2016 MPB and Stand Rehabilitation

Research Forum and Field Tour

fRI Research
Informing Land & Resource Management

Canada

May 10, 11 and 12, 2016 Grande Prairie, Alberta

Acknowledgement

I wish to acknowledge the tremendous support of the many people who assisted with big and small jobs that needed to get done to bring this year's Forum to fruition. In this regard, the Communication and Extension staff of fRI Research, namely, Sean Kinney and Ben Williamson who provided important feedback on techniques of communication and expression, and the Alberta Land-use Knowledge Network's Terri McHugh who developed the registration site and assisted with maintaining it. A special thank you is extended to Fran Hanington, fRI Research, Communication and Extension, who provided unwavering support in terms of logistics for registration, hotel and food arrangements, communication, and importantly, bringing all the details together that appear in the agenda pamphlet. I also recognize the involvement of the Canadian Wood Fibre Centre and in particular, Derek Sidders and Tim Keddy who so actively participated in so many ways to ensure a successful meeting. Planning for transportation and all aspects of the field trip takes tremendous effort and we all know that the Derek and Tim deliver in spectacular ways. Thank you all. KMM

Keith M. McClain, Ph.D., RPF

Keith is a Registered Professional Forester and has worked in the realm of forest science for nearly 40 years. He has worked in Ontario (with the Research Branch, Ontario Ministry of Natural Resources, Thunder Bay), British Columbia (with the Canadian Forest Service, in Prince George) and more recently in Alberta with the Alberta Sustainable Resource Development (now Alberta Agriculture and Forestry) until his retirement in 2012. Keith is now an independent forest science consultant encouraging the use of science information to inform resources decisions and support policy development as well as Program Lead for the fRI Research MPB Program. Keith has Bachelor and Masters degrees from the University of Toronto and a PhD from Oregon State University.

Derek Sidders

Derek Sidders is the Program Manager and Regional Coordinator of the Canadian Wood Fibre Centre for the Prairie Provinces and Northwest Territories. Derek graduated from Lakehead University in 1977 before beginning his career in Northwestern Ontario with the Ministry of Natural Resources. He has thirty-eight years of experience in forest management and afforestation operational development, applied research and technology transfer in Boreal Plains and Boreal Shield ecoregions of Canada. Derek has worked for the Canadian Forest Service since 1985 and for the Canadian Wood Fibre Centre since its inception in 2006.

Derek has spent the last 15 years developing, testing and demonstrating novel mixedwood forest partial harvesting and regeneration systems for the Boreal Plains and leads a national group that develops woody biomass feedstock options for an evolving Bioenergy industry in Canada.

Photo Credit: Dr. Allan Carroll, University of British Columbia

WELCOME TO THE 2016 JOINT FRI RESEARCH AND CANADIAN WOOD FIBRE CENTRE

MPB and Stand Rehabilitation Research Forum and Field Tour

Keith M. McClain, fRI Research and Derek Sidders, Canadian Wood Fibre Centre

As many of us travel easterly across Alberta from British Columbia, we are reminded of the seriousness of the MPB outbreak and the damage that it is causing. Although we probably think about the number of dead trees, we also need to consider the impact the beetle is having on communities, their economies and the provision of ecological services. Just how significant the change is in the flow of ecological services is unknown, but it could be dramatic for some communities that are entirely dependent on forest resources. At last years 2015 MPB Research Forum we heard from Dr. Bruce Larson, from the University of British Columbia, who said that "in order to understand where our forests are going it is sometimes useful to consider how our current forests got here". He said further that "we often get so caught up in immediate issues that we fail to consider the long run". Our forests have been and continue to be shaped by many factors. From early geological times to the present day large scale events have occurred to influence forest development. Up until recently fire, wind, drought, land settlement and industrial development were the major disturbances influencing forests. Now, however, MPB has joined the list of factors and its influence on forests and associated ecological services is expected to be long in duration.

Dr. Larson made a very important point in his opening address and that was that forests are on a basic trajectory that spans millennia, but foresters must make decisions and take action that shape our landscape over the next few decades. Dr. Larson's remarks remind us that we need to pay attention to the reality that in the very, very long run we may not have much of an impact on future natural landscape outcomes. Our focus remains short sighted - simply consider the length of the many forms of forest tenure, from months to 20 years with renewal. In Alberta, "government policies support sustainable forest management to provide ecological, economic, social and cultural opportunities for the benefit of present and future generations[1]. Obviously, good intentions need to be supported by knowledge of the future and how the future will be affected by our actions now.

