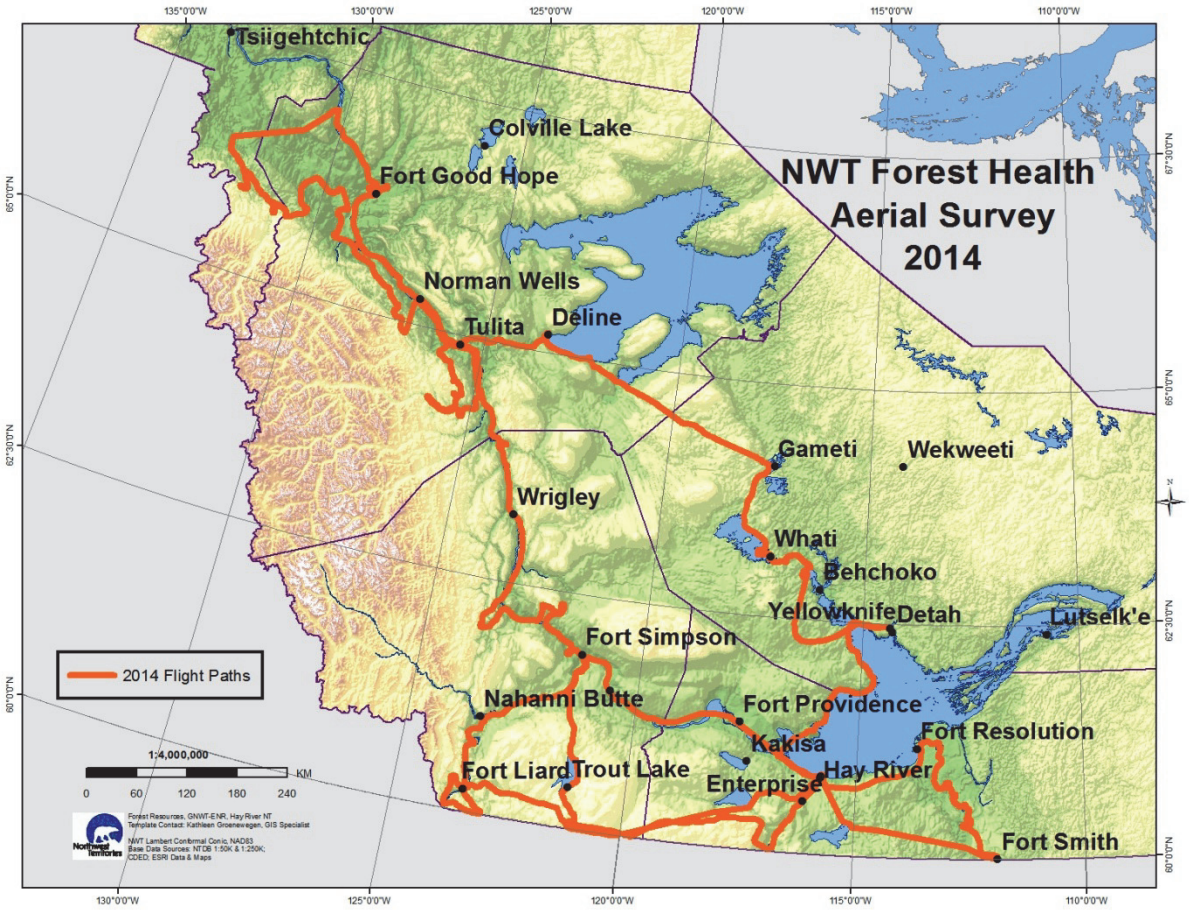

Figure 1. NWT aerial survey flight routes flown in 2014 covered over 6000 km.

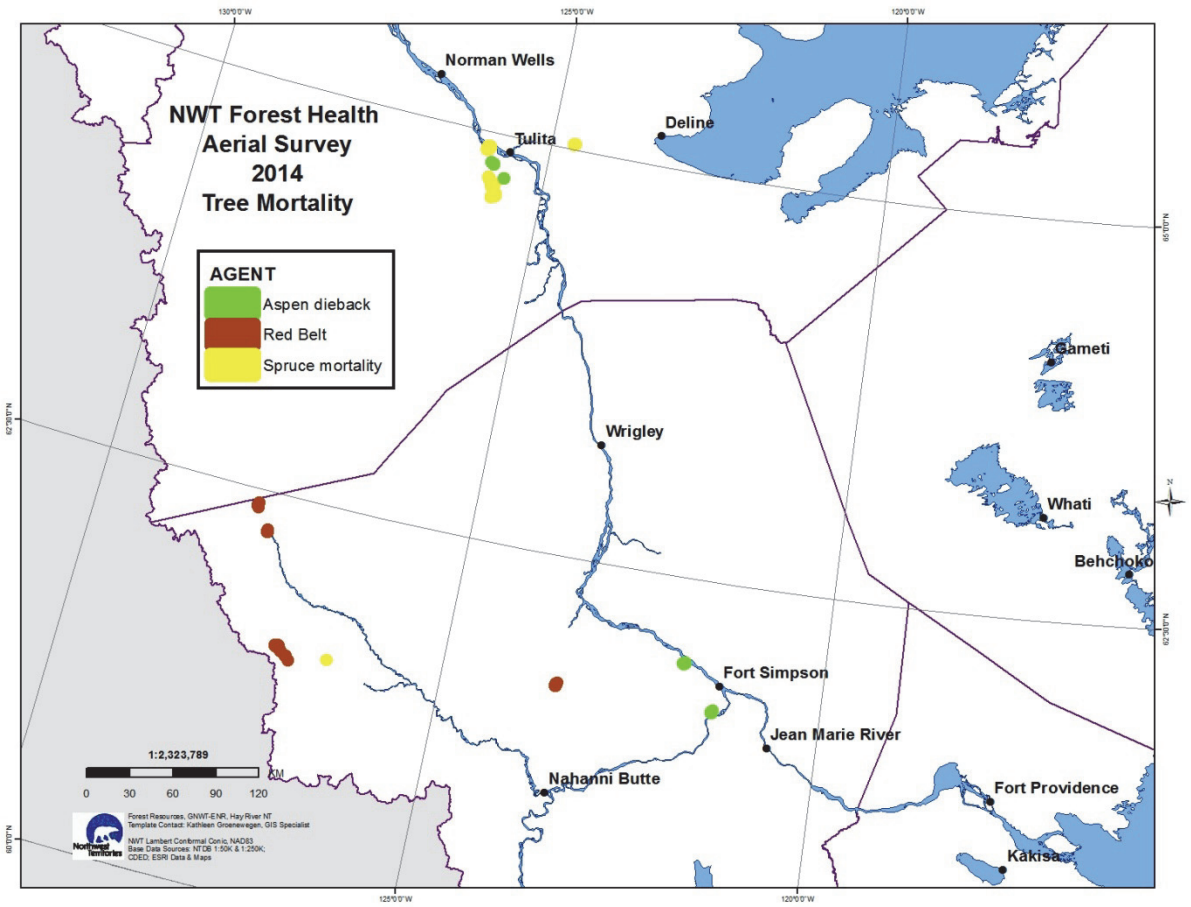

Figure 2. Hot spots of increased tree mortality resulting from abiotic factors (red belt, aspen dieback) and repeated long-term defoliation by spruce budworm (spruce mortality). Shown in the Figure are locations of stands were mortality was >30% of the stand area.

Insect Pest Activity

Spruce Budworm

Spruce budworm remains the most serious forest pest in the NWT; however, since 2005, its population stays at fairly low and stable levels. The total area affected by this pest in 2014 was 76,400 ha with majority of infestations occurring in the Sahtu region (over 37,000 ha) and smaller populations persisting along the Slave River area (approx. 14,000 ha), in the DehCho Region along Mackenzie River and on southern slopes of Ebbutt Hills (11,400 ha), and in the North Slave region on islands of Lac La Martre near Whati and near Benchoko (3,350 ha). Approximately 82% of all spruce budworm infestations in the NWT were mapped as severe, 17% as moderate, and only 1% as light.

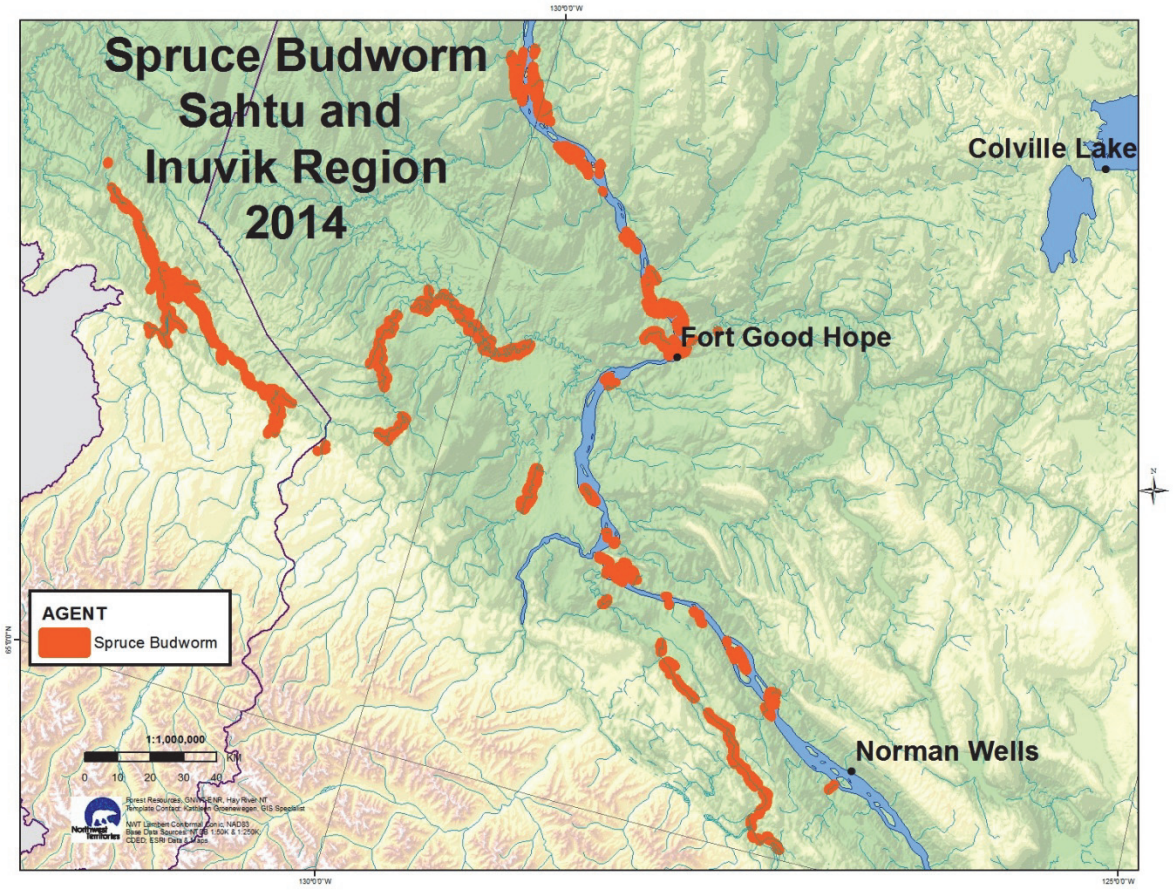

Figure 3. The northernmost populations of spruce budworm along Arctic Red River in the Inuvik region and along the Mackenzie River in Sahtu continued to persist with severe defoliation observed in 2014.

Aspen Serpentine Leafminer

The larva of this moth is a common pest in the northern North America and its population levels fluctuate significantly from year to year in the NWT. Over 266,000 ha were affected by Aspen Serpentine Leafminer in 2014 which is three times greater than the previous year. Majority of infestations occurred in the DehCho region (195,000 ha), along the Mackenzie and Liard Rivers (Figure 4). Other affected areas were mapped in the South Slave (6,700 ha), Sahtu (2,940 ha) and North Slave (1,400 ha) regions. Over 70% of infestations were considered severe and 30% moderate.