MPB has been described as an agent of change and we all agree that change is happening, not only to the obvious features of our forests, but also to the social and economic (and cultural) benefits derived from forests. As alluded to above, supporting sustainable forest management under the province's current challenges presented by MPB is being met by research into its biology, genome, physiology, population dynamics, spread factors and interactions with other competitors. We hope that, collectively, our understanding of the beetle will allow decisive and effective operational decisions to lessen the destruction of forests, prevent its spread eastward and northward and maintain the flow of ecological services. The province is making significant progress through the application of science, but we need to remain cautious because we have been surprised before. With climatic warming, entrance of the beetle into novel habitats with trees with little or no defense mechanisms, beetle populations could expand rapidly. Dr. Barry Cooke (2015 MPB Research Forum) succinctly stated that "because of the inherent uncertainty regarding system transitions from an endemic state to an epidemic state in response to environmental governing of beetle – host interactions, we need to explore ways of coping with unpredictable disturbances, including the development of adaptive capacity to adjust to transformational ecosystem change.

I often wonder about such changes and how we would actually adapt given current forest policies and that change does not always come easily.

At this year's Forum, fRI Research has partnered with the Canadian Wood Fibre Centre (CWFC) to deliver a wide ranging program that will address broad topics of current beetle research and rehabilitation. On Day 2 of the Forum, Derek Sidders, Regional Coordinator and Program Manager, CWFC, will take charge and provide all attendees with a opportunity to see first hand some of the innovative approaches to restore beetle killed stands. With the blend of beetle research and operational field research we are assured to have a successful 2016 Information Forum. Thank you for attending and please take advantage of this learning opportunity by engaging with researchers and your experienced colleagues.

1. http://esrd.alberta.ca/lands-forests/forest-management/forest tenure/documents/DifferencesBetweenForestTenuresInAlberta-2009.pdf

Photo Credit: Brad Hawkes, Canadian Forest Service

Research Priorities: MPB Ecology and Stand Rehabilitation Program

	Research Theme 1: MPB Biology and Management
1.	What is the efficacy of current control measures applied to MPB in Alberta?
2.	What drives local and long distance beetle dispersal, establishment and population dynamics of MPB in novel host environments?
3.	What critical establishment thresholds can be defined to guide operational management of MPB infestations in novel habitats?
	Research Theme 2: Hydrological Impacts of Mountain Pine Beetle
1.	What are the specific thresholds in MPB affected watersheds that are indicative of pending negative conditions such as, changes in water quality and quantity, deterioration in aquatic habitat, flood potential?
2.	What is the range of hydrological impact at stand and watershed levels from variable MPB attack; can hydrological recovery be effectively determined?
	Research Theme 3: Dynamics of Natural and Managed Lodgepole Pine Stands Following MPB
1.	What are the vegetation dynamics in managed and natural pine dominated stands across Alberta's ecosites following variable MPB caused mortality?
2.	What site parameters (e.g. ecosystem services, stand dynamics) ought to be evaluated to determine candidacy for treatment (including salvage) versus those that ought to be left for natural succession? What are the thresholds of these parameters by ecosite that suggest treatment success?
3.	What operational measures can be taken to restore landscapes severely altered by MPB to ensure the flow of ecosystem services?
4.	How is wildlife habitat for grizzly bear and caribou affected by landscape change due to MPB, and what rehabilitative measures can be taken to restore their critical habitat?
5.	How does fire risk and fire behaviour change following MPB?
6.	How will the anticipated increase in soil water affect choice of rehabilitative options and what are the potential implications to the flow of ecosystem services?
	Research Theme 4: Social and Economic Implications of a Changing Landscape
1.	What are the characteristics of resilient communities that are able to ensure their social and economic stability in the midst of a landscape changing due to MPB, and what steps can be taken to enhance resilient capacity of communities?
2.	How is fibre quality related to shelf life of MPB killed trees across ecosites across Alberta and what are the subsequent implications for manufacturing?