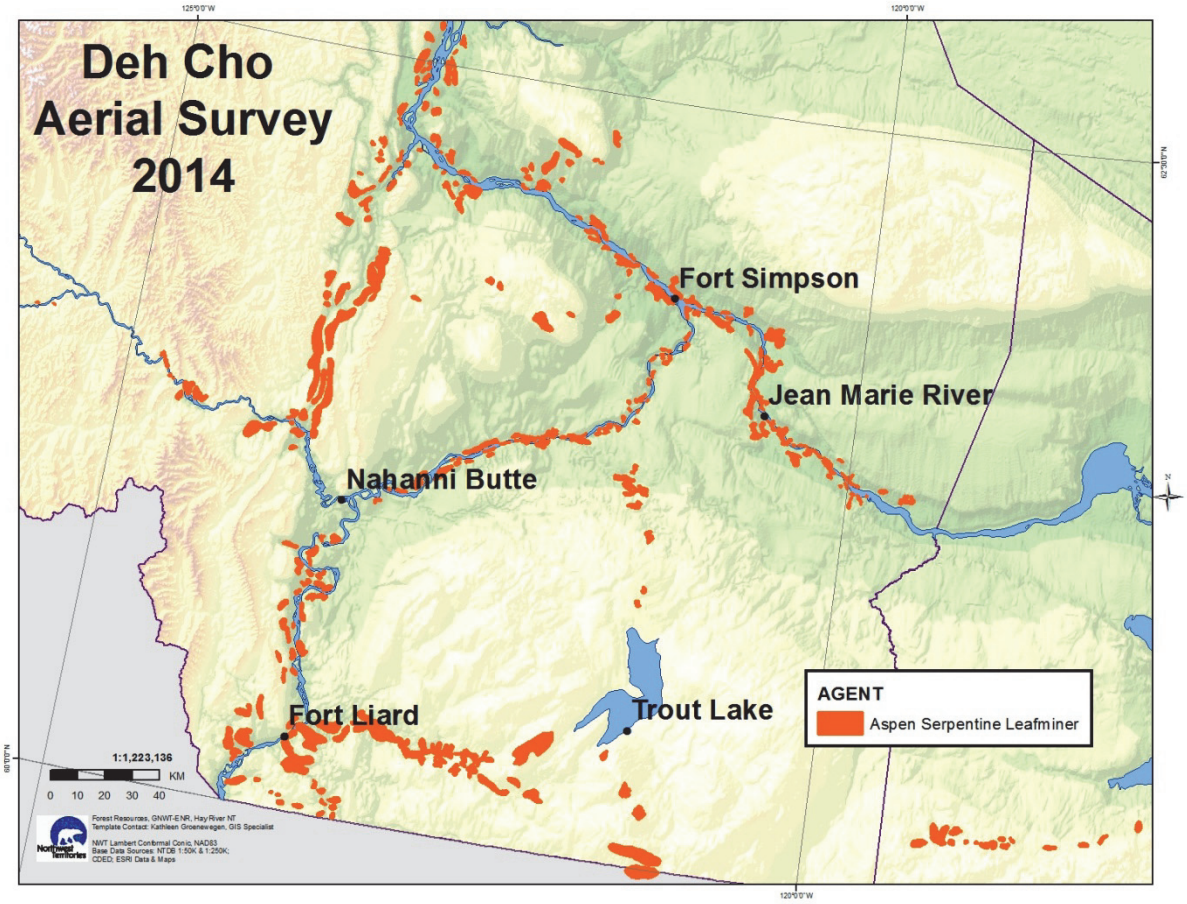

Figure 4. Aspen Serpentine Leafminer is the dominant insect pest in the DehCho region.

Willow Leaf Blotch Miner

Willow Leaf Blotch Miner is a moth known to affect several species of willows found in the NWT. The leaf miner larvae create areas of necrotic blotches on the upper surfaces of the willow leaves which can result in complete defoliation of the tree. Willows are well adapted to disturbances and can usually recover well unless defoliated for several consecutive years. Over 4,600 ha in total were mapped as affected by Willow Leaf Blotch Miner which is approx. a 1,000-ha decrease compared to the previous year. Majority of infestations occurred in the South Slave region along the Slave River (2,700 ha). A few isolated patches were observed in the DehCho (870 ha), Sahtu (870 ha) and in the North Slave (200 ha) regions.

Forest Tent Caterpillar

The Forest Tent Caterpillar is native to North America affecting mainly trembling aspen. Defoliation results from larval feeding that begins about the time aspen buds begin to break in early spring. The risk of aspen mortality is minimized because these trees refoliate 3 to 6 weeks after defoliation, however, stressed trees tend to be more susceptible to decay, boring insects, and their stem growth can be reduced as much as 90% of annual normal growth. Forest Tent Caterpillar has not been observed in the NWT for the previous 5 years with some extensive infestations in the Liard River area in late 90's. In 2014, 1,225 ha were mapped as a moderate to severe defoliation by the FTC along the Slave River (Figure 5).

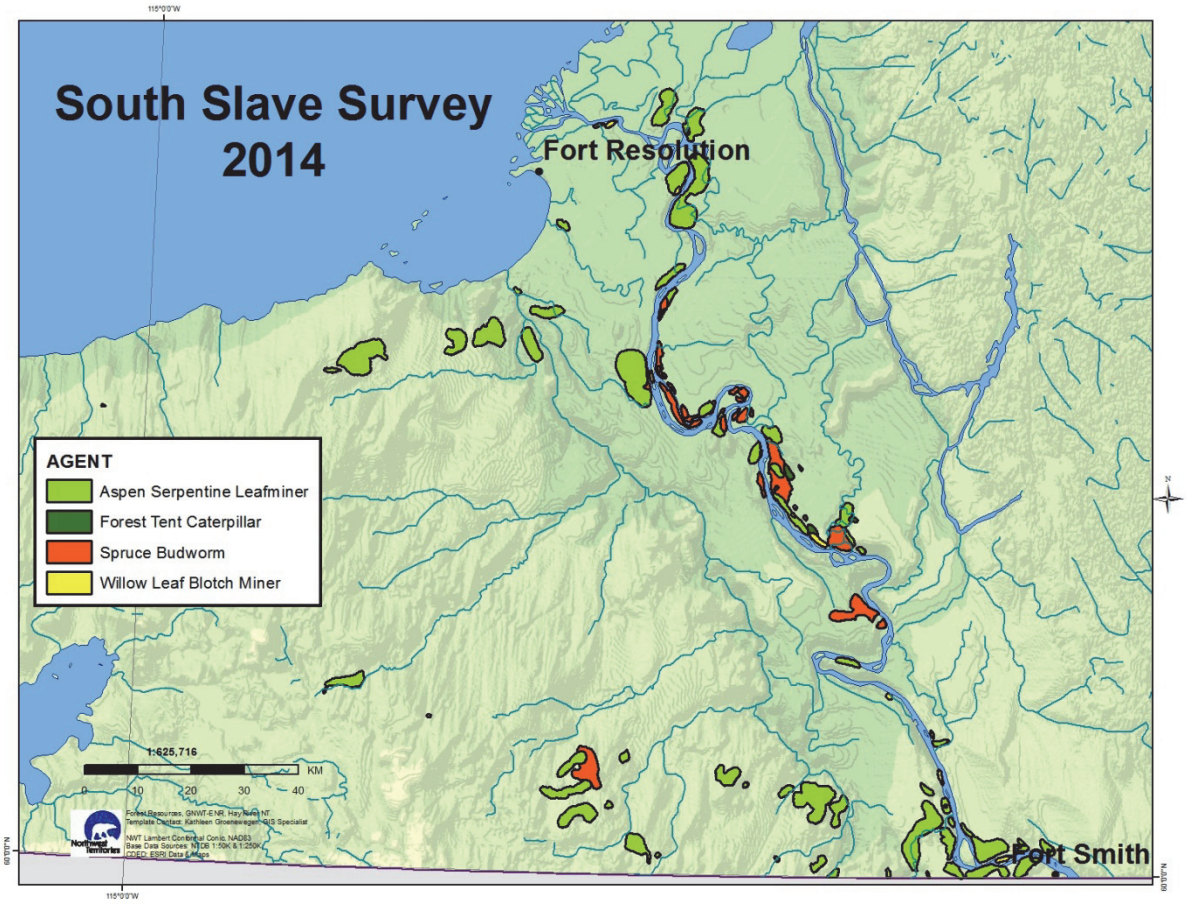

Figure 5. Areas along Slave River have been affected by several insect agents. The 2014 survey found isolated infestations of Forest Tent Caterpillar totaling 1,225 ha.

Update on the Mountain Pine Beetle Situation in the NWT

Mountain Pine Beetle (MPB) was confirmed in the southern NWT in 2012 for the first time. Modest winter survival was confirmed in March 2013 when the attacked trees were cut and burned. No baiting occurred in this and following years.

Mountain Pine Beetle Pest Risk Analysis for the NWT pine forests was completed in 2013 as one of the proactive measures undertaken by the ENR to better understand the risks associated with this pest. The analysis assessed the overall risk of establishment and spread of the MPB into NWT pine forests as low in the short term and medium in the long term. Climate warming is considered a key factor that will contribute to potential expansion of MPB in the NWT.

In 2014, the ENR continued to monitor for the MPB activity in the southern NWT by dedicating a special aerial survey along the NWT – AB border focusing on locating potential infestations. No signs of Mountain Pine Beetle activity were noted in areas previously infested as well as other pine dominated stands along survey routes. In addition, the stand where the MPB was first discovered in 2012 was found to be completely burned in the 2013 fire season. No other locations affected by the MPB were found across the NWT in 2014.

The ENR participates actively in the National Forest Pest Strategy (NFPS) which is a national level program aimed to create the platform for the most efficient use of knowledge and technology to manage forest pests in a proactive integrated way. Currently, the ENR is actively involved in the Action to Slow the Spread of Mountain Pine Beetle across Canada, one of the flagship programs under the NFPS.

Session VII: Pesticide Regulations, Alternatives, Minor Use

When regulatory process and operational requirements conflict: how can we move this forward?

David Kreutzweiser
Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre, 1219 Queen Street East, Sault Ste. Marie, Ontario P6A 2E5

It is widely recognized that Canada has a rigorous forest pesticide regulatory process. It is also recognized that regulatory decisions must follow a standardized process to ensure consistency, thoroughness, and fairness, and that this process may take some time. But it is also clear that some emerging pest management challenges can be urgent, time-sensitive, and economically significant. When these situations require new, amended or modified uses of forest pesticides, sometimes the regulatory process lags behind the pest problem. I use the recent example of an eastern spruce budworm early intervention strategy and the use of tebufenozide to illustrate this dichotomy. In this example, a regulatory position constrained, possibly jeopardized, the intervention strategy and was based on perceived risk to aquatic ecosystems. I will show that a suite of non-guideline data and information exists to update and inform a risk assessment for aquatic systems, but there does not seem to be a clear or expeditious process to include this information to affect a timely regulatory decision. The point of this illustration is to generate thought and discussion on how we might resolve this dichotomy.

Session VIII: Insect Semiochemistry

Effect of pheromone-enhanced lures and trap height on the detection of Cerambycidae

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Exotic bark- and wood-boring beetles, particularly those in the Cerambycidae, Buprestidae, and Curculionidae families, include some of the most damaging forest pests in Canada, and in spite of recent implementation of international phytosanitary regulatory policies such as ISPM 15, continue to be intercepted in solid wood packaging at ports in Canada and the United States. Recent research has demonstrated that numerous species of longhorn beetles respond to pheromones such as hydroxy-ketols, hexane diols, fuscumol, fuscumol acetate, and monochamol. We report results of field experiments conducted in 2013 and 2014 that tested the effects of trap lure and trap height on the efficacy of detecting species of longhorn beetles. In general, the number of longhorn species detected per site was increased by baiting traps with pheromone-enhanced lures, by placing traps in the upper tree canopy as well as in the understory, and by increasing the number of traps per site. We also present preliminary data suggesting that it takes an average of only 4.5–6 minutes longer per trap and costs about $2.50 more per trap to place traps in the upper canopy compared to placing traps at the standard 1.5-2 m height.

The impact of trap design and distance among traps on the capture of Cerambycidae

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Survey and detection programs for exotic and native forest insects (including Cerambycidae) frequently rely on traps baited with odorants. In recent years, remarkable progress has been made in the identification of attractants for cerambycid beetles. Comparatively few studies have explored the relationship between trap design and performance for cerambycid beetles, and measures directly relevant to detection efforts and the logistics of trap deployment have received little attention. The majority of studies that have examined trap performance have used the metric of abundance of target taxa that are usually common or abundant in the environment. Ideally, operational survey and detection programs would detect non-native species before they become abundant (i.e. when they are rare). This presentation will outline the results of recent work: 1) using the metrics of species richness, diversity and abundance to compare several intercept trap designs for the effectiveness of sampling Cerambycidae in eastern North America; 2) examining how the logistics of trap deployment (intertrap distance) influence the capture of target Cerambycidae; and 3) looking at design factors that influence the performance of different intercept traps for the capture of Cerambycidae.

Early detection of non-native insects: U.S. perspective

Robert Rabaglia

USDA Forest Service, Forest Health Protection, 1400 Independence Avenue SW, Washington, DC 20250

The introduction and establishment of non-native insects is a growing threat to the health of North America's urban and rural forests. The early detection of these invasive species has been called the second line of defense in protecting our forests. The challenge has been to identify potential threats, detect them in a timely manner and then quickly respond to minimize impacts. The US Forest Service has been implementing an Early Detection/Rapid Response program since 2007, and has detected seven species of bark and ambrosia beetles new to North America; however, these species were all well-established before they were detected. This presentation will discuss efforts to improve early detection to quickly respond to an introduction; however, management may be the long term response that will be used for many of these new invasive species.

The impact of landscape heterogeneity on the survey and detection of Cerambycidae

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The success of insect detection and monitoring programs is affected by many variables, some of which are under program control and many others that are not. Primary to program success is knowledge about the impact of trap location habitat on capture of target species. Decisions about trap deployment location are informed by experience and/or research results, which may or may not have wide applicability amongst taxa. Our overall study objectives are to measure environmental variability and evaluate its impacts on the number of individuals captured amongst target insect groups. We have begun with experiments in Louisiana and northern Ontario to assess the capture of longhorned beetles (Cerambycidae: Cerambycinae and Lamiinae) on short transects running perpendicular to forest edges, extending from canopied forests into clearings. Preliminary analyses will be presented and suggest that the effect of trap habitat varies with species. Interactions between insect species and heterogeneity in forested environments are multifaceted and will require more experimentation before trap habitats for select taxa may be chosen with confidence. However, despite the complexities, progress continues to be made through cooperative efforts between the United States and Canada; pooling of resources increases the scope of the work and the probability of identifying robust solutions.

CFIA priorities and needs re: forest invasive alien species detection and surveillance

Troy Kimoto

Canadian Food Inspection Agency, 4321 Still Creek Drive, Burnaby, British Columbia V5C 6S7

The Canadian Food Inspection Agency (CFIA) conducts a variety of plant health pest surveys in order to delimit the boundary of established populations, detect new pests or determine pest-free areas. Ground-based visual surveys, semiochemical-baited traps and public outreach are tools used by the CFIA for invasive forest pest surveillance. Although the CFIA continues to collaborate with the Canadian Forest Service, academia and industry on developing new survey tools, there are still many gaps that need to be addressed (e.g. absence of tools for some taxa) or room to improve current survey methods (e.g. pink gypsy moth pheromone, public outreach, etc.). The CFIA continues to work alongside its partners to improve surveillance techniques for invasive forest pests.

Session IX: Alien Invasives and Wood Packaging Updates

Session X: Western Pest Management Issues

Manitoba Report

Fiona Ross

Forestry and Peat Land Management, Manitoba Conservation and Water Stewardship,
200 Saulteaux Crescent, Winnipeg, Manitoba R3J 3W3

Aerial Surveys

In 2014, Manitoba Conservation and Water Stewardship (MCWS) continued with a province wide systematic aerial survey. The survey provided an overall picture of health issues and an estimate of forest defoliation. The survey uses mobile PC Tablets to map defoliation in the following forest regions of Manitoba: Northeast region, Northwest region, Western region, Interlake region and Eastern region. The survey design allows for more coverage over a specific area when required with a baseline survey conducted in each region every year. In 2014, a base line survey was conducted across the province of Manitoba as depicted in Figure 1.

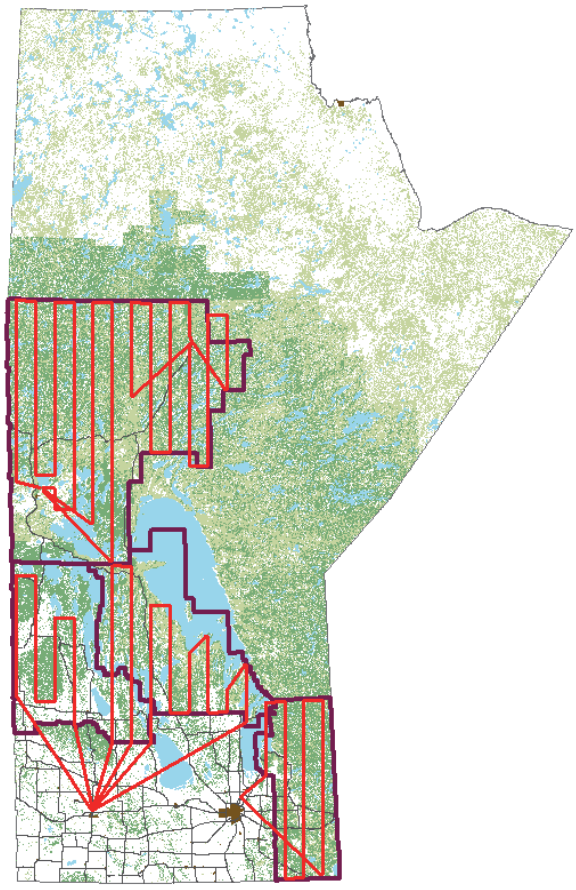

Figure 1. Map of aerial survey conducted in Manitoba in 2014.

Forest Tent Caterpillar - *Malacosoma disstria*

The population of forest tent caterpillar increased within the province in 2014. The aerial survey observed that the Nelson River and Interlake forest section experienced the most severe defoliation. However, all forest sections had some moderate to severe defoliation from forest tent caterpillar (Figure 2). The total estimated defoliation province wide for 2014 is 904,126 ha. Similar defoliation is expected for 2015.

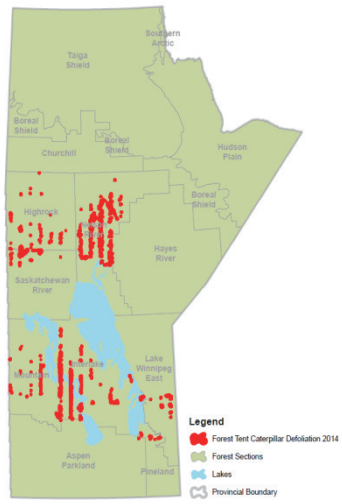

Figure 2. Map of forest tent caterpillar defoliation observed by aerial survey in Manitoba in 2014.

Jack Pine Budworm - *Choristoneura pinus*

A small pocket of jack pine budworm defoliation was observed in the Pineland forest section (Figure 3). The estimated province wide defoliation is 4,345 ha.

Figure 3. Map of jack pine budworm defoliation observed by aerial survey in Manitoba in 2014.

Budworm Field Plots

In 2014, Manitoba started re-distributing its spruce and jack pine budworm field plots in order to mirror the change in aerial survey method. By 2015, all 33 SBW and 33 JPBW plots will be new.

In August and September, branch samples and pheromone traps are collected from all spruce and jack pine budworm plots. Branches are processed to assess current defoliation levels and egg mass densities. Moths are counted from traps. Data analysis generates hazard ratings that predict the next year's defoliation.

Spruce budworm - *Choristoneura fumiferama*

In 2014, no defoliation by spruce budworm was observed throughout Manitoba.

Based on 2013 defoliation predictions derived from fall egg mass surveys and hazard rating for tree condition, no operational spruce budworm suppression program was implemented in 2014.

In August and September, spruce and fir branch samples are collected at plots throughout the province and processed to assess current defoliation levels and determine egg mass densities to predict 2015 defoliation (Table 1).

Table 1. 2014 spruce budworm defoliation and average egg mass, and predictions for 2015.

Location	2014 defoliation*	2014 average egg mass/10 m²	2015 defoliation prediction
Northeast Region	Light	0	Light
Northwest Region	Light	18.7	Light
Western Region	Light	15.7	Light
Interlake Region	Light	0	Light
Eastern Region	Light	0	Light

*Defoliation classes are as follows:

Light - up to 35% defoliation of current shoots
- based on <40 egg masses per 10 m² of branch area

Moderate - 35% to 70% defoliation of current shoots
- based on 40 to 185 egg masses per 10 m² of branch area

Severe - greater than 70% defoliation of current shoots and possible feeding on old foliage
- based on >185 egg masses per 10 m² of branch area

Spruce budworm pheromone traps were placed at 32 locations throughout the province. Traps/lures were provided to Riding Mountain National Park for monitoring six 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) are placed 40 m apart at each plot location in a triangular configuration. Average moth captures per trap increased in three regions with a large drop in moth captures found within the Northwest region, however, moth captures are still low province wide (Table 2). No operational suppression program is planned for 2015.

Table 2. Spruce budworm pheromone trapping.

Location	2013 moth capture/trap	2014 moth capture/trap	% change
Northwest Region	151	650	+330%
Northeast Region	424	132	-69%
Western Region	367	550	+46%
Interlake Region	64	51	-20%
Eastern Region	20	22	+9%

Jack Pine Budworm - *Choristoneura pinus*

Defoliation by jack pine budworm, continues to be negligible throughout jack pine (*Pinus banksiana*) forests in Manitoba. In 2014, 33 trapping locations were distributed across the province using a 0.03% or 100 µg concentration of pheromone lure. 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 August and September, jack pine branch samples are collected at plots throughout the province and processed to assess current defoliation levels and determine egg mass densities to predict 2015 defoliation (Table 3).

Table 3. 2014 jack pine budworm defoliation and average egg mass, and predictions for 2015.

Location	2014 defoliation*	2014 average egg mass/10 m²	2015 defoliation prediction
Northeast Region	Light	0	Light
Northwest Region	Light	0	Light
Western Region	Light	0	Light
Interlake Region	Light	0	Light
Eastern Region	Light	0.28	Light

*Defoliation classes are as follows:

Light - up to 35% defoliation of current shoots
Moderate - 36% to 70% defoliation of current shoots
Severe - greater than 70% defoliation of current shoots and possible feeding on old foliage

Dutch Elm Disease - *Ophiostoma novo-ulmi*

Provincial Dutch elm disease (DED) sanitation crews removed 3,892 trees in 2013-2014; 2,311 within the DED buffer zone of Winnipeg and 1,581 throughout the remainder of the province. The City of Winnipeg removed 4,850 elms, and Brandon removed 182 elms. Total elm tree removals were 8,924.

In 2014, Cost-Sharing Agreements were administered within 34 communities and six rural municipalities in the buffer surrounding Winnipeg. Provincial survey crews marked 4,000 elms for removal (2,272 within the Winnipeg buffer zone, 248 in the City of Brandon and 1,480 in and

around the 34 Cost-Sharing Agreement communities). In addition, 73 elm firewood piles were identified for removal. In the City of Winnipeg, 4,850 elms were marked for removal.

Elm Bark Beetle Monitoring - *Scolytus multistriatus and Scolytus schevyrewi*

In 1982, MCWS 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 are situated at several locations throughout southern Manitoba. From 1982 to 2006, only eight specimens of *S. multistriatus* had been captured. In 2011, an adult of *S. multistriatus* was captured. Numbers of *S. multistriatus* continued to increase with six beetles caught at three locations in 2012. In 2014, no *S. multistriatus* were caught.

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 (CFIA). This new invasive insect to Canada attacks and breeds in both American and Siberian elm and has the potential to transmit Dutch elm disease. Since its introduction several *S. schevyrewi*, have been captured in 2008, 2009, 2011 and 2012. In 2013, 10 *Scolytus schevyrewi* were caught at four locations within Manitoba.

European Gypsy Moth - *Lymantri dispar*

In the fall of 2014, Manitoba Conservation and Water Stewardship assisted the Canadian Food Inspection Agency (CFIA) in conducting a survey for gypsy moth egg masses within the Rural Municipality of Lac du Bonnet. 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, pupal casings, dead larva and a dead adult moth. An eradication program is now being planned for 2015. Monitoring for this invasive forest pest will continue in 2015 with trap delineation deployed by the CFIA.