AGENDA

Day 1 TUESDAY - MAY 10, 2016 Travel Day: Destination Grande Prairie, Alberta		
Time	Presentation	Presenter
6:00 – 7:00	Arrive: Grande Prairie	Check into Pomeroy Hotel & Convention Centre
7:00 – 9:00	Ice Breaker	Pomeroy Ball Room 1

Day 2 WEDNESDAY - MAY 11, 2016 Ballroom 1 - Pomeroy Hotel & Conference Centre		
Time	Presentation	Presenter
7:45 – 8:30	HOT BREAKFAST BUFFET – THE OFFICE RESTAURANT IN HOTEL	
8:30 – 8:45	Welcome and the day ahead	Dr. Keith McClain, R.P.F., Program Lead - Mountain Pine Beetle Ecology Program, fRI Research Derek Sidders, Regional Coordinator and Program Manager - Canadian Wood Fibre Centre, NRCan
8:45 – 9:15	Adaptive management for uncertain times: Alberta's future with the mountain pine beetle	Dr. Allan Carroll, Professor and Director - Forest Sciences Undergraduate Program, Department of Forest and Conservation Sciences, UBC
9:15 – 10:30	Corralling the beetle: detection, predicting spread, spread factors, management actions and outcomes	Moderator: Erica Samis, Director - Forest Health & Adaptation, Forest Management Branch, Alberta Agriculture and Forestry Dr. Nadir Erbilgin, Associate Professor and Canada Research Chair - Forest Entomology and Chemical Ecology, Department of Renewable Resources, UofA Drs. Barry Cooke, Research Scientist - Canadian Forest Service, NRCan and Allan Carroll, Professor and Director - Forest Sciences Undergraduate Program, Department of Forest and Conservation Sciences, UBC Dr. Katherine Bleiker, Research Scientist - Bark Beetle Ecology and Greg Smith, Forestry Officer, Bark Beetle Ecologist -Canadian Forest Service, NRCan
10:30 – 10:45	HEALTH BREAK	

AGENDA

Day 2 WEDNESDAY - MAY 11, 2016 Ballroom 1 - Pomeroy Hotel & Conference Centre		
Time	Presentation	Presenter
10:45 – 12:00	What is changing at the landscape/ ecosite level: what is benefiting, what is suffering?	MODERATOR: John Stadt, Provincial Forest Ecologist - Forest Management Branch, Alberta Agriculture and Forestry Dr. Axel Anderson, R.P.F., P. Eng., Program Lead - Water Program, fRI Research, Amy Goodbrand, PhD Student, and Dr. Uldis Silins, Professor - Forest Hydrology and Watershed Management, Department of Renewable Resources, UofA Dr. Ellen Macdonald, Professor - Forest Ecology, Julie Steinke, and Lori Schroeder, Graduate Students - Department of Renewable Resources, UofA and Dr. Anne McIntosh - Assistant Professor - Augustana Campus, UofA Dr. Laura Finnegan, Research Scientist and Caribou Program Lead, Terrance Larsen, Research Biologist, Dr. Karine Pigeon, Research Biologist and Gord Stenhouse, Research Scientist and Grizzly Bear Program Lead - fRI Research Drs. Justine Karst, Assistant Professor - Restoration , and Nadir Erbilgin, Associate Professor and Canada Research Chair - Forest Entomology and Chemical Ecology, Department of Renewable Resources, UofA
12:00 – 1:00	**LUNCH**	
1:00 – 1:30	The implications to the forest industry of MPB affected stands and associated volume in the Grande Prairie Region	Rob McLaughlin, RPFT, Operations Superintendent – Canfor Corporation, Grande Prairie
1:30 – 2:00	MPB impact to date, possible effects on mid- term wood supply/ ecosystem function and the need for mitigative efforts	Brooks Horne, R.P.F., Senior Forester – Forest Rehabilitation, Forest Management Branch, Alberta Agriculture and Forestry
2:00 – 2:30	Beyond Beetle: Facilitated and natural regeneration of conifers in lodgepole pine forests following MPB attack	Drs. Ellen Macdonald, Professor - Forest Ecology, Vic Lieffers, Professor and Department Chair - Silviculture and Forest Ecology and Nadir Erbilgin, Associate Professor and Canada Research Chair - Forest Entomology and Chemical Ecology. Department of Renewable Resources, UofA