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 and Water Stewardship is asking the public not to transport firewood into the province and to deposit all wood they are transporting in the bins. For 2014, travelers deposited pine, ash, oak and other tree species, in both bins along Highway 1 and in bins along Highways 16 and 5. A total of 159 pieces of firewood were deposited by the public. Firewood is inspected for signs of insect activity and burned.

Emerald Ash Borer - *Agrilus planipennis*

Ash species (*Fraxinus spp.)* are a cornerstone species along riparian forest and within Manitoban communities. Planning and preparation continues within Manitoba for the invasive forest insects, Emerald ash borer (EAB). To aid in EAB detection MCWS deployed 34 green prism traps placed at high risk location within the province. Trap deployment is coordinated between the City of Winnipeg, MCWS, CFIA and Trees Winnipeg. All traps in Manitoba were found to be negative for the presence of EAB.

Municipalities and communities are encouraged to start monitoring for EAB within their community with technical support provided from the province. In 2014, four additional communities' purchased green prism traps to complement the current ongoing effort by the province.

Public Education and Outreach

Increasing public knowledge and understanding of forest health issues including the risk associated with firewood movement and invasive species management is important to the province of Manitoba. In 2014, Manitoba Conservation and Water Stewardship launched a new online questionnaire Got a Sick Tree? www.gov.mb.ca/conservation/forestry/questionnaire/. Forest health staff participated in 10 trade shows attended by tens of thousands, provided 10 presentations to special interest groups and responded to 425 public inquiries.

Saskatchewan Report

Rory McIntosh

Saskatchewan Ministry of Environment, Prince Albert, Saskatchewan

Defoliators – Softwood

Spruce budworm, *Choristoneura fumiferana*

Since the peak of the outbreak in 2002, defoliation by the eastern spruce budworm (*Choristoneura fumiferana*) has been gradually declining (Figure 1). Aerial surveys in 2011 revealed 92,406 ha of moderate and severe defoliation. This area dropped significantly to 28,272 ha in 2012. In 2013, just over 13,000 ha of mostly moderate defoliation was mapped. In 2014, **no area of defoliation was mapped** during aerial surveys – this is the first time since the early 1990s. Although small pockets are present in the Pine House and Besnard Lake areas in north-central Saskatchewan, the outbreak throughout the rest of the province has collapsed. In 2014, overwintering L2 surveys reveal low numbers. No spray program will be implemented in 2015.

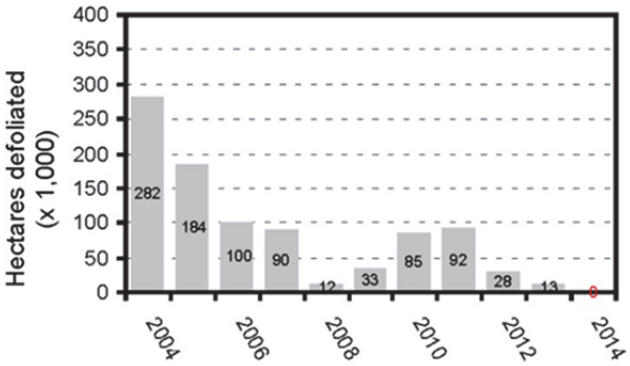

Figure 1. Area of moderate to severe defoliation caused by the spruce budworm *Choristoneura fumiferana* in Saskatchewan 2004-2014.

Jack pine budworm, *Choristoneura pinus pinus*

In 2014, there was again no detectable jack pine budworm defoliation in Saskatchewan. Jack pine budworm, a periodic defoliator of jack pine, has not been detected since the early 1980s. In 2014, the province continued the pheromone trapping network to monitor moth activity. In general, trap counts remained low throughout the province with the exception of some elevated counts in the Fort a La Corne. No significant trap counts were recorded in 2014.

Defoliators – hardwood

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

The annual area of hardwood defoliation has been approximately doubling since 2010. In 2014, the outbreak really took off and the area of defoliation tripled to 304,107 ha. While in 2011 the damage was predominantly caused by the large aspen tortrix, this disturbance continues mostly in the western part of the province. The damage in the central (Prince Albert National Park and the Churchill River) and eastern parts of the province (including

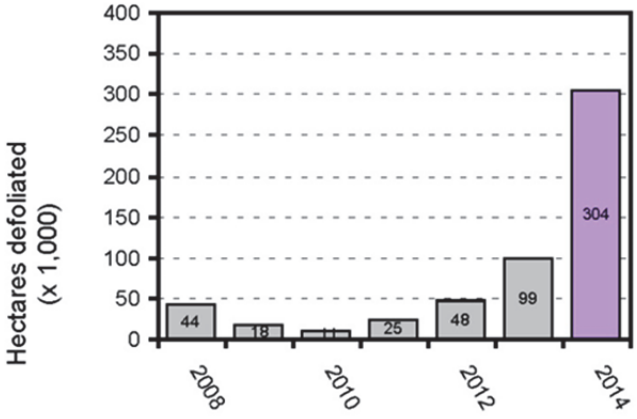

Figure 2. Net area of moderate to severe defoliation caused by hardwood defoliators in Saskatchewan 2008-2014.

Greenwater Lake and Duck Mountain provincial parks), is caused by forest tent caterpillar. Forest tent caterpillar is also defoliating aspen in the Cypress Hills in the southwest (Figure 3).

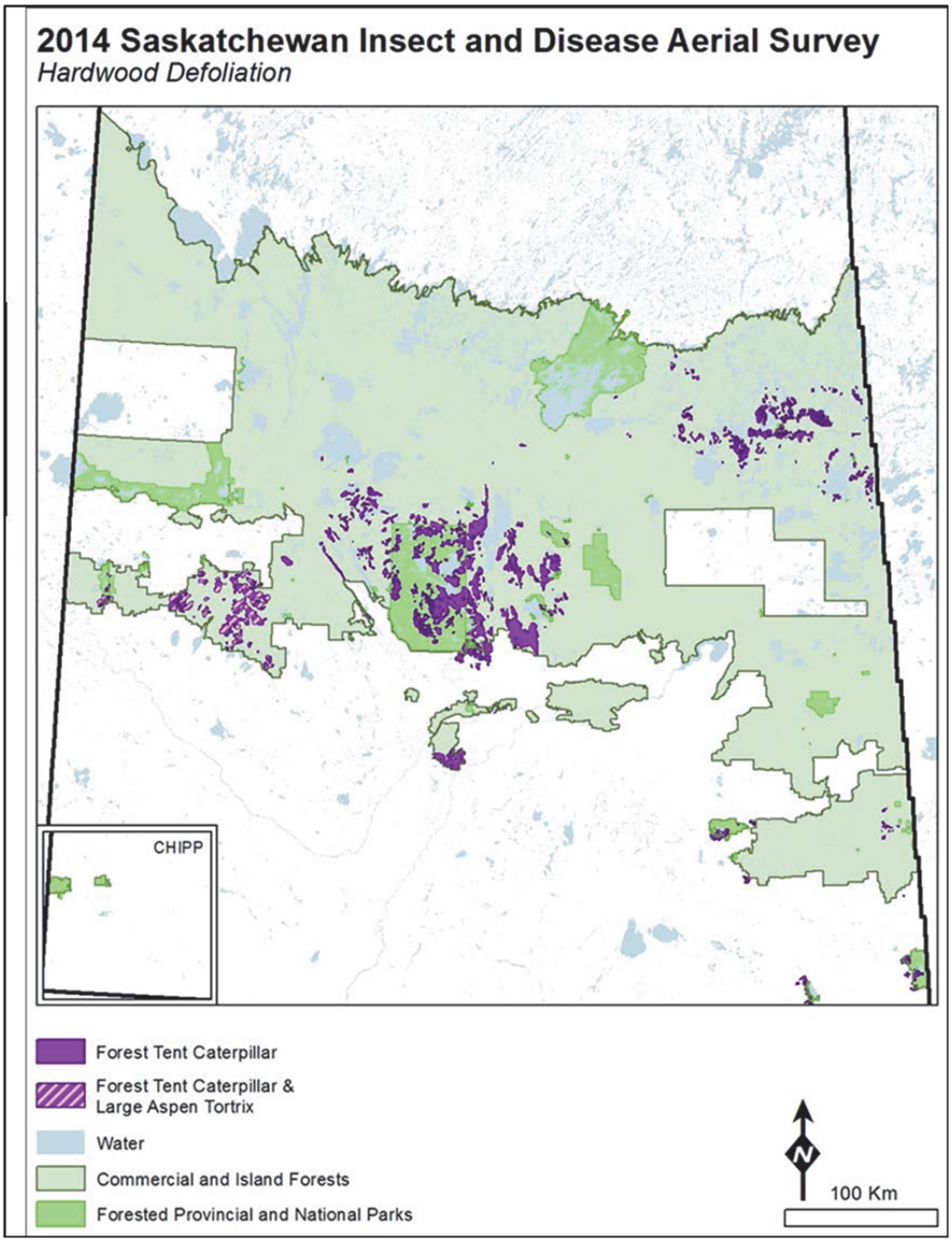

Figure 3. Area of moderate to severe defoliation caused by the forest tent caterpillar *Malacosoma disstria* (solid fill) and large aspen tortrix *Choristoneura conflictana* (diagonal fill) in Saskatchewan in 2014.

Foliar Diseases

Spruce needle rust, *Chrysomyxa ledicola*

Spruce needle rust *Chrysomyxa ledicola* (Figure 4) was detected again in 2014, for the fourth year in a row. In 2013, the net area affected was 98,712 ha. In 2014, aerial and ground surveys revealed that the area affected had increased dramatically to 152,427 ha. Areas affected by spruce needle rust were predominantly in the western part of the province in and around Dillon Lake, north of the Cold Lake Air Weapons Range, and large areas south of the Weapons Range and around Meadow Lake. There were also significant areas affected around Turtle Lake between Glaslyn and Turtleford (Figure 5).

Figure 4. Spruce needle rust C*hrysomyxa*.

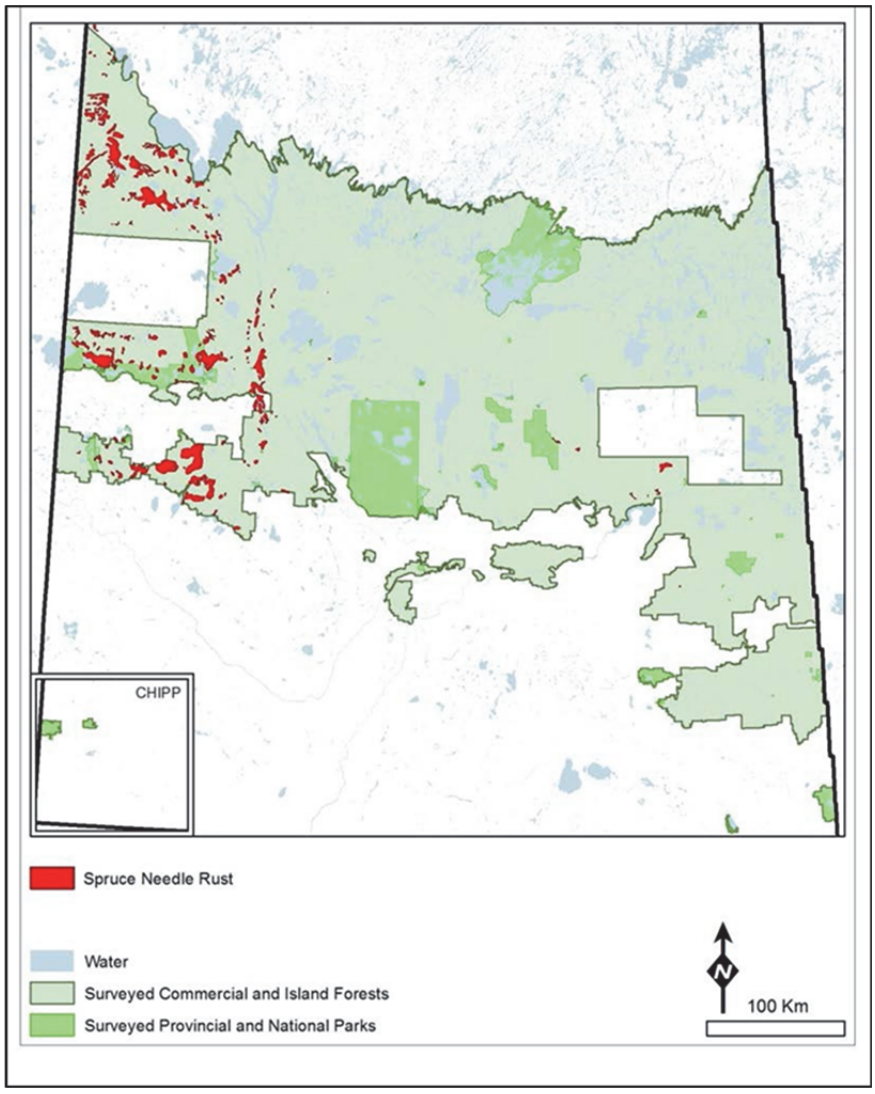

Figure 5. Distribution of spruce needle rust defoliation in Saskatchewan in 2014.

Invasive and non-native pests

Dutch elm disease, *Ophiostoma novo ulmi*

In 1980, Dutch elm disease (DED) was first discovered in Saskatchewan (Regina). Since then, DED has slowly spread along the Souris and Qu'Appelle river valleys in southeast and eastern Saskatchewan and is now found throughout most of the range of native elms in Saskatchewan (Figure 6).

With the exception of the larger urban centres, since 2010, 17 communities (shown in Figure 6 as stars) have secured a contractor to conduct surveillance in their jurisdictions. These communities include:

- Balcarres
- Broadview
- Carlyle
- Caronport
- Estevan
- Indian Head
- Langham
- Moosomin
- Outlook
- Oxbow
- Pense
- Preeceville
- Spiritwood
- Wadena
- Watrous
- Wolseley
- Wynyard

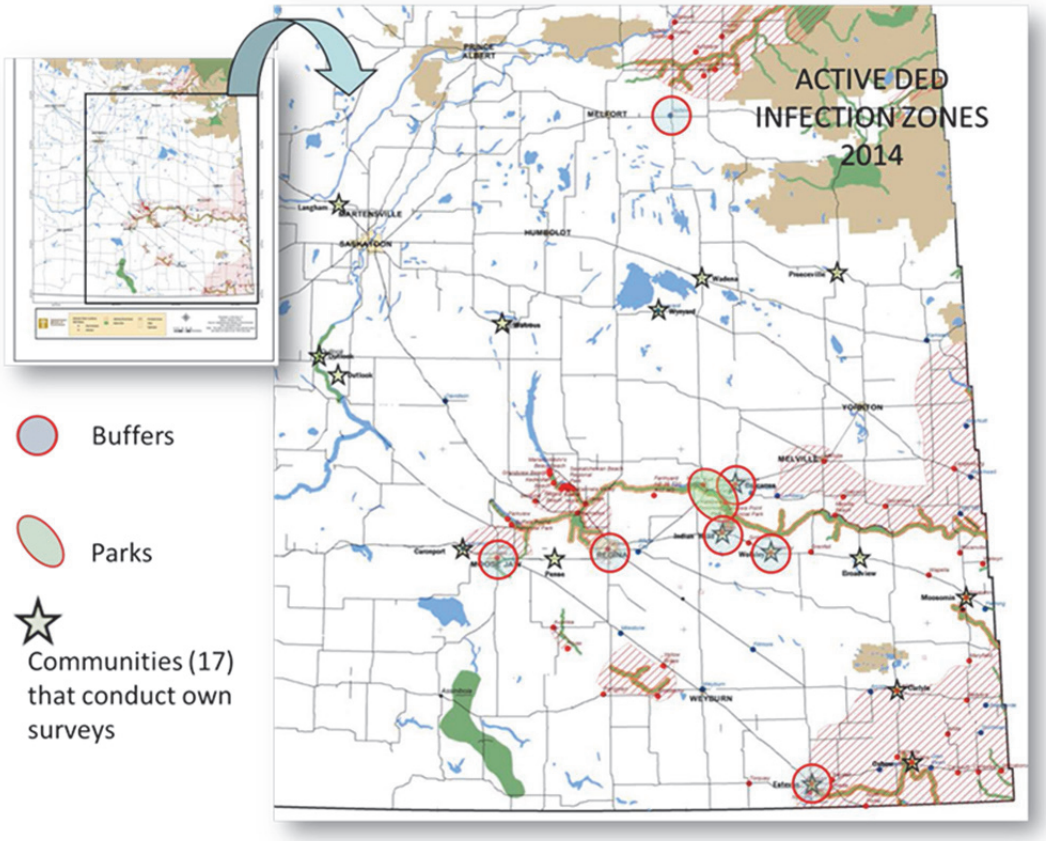

Figure 6. Distribution of Dutch elm disease active zones (red cross-hatch) throughout Saskatchewan in 2014. Saskatchewan Ministry of Environment continues to survey in wild stands in seven buffer areas outside major communities (circles) and in two Provincial Parks (oval). In addition to the major urban centres, 17 communities (stars) conduct DED management action in their own communities.

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

2014 Highlights

- According to the provincial crop protection laboratory, no new communities reported DED in 2014.
- The number of infected trees removed in 2014 management (buffer) zones has increased when compared to 2013. This is particularly evident in the Regina buffer zone, where the number of infected trees removed almost doubled (Table 1).
- The number of trees removed from provincial parks is slightly lower than in 2013 (Table 2).
- DED still extensive in the southeast region of the province.

Table 1. Comparative number of DED infected trees marked for removal in the seven buffer zones in Saskatchewan from 2012 to 2014.

Buffer	Removed		
	2012	2013	2014
Balcarres	73	79	43
Estevan	2	4	0
Indian Head	23	28	24
Moose Jaw	22	27	38
Regina	37	64	118
Tisdale	5	12	23
Wolsley	0	0	0
Total	162	214	246

Table 2. Comparative number of DED infected trees marked for removal in two parks in Saskatchewan from 2012 to 2014.

Parks	Marked Trees		
	2012	2013	2014
Katepwa Point Prov Park	0	3	8
Echo Valley Prov Park	32	132	112
Regina Beach Rec Site	NO SURVEY	NO SURVEY	3
	32	**135**	**123**

European gypsy moth, *Lymantria dispar*

In 2014, the Canadian Food Inspection Agency (CFIA) continued its on-going monitoring in Saskatchewan, deploying 522 Tréce delta II green traps baited with Gypsy Moth String Lure (Table 3). All traps were targeted at the European gypsy moth *Lymantria dispar*. No male gypsy moths were caught. In 2014, the CFIA conducted delimitation surveys (16 traps/mile) around all three 2013 positive finds. In 2014, all delimitation traps were negative.

Table 3. Number and distribution of gypsy moth traps in Saskatchewan, in 2014.

LOCATION (and area)	NUMBER Traps	NUMBER Positive
REGINA/MOOSE JAW*	195	0
SASKATOON	142	0
YORKTON	65	0
N. BATTLEFORD	40	0
NIPAWIN	40	0
MELFORT	40	0
Total	**522**	**0**

*Includes 23 traps deployed by the City of Regina.

2014 Highlights

- In 2014, the CFIA continued its on-going monitoring in Saskatchewan, deploying **499 Tréce Delta II Green Traps** baited with Disparlure Flex lure. All traps were for the detection of **European gypsy moth,** *Lymantria dispar*. The City of Regina deployed an additional 23 traps, for a total of 522 traps. All gypsy moth traps deployed in 2014 were negative.

- In total, 195 (172 by the CFIA and 23 by the City of Regina) European gypsy moth traps were deployed in Regina, Moose Jaw and the surrounding area. 142 traps were deployed in Saskatoon and the surrounding area. An additional 40 traps were deployed in and around North Battleford, Nipawin and Melfort.
- All traps (16 traps/mile) deployed in delimitation surveys around the three positive sites reported in 2013 were negative.
- The CFIA continued emerald ash borer (EAB) trapping and visual surveillance. In total, 20 green panel traps were deployed in 2014. The City of Regina deployed three.
- In the fall, the CFIA conducted visual surveys at 20 sites for the Asian longhorned beetle (ALB). No signs of ALB were found.
- **NO GYPSY MOTHS WERE FOUND IN ANY OF THE TRAPS IN SASKATCHEWAN IN 2014.**
- **NO EMERALD ASH BORERS WERE FOUND IN ANY OF THE TRAPS IN SASKATCHEWAN IN 2014.**

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 2013, the Government of Alberta reported that MPB had been found in a baited tree southwest of Fort McMurray, within 50 km of the Alberta– Saskatchewan border. **In 2014, the closest detected beetle was in a baited tree 120 km west of the border.** Currently, there is an active MPB outbreak in the Cypress Hills Interprovincial Park in southwestern Saskatchewan (Figure 7).

Figure 7 Building mountain pine beetle infestation in and around Cypress Hills Interprovincial Park, in southwestern Saskatchewan.

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

Since 2002, the Saskatchewan Ministry of Environment (MOE) 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 & Alberta interprovincial agreement to slow the spread of MPB, in Alberta

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

a multi-year agreement to partner with the province of Alberta to develop a coordinated, strategic approach to control the spread of the mountain pine beetle into Saskatchewan's boreal forest. The agreement ended in April 2014. In December 2014, the agreement was renewed for an additional three-year term.

Under this agreement annual work plans are developed by the Spread Management Action Collaborative (SMAC) integrating Alberta's current aerial and ground survey data to prioritize and coordinate control activities. Work in 2014 continued to focus on the leading edge through maintaining a tree-baiting network to delineate the leading edge and Level 1 (single tree) removal of MPB infested trees in the Slave Lake and Marten Hills areas.

Saskatchewan continues to be vigilant in early detection surveillance and preparations for rapid response. In 2011 a tree-baiting grid was established in northwestern Saskatchewan to provide an extension of the Alberta detection baiting program to help detect and delineate the "leading edge" of MPB and detect its presence/spread into Saskatchewan. This grid was expanded in 2013 and 2014. In total, there are 69 landing areas in which tree baiting sites are located.

Mountain pine beetle surveys

The surveillance program is divided into two components: the Cypress Hills Interprovincial Park (CHIPP) and the northern boreal forest. Saskatchewan's strategic approach to the MPB threat is very similar to that of fire-fighting: early detection leading to immediate, rapid and aggressive response. To help focus surveillance and detection of MPB, Saskatchewan has implemented risk and susceptibility mapping, i.e. 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, is used to help focus efficient aerial and ground surveillance activities. In late August and early September 2014, systematic surveys were conducted in the northwest using rotary wing aircraft (Figure 8).