AGENDA

Day 2 WEDNESDAY - MAY 11, 2016
Ballroom 1 - Pomeroy Hotel & Conference Centre

Time	Presentation	Presenter
2:30 – 3:00	Fire risks following MPB and how will they change with time	Dr. Mike Flannigan, Professor - Wildland Fire and Director of the Western Partnership for Wildland Fire, and Hugh Wallace, MSc Student - Department of Renewable Resources, UofA
3:00 – 3:30	HEALTH BREAK	
3:30 – 4:00	Innovative stand enhancement and regeneration systems to recover value, reduce risk and rehabilitate Mountain Pine Beetle affected stands in the Alberta Boreal Plains Ecozone	Derek Sidders, Regional Coordinator and Program Manager, and Tim Keddy, Wood Fibre Development Specialist – Canadian Wood Fibre Centre, NRCan
4:00 – 4:30	FRIAA – Mountain Pine Beetle Forest Rehabilitation Program	Byron Grundberg, MF, R.P.F., Consulting Services – MNP
4:30 – 4:45	Concluding discussions and the day ahead at Spirit River	Derek Sidders, Regional Coordinator and Program Manager – Canadian Wood Fibre Centre, NRCan
5:00 – 7:00	Evening Social	Cash bar and hors d'oeuves

Day 3 THURSDAY - May 12, 2016
Field Tour – Spirit River Innovative Rehabilitation Trials

Time	Title	Presenter
7:00 – 8:00	HOT BREAKFAST BUFFET	

Executive Summary

For the field tour portion of this Forum we will travel 156 km (25 not paved) north and west of Grande Prairie to the Dry Mixedwood subregion of the Boreal Plains Ecoregion, comprised of lodgepole pine, white spruce, trembling aspen and white birch. Tour stops will include a variety of natural and treated mixedwood stands comprised of at least 50% lodgepole pine, taller than 15 metres and with at least 50% of the stand affected by active or previous MPB attack. The tour will include the following site stops:

1. a typical non-treated MPB affected candidate lodgepole pine mixed stand;
2. stands partially harvested using a systematic, variable retention design that recovers active MPB attack trees, green and red softwood trees larger than 20 cm in diameter, green lodgepole pine that are closer than 3 metres apart, and all trees within the 5 metre wide, parallel machine corridors that are spaced 20 m apart;
3. stands site preparation and planted using several selective patch microsite treatments;
4. one of 4 replicates of a 4 microsite/2 regen type, silviculture study; 5) a wildfire research study, and
5. a site where varying land values are effected by MPB. Food and drinks will be supplied.

AGENDA

Day 3 THURSDAY - May 12, 2016 Field Tour – Spirit River Innovative Rehabilitation Trials		
Time	Title	Presenter
8:15 – 10:00	On route to Spirit River Site	Appropriate entertainment
10:15 – 10:45	Stop 1 Introduction to MPB affected immature stands	Derek Sidders, Regional Coordinator and Program Manager - Canadian Wood Fibre Centre, NRCan
10:45 – 11:15	Stop 2 Innovative Partial Harvest Systems Design to recover value, reduce stand risk and enhance rehabilitation efforts - Block 674	Tim Keddy, Wood Fibre Development Specialist - Canadian Wood Fibre Centre, NRCan and Dean Marshall, R.P.F., Vice President – Operations - Spectrum Resources Group Inc., Prince George BC
11:15 – 12:00	Stop 3 Reforestation applications to rehabilitate MPB affected stands - Block 674	Derek Sidders, Regional Coordinator and Program Manager -Canadian Wood Fibre Centre, NRCan
12:00 – 1:00	LUNCH	
1:00 – 1:45	Stop 4 Reforestation research study: 4 microsites and 2 regeneration methods - Block 201S	Julie Steinke, Dr. Ellen Macdonald, Dr. Vic Lieffers and Lori Schroeder - Department of Renewable Resources, UofA, and Derek Sidders, Regional Coordinator and Program Manager – Canadian Wood Fibre Centre, NRCan
1:45 – 2:15	Stop 5 Wildfire research study on fuel moisture content and fuel composition, Block 201s	Dr. Mike Flannigan, Professor, Wildland Fire and Director of the Western Partnership for Wildland Fire, and Hugh Wallace, MSc Student - Department of Renewable Resources, UofA
14:15 – 3:00	Stop 6 Integrated land use in MPB affected stands: oil and gas exploration and recovery, wildlife management and water protection - Block 576 and Stand dynamics after MBP attack	Open Discussion Sharon Meredith, Director - Forest Growth Organization of Western Canada (FGrOW
3:00 – 9:00	Return to Grande Prairie, Edmonton and stops in between	Meals will be provided for travellers to Edmonton