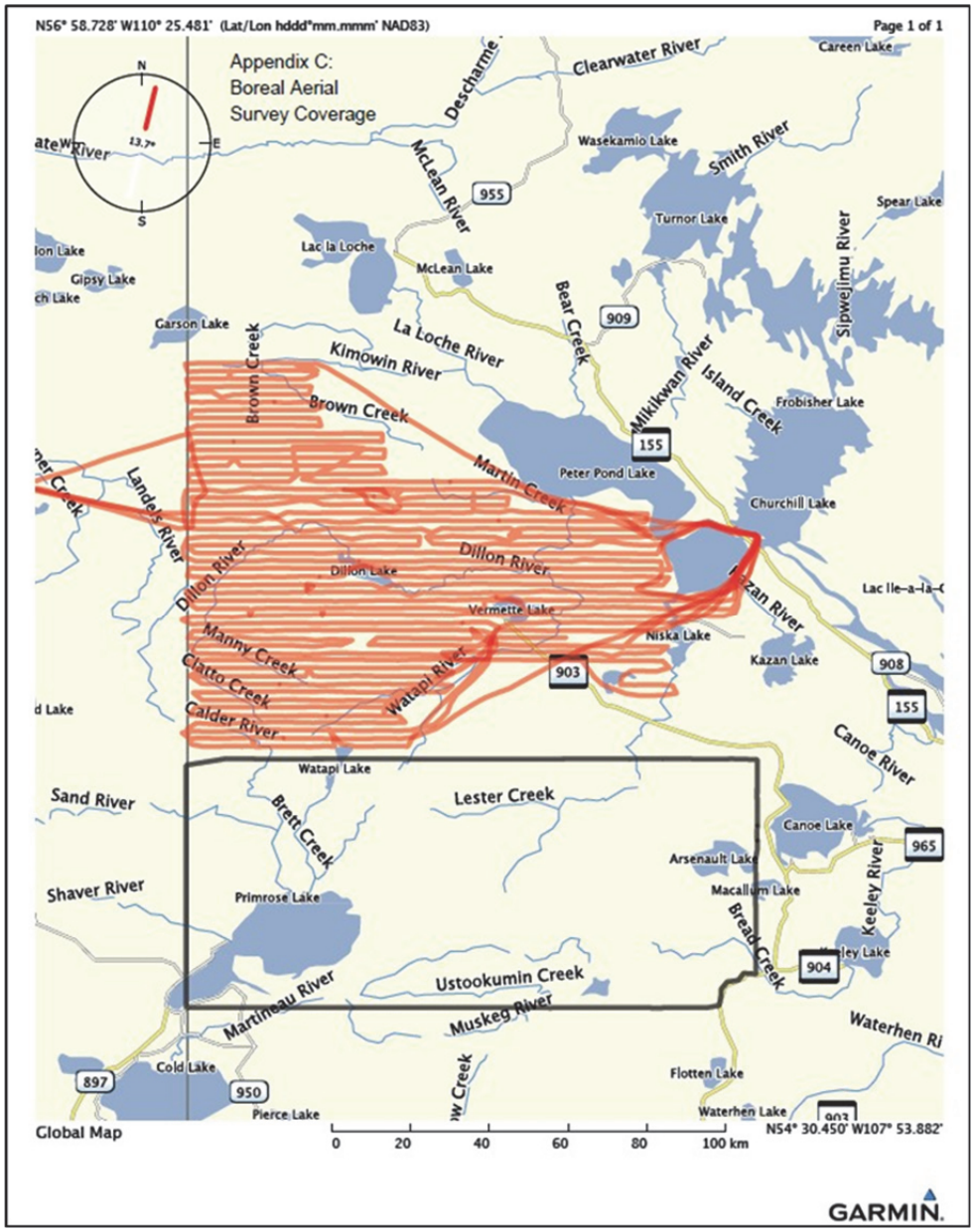

Figure 8. Track log map of western Saskatchewan showing areas where the Saskatchewan Ministry of Environment conducts extended aerial surveys of susceptible pine stands.

Cypress Hills Interprovincial Park (CHIPP)

The Saskatchewan Ministry of Environment has been monitoring MPB in the CHIPP since the last outbreak declined in 1985-1986. Aerial overview surveys are used to locate all red trees, shown as red dots on the map. These observations are then verified by detailed and systematic ground surveys. In the West block, the outbreak remains concentrated in the southwest corner (Figure 9) and throughout the core area of the Centre block (Figure 10).

Each year, all trees verified during the ground surveys and marked for removal are removed. In 2006, only two trees were removed; however, this number started to increase in 2008-2009. In

2010, there were 257 trees controlled; in 2011 this number was 280, it increased to 417 in 2012 and in 2013, 411 trees were marked in the West block (see the red curve Figure 9).

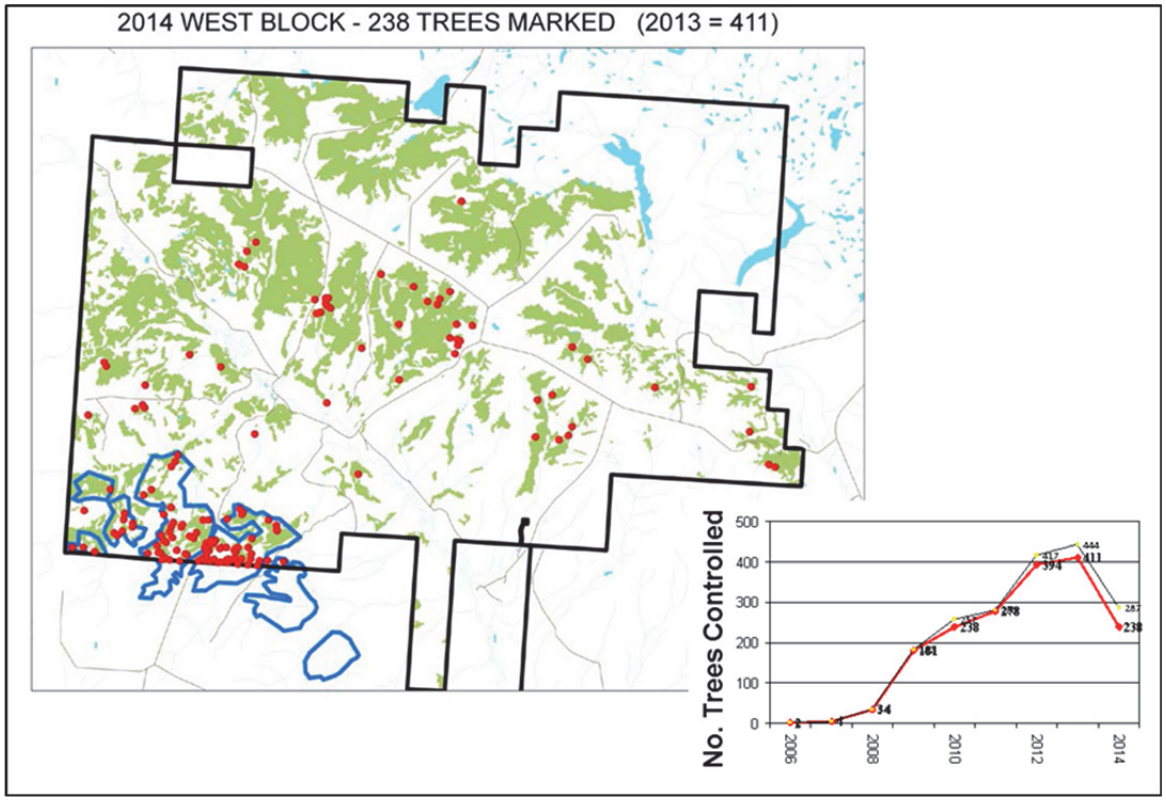

Figure 9. Location and distribution of mountain pine beetle infested trees (red dots) detected through aerial surveys and confirmed by ground checks in the west Block of the Cypress Hills Interprovincial Park in southwestern Saskatchewan, in 2014. Note: infestations in the southwest of the West block, both inside and outside the park, are so extensive they are represented by blue polygons.

The number of trees to be removed in Centre block (Figure 10) has been low overall (note the green curve); however, in 2014, the map shows there are two areas of concern: one in the northeast, and one in the south. The number of trees removed increased slightly from 33 in 2013 to 49 in 2014. **However, overall, the TOTAL number of trees marked for removal in Cypress Hills was DOWN in 2014** (Figure 11).

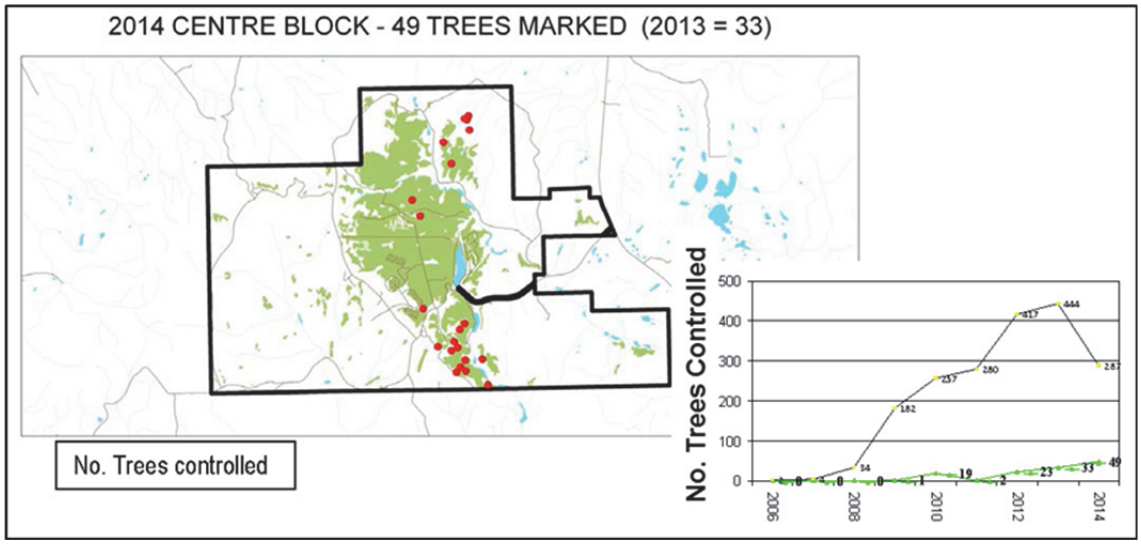

Figure 10. Location and distribution of Mountain pine beetle infested trees (red dots) detected through aerial surveys and confirmed by ground checks in the Centre block of the Cypress Hills Interprovincial Park in southwestern Saskatchewan, in 2014.

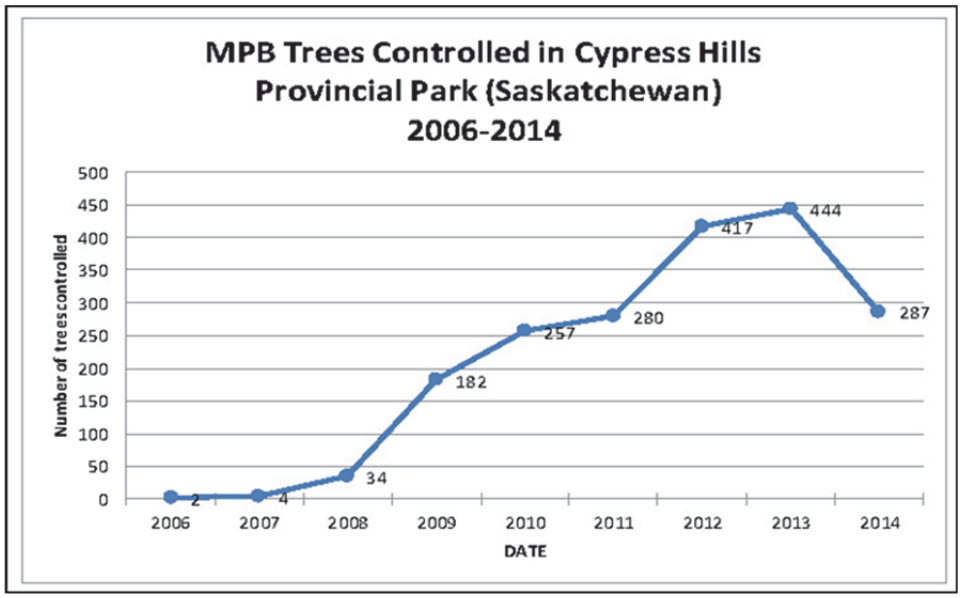

Figure 11. Total number of trees controlled in the Centre and West blocks of the Cypress Hills Interprovincial Park, from 2006 to 2014.

Since this outbreak is located across multiple jurisdictions, including private land to the south of the CHIPP, Saskatchewan continues to extend aerial surveillance to monitor all susceptible pine stands inside and adjacent to the park (with the exception of Alberta). The province continues to work together with federal agencies and First Nations to coordinate work and assist in the control of infested trees on First Nations lands outside of the park boundaries. The ministry is also working with the Province of Alberta, ranchers and municipal leaders to develop a collaborative, regional approach to managing mountain pine beetle in the area.

Northern boreal forest surveys

The Ministry of Environment conducts systematic monitoring at the northwestern Alberta-Saskatchewan border, with a focus on areas of highly susceptible jack pine. The Ministry surveys approximately 1.6 million ha of pine forests, extending 100 km east from the Alberta border and from the southern forest fringe north to the Churchill River.

In 2012, in alignment with the leading edge monitoring network in Alberta, the Ministry expanded the existing early detection baited tree network. To serve this purpose, 40 heli-landing areas were cut in pine and pine-leading stands (one per township, location is represented by the helicopter symbol within the yellow squares in Figure 12). In 2013, an additional 24 sites were added, for a total of 69 sites represented by the black dots in Figure 12. The purpose of this initiative was two-fold: first, to provide a contiguous grid within which to deploy tree baiting stations to delineate the leading edge as it transitions across Alberta and Saskatchewan; and second, to provide a network of access points from which Level 1 single tree response action might be deployed if necessary.