2015 Mountain Pine Beetle Status Update for British Columbia

Submitted by Tim Ebata, MSc, RPF, Forest Health Officer, Resource Practices Branch,
BC Ministry of Forests, Lands and Natural Resource Operations, Victoria, B.C.

Biographical Sketch

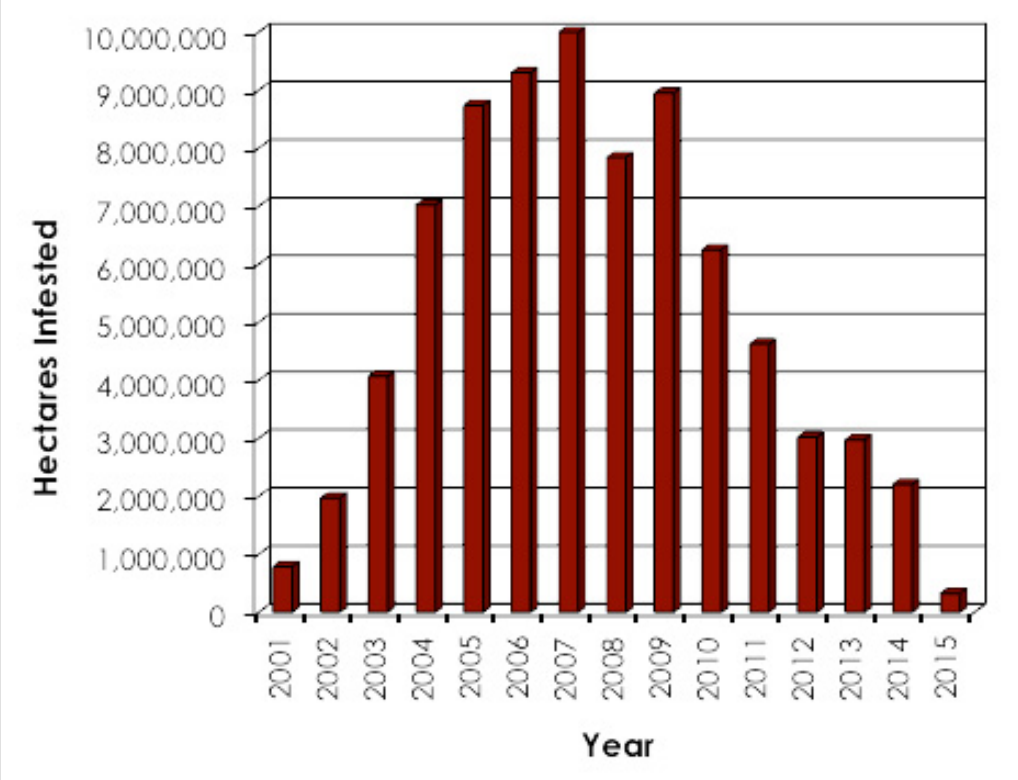
Tim Ebata is a Forest Health Officer for the Resource Practices Branch, BC Ministry of Forest, Lands and Natural Resource Operations in Victoria. He is responsible for managing the province's forest health program along with our HQ and regional pathologists and entomologists and has also been coordinating the provincial aerial overview survey program that we "inherited" from CFS in 1996 and was fortunate to be able to document the rise and fall of the MPB outbreak in BC. Prior to being posted to Victoria, Tim started his career before completing his MSc in the forest entomology program at the UBC Faculty of Forestry in 1986 by accepting the position as the regional entomologist for the former Prince Rupert Forest Region in Smithers in NW BC. His primary function was to implement the MPB suppression program for the region but was also involved in studies on spruce weevil and Warrens root collar weevil.

Excerpt from the "2015 Summary of Forest Health Conditions in British Columbia" report.

The current mountain pine beetle outbreak peaked in BC in 2007 with a record 10 million hectares of recent damage. Infestations have generally been in decline for six consecutive years with a large drop in 2015 to 326,477 ha (Figure 1). However, observed mortality intensity increased slightly since last year however to 166,061 ha (51%) trace, 119,813 ha (37%) light, 31,944 ha (10%) moderate, 7,704 ha (2%) severe and 955 ha (<1%) very severe.

A large percentage of the decline in affected area occurred in the northwest: large trace polygons (representing remnants of old infestations or in some areas population expansions) did not show current damage in 2015. The only widespread relatively active populations noted were in Fort St. John TSA, one southeast area in Dawson Creek TSA and some main drainages in Robson Valley TSA (Figure 2). Southern disturbances primarily continued to decline and were small and scattered, with the exception of a few areas in Lillooet TSA and some Beetle Management Units (BMUs) in the southern Kootenay/Boundary Region where some control measures are still being conducted.

Figure 1 - Infested area (hectares, combined severity classes) by mountain pine beetle from 2001 – 2015 in British Columbia.



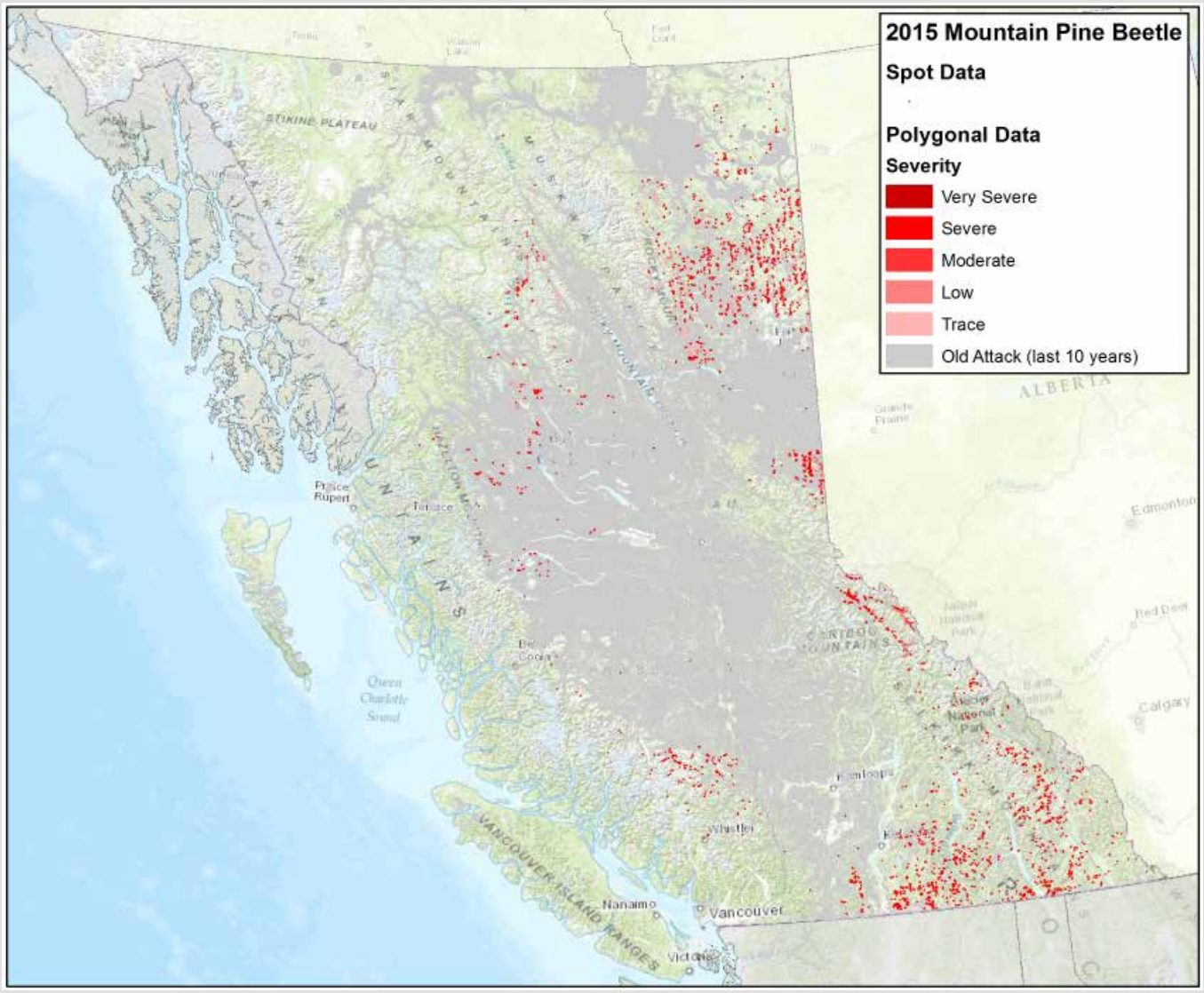


Figure 2 - Current mountain pine beetle infestations recorded in British Columbia in 2015 with old attack in grey.

An estimate of the cumulative volume of mature pine impacted by the mountain pine beetle has been recently updated with the 2015 provincial aerial overview survey data (see https://www.for.gov.bc.ca/hre/bcmpb/). Approximately 731 million m3 (54%) of the merchantable pine volume in the province has likely already been killed (red- and grey-attack), which includes approximately 1 million m3 observed as red-attack in the summer 2015 (Walton 2016). Furthermore, it is anticipated that by the time the infestation is over (by 2020) the infestation will have killed approximately 55% of the mature merchantable pine (less than 740 million m3). This is significantly less than the 80% projected mortality published in 2006. (Walton 2016).

Aggressive management of mountain pine beetle continues to be done in the Kootenay – Boundary Region where beetle populations are relatively low and large volumes of mature healthy pine still remain. In the Skeena Region, treatment programs are being considered to resume where the beetle populations have returned to endemic/incipient levels but significant pine volumes remain undamaged.