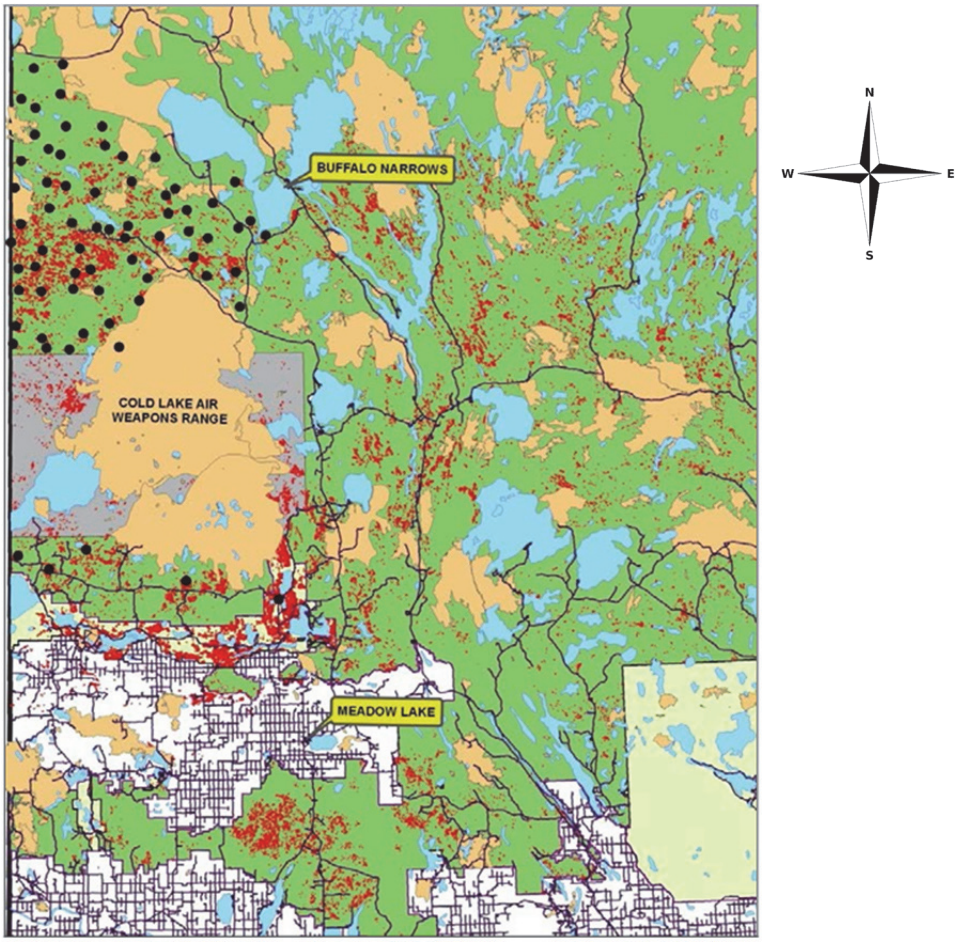

Figure 12. Distribution of heli-landing sites (black dots) installed in 2011-14 to create access opportunities and to expand the leading edge monitoring network across the region. Red polygons show the distribution of susceptible pine stands; orange polygons are areas burned by forest fires over past 30 years.

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

Forest Pest Conditions in Alberta

Erica Samis

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Aspen defoliation decreased in 2014 by over 40% from 2013. The gross area of aspen defoliation in Alberta was 3,586,005 ha. Of this, 99% was caused by the forest tent caterpillar (*Malacosoma disstria*). A major change was the decrease of aspen two-leaf tier (*Enargia decolor*) from over 2,000,000 ha in 2013 to less than 20,000 ha in 2014.

Pheromone monitoring of eastern spruce budworm (*Choristoneura fumiferana*) has not been carried out in Alberta since 2013. Predicted defoliation and observed defoliation were correlated; however, the need to predict defoliation in the absence of multiple severe defoliations and the potential initiation of a spray program was not warranted. Defoliation of white spruce increased from 37,195 ha in 2013 to 70, 935 ha in 2014. All defoliation was moderate. There was no defoliation of Douglas fir by the western spruce budworm (*Choristoneura occidentalis*) detected. This insect pest has not been detected in southern Alberta after 2011 when 6,914 ha of defoliation were mapped.

The mountain pine beetle (*Dendroctonus ponderosae*) program reporting year spans August 1 to July 31 of the following year. For the reporting year of August 1, 2013 – July 31, 2014 ground surveys were conducted at 17,486 individual sites and 167,900 trees were controlled through single tree treatments. Activities conducted from August 1, 2014 to December 1, 2014 include aerial surveys, Green:Red ratios and dispersal bait removals. Dispersal baits were set up at 313 sites across the province. Presence of mountain pine beetle was detected over 100 km west of the Alberta–Saskatchewan border. This is in comparison to detecting beetle presence 35 km from the border in the year previous. Aerial surveys were conducted over a large portion of the province with flight lines totalling over 106,000 km in length. Green:Red rations were conducted at 413 sites. These surveys provide an estimation of the number of current year attacked trees for each previously attacked red tree detected through aerial surveys.

Dothistroma needle blight was detected at ATISC for the first time in 2013 in a high value pine clone bank. In order to decrease mortality, Bordeaux mixture was sprayed twice in 2013 and twice in 2014. Foliar assessments have not noted any improvement in the overall per cent crown affected but there has been no further mortality. Based on the per cent crown affected, preliminary data analysis of species suggests that jack pine are more resistant to the fungus than are lodgepole pine. Analysis of original geographic location suggests that the farther the distance of the source of clones to ATISC, the less resistant the clones are. Two other locations in Alberta have been confirmed. Needle rusts of spruce was prevalent in the northern portion of the province 2014.

Whitebark Pine (*Pinus albicaulis*) and limber pine (*Pinus flexis*) are both listed as *Endangered* under the Alberta *Wildlife Act*. A series of 273 monitoring plots for the invasive white pine blister rust (*Cronartium ribicola*) have been established across the province to determine rust severity and changes in rust severity in both species. In 2014, 200 of these plots were visited as 2014 was the third 5-year measurement. Results of the two previous measurements have been published. The 2014 data will be analysed and published as well.

Alberta Agriculture and Forestry publishes an annual report on the forest pest and damaging agents. This report can be found at http://esrd.alberta.ca/lands-forests/forest-health/default.aspx.

British Columbia Report

Tim Ebata

B.C. Ministry of Forests, Lands, and Natural Resource Operations,
Resource Practices Branch, P.O. Box 9513, Stn. Prov Govt, V8W 9C2

This report covers the highlights from the 2014 provincial aerial overview survey and some additional activities that were conducted this year. The provincial overview survey covered approximately 89% of the provincial forested land base (Figure 1). Smoke from wildfires hampered the completion of the survey in the Omineca region and it was conducted up to mid-November. The later surveys focused on mapping red attacked pine and did not capture any deciduous pest damage that is common in this area.

Mountain pine beetle continues to decline. Although the area damaged declined only slightly in total area damaged from 2013 (Figure 2), the severity of the damage was mostly recorded as trace (<1% attack) polygons meaning the actual number of trees killed declined. This continued decline verifies the predicted collapse of the current MPB outbreak. The threat of the beetle moving into the Yukon and NWT was poorly documented this year due to the inaccessibility of areas with extensive suspected MPB attack. Some of these infestations were checked using low level helicopter flights which revealed they were either porcupine or lodgepole pine beetle killed trees and not MPB. MPB continues to be managed in south eastern B.C. but the numbers have either declined or are static compared to last year.

Other bark beetles of note in B.C. are the Douglas-fir beetle and the spruce beetle. Both beetle species have increased in area attacked since 2013 with spruce beetle showing the greatest growth. Douglas-fir beetle management is confounded by constraints placed on harvesting in stands being managed for non-timber resources, particularly for mule deer winter range. Interior Douglas-fir stands are complex and difficult to manage.

Major defoliators in the province are the western spruce budworm, 2-year cycle budworm, serpentine (aspen) leaf miner, and the North American strain of European gypsy moth. Western spruce budworm infested stands in the Cariboo and Thompson Okanagan regions were treated with a single application of Btk (Foray 48B). Defoliation declined dramatically this summer and a treatment is unlikely to occur in 2015. Gypsy moth pheromone trapping in the summer of 2014 resulted in 220 male moths being caught (vs. only 13 being caught in 2013). Most of the moths were caught in Surrey and Delta. A 5,000 ha aerial spray program is being proposed for Spring 2015 (Figure 3). This is the third largest aerial spray operation ever conducted in B.C. for gypsy moth eradication. Two-year cycle budworm defoliation was higher in the southern half of its range with 164,979 ha of defoliation being mapped. It is expected to decline in the south and increase in the northern half as the continued pattern of alternating peak years continues. The highest recorded defoliation was caused by the Serpentine (aspen) leaf miner which defoliated 3.6 million ha of aspen across the province.

Other disturbances mapped included foliar diseases (Venturia poplar shoot blight, dothistroma needle blight and larch needle blight being the most prolific), the Mount Polley tailings pond rupture, and extensive cedar flagging/ top kill throughout the Interior Cedar Hemlock subzone in southern B.C.

Two forest health projects of note involved a poplar disease and a bark beetle. The first is an update on the *Septoria musiva* study being led by Dr. Richard Hamblin's genomics lab at UBC and working with FLNR forest health specialists, Dr. Harry Kope and Stefan Zeglen. The poplar foliar blight is native to Eastern Canada but has been accidentally introduced in to B.C. via infected hybrid poplar cuttings being used for poplar plantations supplying the tissue paper industry. Initial sampling showed the disease is in the province but restricted to the Fraser Valley. Concerns for disease transmission to native black cottonwood lead the team to examine black cottonwood in adjacent natural stands. Survey results showed that only a very low rate of infection occurred on native poplars. Another study conducted by Dr. Lorraine Maclauchlan, regional entomologist in the Thompson Okanagan region, re-examined aerial surveyed strip plots in high elevation subalpine fir stands to document the mortality rate of the mature fir with the primary mortality agent being the western balsam bark beetle. The initial survey was conducted 14 years ago and the researchers were able to relocate the same strip lines and tally the condition of all fir trees within the strips. Over the 14 years, the average attrition rate was about 1% of the mature volume was killed per year with the standing dead volume in these stands were >31% of the total stand volume. This information will be directly included into the estimates of timber loss applied to these high elevation stands found throughout the southern interior. With the decimation of the area's timber supply by the mountain pine beetle, obtaining more accurate estimates of loss rates in subalpine fir is now very important.

Finally, the province has revised and updated the popular pest identification book "Field guide of forest damage in British Columbia, 3rd Edition." The hardcopy can be ordered from B.C.'s Crown Publications: https://www.crownpub.bc.ca/Product/Details/7610003512_S.

Session XI: Forest Pathology

Root disease pathogen *Heterobasidion irregulare*: invader, proliferator, or just important?

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The conifer root disease pathogen *Heterobasidion irregulare* has been found in at least 60 distinct locations in Wisconsin. Invasion of northcentral and northeastern North America by *H. irregulare* may have occurred centuries earlier, but its first detection in Wisconsin only 21 years ago suggests more recent establishment in the state, where most affected stands are red pine plantations. Thinning at regular intervals produces fresh stump surfaces that become infected, and frequent root grafts facilitate tree to tree spread. The importance of *H. irregulare* is linked to the value of the threatened resource, consequences of the disease, and practices that can prevent losses. The majority of the red pine type in the northcentral region of the United States is comprised of highly productive plantations established at considerable cost. Because most of these plantations are now in age classes in which thinning occurs, infestations are likely to become more common. Loss in value due to mortality increases as trees grow from pulpwood to pole and sawlog sizes, thus expanding root disease foci. Stump infection, numbers of foci, and thus damage can be minimized if protective chemical or biological treatments are applied to fresh stumps.

Session XII: Urban Forestry

Canadian Forest Service urban forest engagement: science, policy and positioning

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The Canadian Forest Service of Natural Resources Canada (NRCan-CFS) has a long history of providing scientific information, tools and policy expertise to address native and invasive alien species – pests and pathogens – that impact Canada's urban forests. From a policy perspective, the extent to which these activities can or should be considered urban forest science (as opposed to a strategic response to forest disturbance, regardless of location) is of increasing interest. NRCan-CFS has committed to raising its profile with Canadians who live in urban communities and to providing science and policy leadership on matters relevant to urban forests throughout Canada. This presentation will offer an analysis of the current NRCan-CFS presence in urban forestry, of potential for new engagement and of the implications for NRCan-CFS science and policy moving forward.

Session XIII: CFIA Updates

CFIA plant health surveillance update

Mireille Marcotte
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The Canadian Food Inspection Agency's national plant protection survey program provides information in support of import, export, and domestic regulatory programs and is the basis for sound regulatory decisions. Pest surveys are required to maintain claims of "pest-free" status of an area, to detect new populations of quarantine pests, and to delimit populations of quarantine pests with limited distributions in Canada. Pest surveys are also an integral part of control and eradication programs. Highlights from the 2014 plant health surveys as well as key outreach initiatives undertaken by the Plant Health Surveillance Unit will be presented.

The importance of the International Plant Protection Convention and its standards

Marie-Claude Forest (presented by Cameron Duff)
Canadian Food Inspection Agency, Plant Protection Division
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The International Plant Protection Convention (IPPC) is an international plant health agreement that aims to protect cultivated and wild plants, such as forests, by preventing the introduction and spread of pests. The Convention also covers vehicles, aircraft and vessels, containers, storage places, soil, and other objects or material that can harbor or spread pests that could be a threat to forests. The IPPC standard-setting process will be explained, with particular focus on the approach for developing the Canadian position, especially where input from the forestry sector is needed and most effective. The current International Standards for Phytosanitary Measures (ISPMs) and those under development that are relevant to preventing the introduction and spread of forest pests will be summarized.

Protecting plant resources while facilitating trade in North America

Rebecca Lee

North American Plant Protection Organization, 1431 Merivale Road, Ottawa, (Ontario K1A 0Y9

The North American Plant Protection Organization (NAPPO) provides a forum for public and private sectors in Canada, the USA and Mexico to collaborate in developing science-based standards to protect agricultural, forest and other plant resources against regulated plant pests, while facilitating trade. Regional standards help define risks of introduction and spread of key pests, and provide harmonized procedures for detecting and managing those pests taking into account feasibility of options. NAPPO depends on a range of stakeholders including regulators, scientists, academics, producers and national industry associations to achieve its mission. Involving these stakeholders throughout the preparation of NAPPO documents encourages information sharing, provides the practical experience of producers and brings in environmental concerns. This leads to the development of standards and discussion documents that are up-to-date, science–based and relevant. NAPPO has also prepared diagnostic and surveillance protocols, as well as science and technology documents, such as a Review of heat treatment of wood and wood packaging. Numerous NAPPO standards have been presented to the International Plant Protection Convention of the Food and Agriculture Organization of the United Nations. These standards have formed the basis for International Standards for Phytosanitary Measures (ISPMs) that are now applied globally. The most widely recognized example has been ISPM 15, Regulation of wood packaging material in international trade.

Session XIV: Spruce Budworm

News from the frontlines: what we are learning about spruce budworm management approaches

***Jacques Régnière*[1], *Ariane Béchard*[1], *Johanne Delisle*[1], *Alain Labrecque*[1], *Robert Johns*[2], *Véronique Martel*[1], *Kees vanFrankenhuyzen*[3], *Lucie Royer*[1], *Deepa Pureswaran*[1]**

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Since 2008, we have taken advantage of the rise of a new spruce budworm (SBW) outbreak in eastern Canada to observe the demographic processes that underlie the shift of populations from an endemic to an epidemic state. We have shown that SBW populations were subject to density-dependent mating failure. We have also observed a strong demographic Allee effect caused by the impact of natural enemies in low populations. These results suggest the existence of a density threshold below which a SBW population cannot grow unless it is subsidized by migration. We also tested the efficacy of several types of treatments (Bt, Mimic, pheromone) in low density SBW populations. All this new information allows us to contemplate the possibility of an early intervention strategy aiming to stop, or at least slow-down, the progression of an outbreak. What would such a strategy look like? Is it utopic or a real possibility?

A bio-indicator of spruce budworm migratory flight

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The red mite, *Leptus triati*, is a larval ectoparasite of spruce budworm (SBW) moths. This association has been used as a bio-indicator of SBW migratory flight by comparing mite parasitism between rising populations from the Lower St. Lawrence region (LSL) and three endemic populations: Armagh and Epaule (Quebec) and Juniper (New Brunswick). Mite parasitism has been estimated from moths captured in light traps. In 2011 and 2013, parasitism was about 12% in the LSL whereas in Quebec, it was almost absent. However, on the night of 15 to 16 July 2013 (peak of moth flight in the LSL), an invasion of SBW moths was observed in Armagh and Juniper but not in Epaule. Following this immigration event, mite parasitism suddenly increased to 12 %, as observed in the LSL. In contrast, in 2012 and 2014, mite parasitism was <2 % almost everywhere in Quebec, suggesting that the life cycle of *L. triati* is bi-annual. The impact of SBW moth invasion on the dynamics of the population in Armagh will be discussed.

Mating disruption trials against spruce budworm in Quebec: 2014 edition

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After the mixed results obtained in mating disruption trials done in 2008 on the North Shore and in 2013 in the Matapedia Valley (Lower St. Lawrence, LSL) in Quebec, a new trial was conducted in 2014, about 60 km to the southwest of the 2013 LSL area. In all, ten 1-km^2 plots (5 treated, 5 controls) were established in populations that covered a wide range of larval densities (from 0.04 to 0.32 L4/shoot). As was observed in 2008 and 2013, the 2014 applications were very effective at lowering catch in pheromone traps and mating success among caged virgin females, regardless of population density. However, egg laying (measured as the Eggs/moth or L2/moth ratios) was identical between treated and control plots, confirming the inefficacy of the pheromone treatment in reducing the density of the next generation. In this presentation, we discuss the future of pheromone applications as an early intervention tool against spruce budworm.

Public engagement and partnership: developing a proactive approach to communicating issues surrounding spruce budworm management

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Spray programs associated with SBW have caused controversy in the past due to the widespread use of chemical insecticides. Much of this controversy has been encapsulated in books like 'Silent Spring' (Rachel Carson) or 'Budworm Battles' (Elizabeth May). Even though broad-spectrum insecticides have been banned in favor of less toxic, narrower spectrum alternatives, public distrust remains high. It is thus important to establish good communication with local communities to provide scientific understanding of the action mechanisms and the potential health or ecological impacts of these products. A communication strategy has been implemented in New Brunswick as part of the ACOA EIS project. The guiding principles of this proactive strategy include having scientists leading the research and the communication/outreach for all science-related issues, and to ensure that questions and concerns raised by the public are addressed as expediently and directly as possible. A citizen-science project is also being implemented to increase public knowledge and engagement regarding SBW management, and provide important data.

Spruce budworm 'early-intervention strategy' in Atlantic Canada: translating theory into practice

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During the past decade there has been a gradual shift in our understanding of spruce budworm population dynamics, which has prompted us to reconsider our strategic approach to managing budworm outbreaks. This so-called 'early-intervention strategy' (EIS) focuses on targeting relatively low density populations ('hot spots') as a means of halting or slowing outbreak spread. However, even as the theoretical basis of EIS solidifies, many questions remain regarding how to actually implement this strategy in the real world. I will discuss some of the central questions being addressed in the ongoing Atlantic Innovation Fund project aimed at developing this strategy, and provide an early snapshot of results from our first year.

POSTER ABSTRACTS

Databases to sustain pest risk analysis

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This poster introduces the database on pests found outside Canada on Canadian tree species and/or on exotic species introduced in Canada, a joint work of the Laurentian Forestry Centre (P. DesRochers) and of the Pacific Forestry Centre (E. Allen). Scientists from these two centres have read and summarised more than 900 science papers in order to collect information on pests found abroad that attack Canadian tree species planted outside Canada or exotic tree species planted in urban areas in Canada. Another database on trees planted in major Canadian cities is being developed. These two databases should be available online in 2015-2016.

Continuous cover forestry: a pest management strategy

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Forests contain significant biological diversity such as fungi, insects, wildlife and plants which interact directly or indirectly with trees and their environment to produce the health of forest ecosystems. Silvicultural systems with continuous cover forestry represent an alternative for pest management and may require less or no use of chemical products and increase the health of forest ecosystems. It is argued in this paper that continuous cover forestry increases tree species diversity and biological diversity and can be used as an efficient low cost pest management strategy. A harvest event in a 2 ha forest is used to show how a continuous cover can be maintained in a forest stand while preserving other functions of the forest. In this research, the harvest has modified the stem number per hectare, mostly in bigger diameter classes. The thinning removed 15% of the basal area and 16% of the volume of the forest stand. The harvest event has induced changes in the spatial distribution of the forest stand. This change will help natural regeneration, which will grow under the shelter of bigger trees to maintain the health of the forest.

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

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

The beech leaf-mining weevil, *Orchestes fagi* – ecology and management

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The beech leaf-mining weevil, *Orchestes fagi,* is a widespread pest of beech, *Fagus sylvatica* L., in Europe. In 2011, *O. fagi* was discovered in North America in Halifax, causing significant damage to the foliage of American beech, *Fagus grandifolia*. To determine the impact of this invasive species, we are investigating overwintering substrates, chemical ecology and development of tools (traps, lures) for surveys, host range tests, efficacy of TreeAzin stem injection for control, and impact of the weevil on beeach growth and mortality. Research to date has determined that 1) densities of overwintering *O. fagi* adults were very high on boles of beech, red maple and red spruce, suggesting firewood poses a high risk for human-assisted movement of the weevil; 2) antennae of *O. fagi* responded to green leaf volatiles but in choice assays, adults did not orient to conspecifics nor host plant compounds; 3) yellow sticky traps captured more weevils than non-sticky boll weevil traps but baiting traps with host volatiles and/or pheromone candidates did not affect mean catches; and 4) injecting beech trees with TreeAzin prevented larvae from reaching the pupal stage but did not reduce the number of leaves with mines.

Host-plant feeding preference of an invasive beech leaf mining weevil in Atlantic Canada

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The exotic beech leaf-mining weevil (*Orchestes fagi* L.) has caused significant damage to American beech (*Fagus grandifolia*) trees in Atlantic Canada. Although this feeding behavior is consistent with its role as a widespread pest of beech (*Fagus sylvatica*) throughout its European range, evidence of feeding on several additional native hosts suggests that its impact in North America could extend beyond a single plant species. We employed a combination of observational studies and no-choice feeding assays to assess feeding damage on a variety of potential hosts (including beech) within its introduced range. Surprisingly, weevil feeding damage was almost entirely exclusive to beech, possibly resulting from nutritional inequality or host phenological asynchrony with indigenous plants. Overall, although weevils have been observed to use secondary hosts in other capacities such as overwintering sites, its complete dependence on beech as a food resource suggests that impacts on secondary hosts will be minimal.

Ipsenol, monochamol and α-pinene: trap lure blend for *Monochamus* species (Cerambycidae) in Canada and the United States

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Sawyer beetles, *Monochamus* spp. (Coleoptera: Cerambycidae), are broadly attracted to volatiles released from pine trees as well as pheromones of *Ips* bark beetles associated with the same hosts. The generic *Monochamus* pheromone, "monochamol", is attractive to several species of *Monochamus* in eastern United States, particularly when combined with α-pinene. Our objective was to determine the interaction between ipsenol and monochamol on attraction of *Monochamus* species to traps baited with α-pinene. We compared mean catch of *Monochamus* spp. in multiple funnel traps baited with four different lure treatments: 1) α-pinene alone; 2) α-pinene + ipsenol; 3) α-pinene + monochamol; and 4) all three compounds. The experiment was replicated at 11 locations across Canada and the USA in 2012-2014. Seven different *Monochamus* species were trapped: *M. carolinensis, M. clamator, M. mutator, M. notatus, M. obtusus, M. s. scutellatus,* and *M. titillator* complex. Traps baited with the combination of α-pinene + ipsenol + monochamol captured the most beetles in 16 of 19 site-years, with significantly greatest mean catch in 11 of 19 site-years. Results suggest this triple-lure combination would be very effective for surveillance of North American *Monochamus* species.

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