The full provincial report and data summaries, including spatial data, is now available on the BC Government web site at:

http://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/monitoring/aerial-overview-surveys

2015 Mountain Pine Beetle Status Update for Alberta

Prepared by Caroline Whitehouse, Alberta Agriculture and Forestry, Forest Health and Adaptation Section, Forest Management Branch

Biographical Sketch
Caroline Whitehouse

Caroline is a Forest Health Specialist with the Government of Alberta. She works as part of an interdisciplinary team of scientific and resource specialists to develop and deliver comprehensive forest health scientific programming for forest insects, diseases, and climate change impacts for Alberta. She started with the Government of Alberta as a Forest Health Officer in the Peace River and High Level Forest Areas and moved back to Edmonton to start her current role in the fall of 2015. Prior to joining the government she worked at the University of Alberta as a Research Technician in a lab focused on the ecology of insect pests such as mountain pine beetle and forest tent caterpillar. She obtained a Bachelor of Science in Ecology from the University of Alberta. Her Masters in Environmental Sciences was focused on the reproductive biology of a cone-feeding insect pest.

Forest health monitoring is the responsibility of Forest Health and Adaptation (FH&A) Section of Alberta Agriculture and Forestry (AAF). The following is a summary of mountain pine beetle (MPB) survey results and control activity for 2015-16. This summary concludes with a brief description of a project aimed at quantifying the cumulative mortality attributed to MPB in northwestern Alberta.

Population forecast surveys are conducted each spring to assess the relative overwintering success of MPB and the potential for spread in the coming year. Approximately 560 trees at 100 sites were surveyed between mid-May and mid-June, 2015 (Fig. 1). Overall MPB population forecast surveys suggested reduced success in 2015 compared to 2014, with some populations remaining stable.

Aggregation pheromones are used to primarily monitor the presence/absence of MPB along the eastern slopes of the Rocky Mountains and in eastern Alberta along the Saskatchewan border. Sites are ranked as MPB being absent (zero attacked trees), present (at least one tree with less than 40 attack starts), or mass-attacked (at least one tree with more than 40 attack starts). In 2015, 265 sites were monitored (Fig. 2). Mountain pine beetle activity increased south of Hinton; a greater number of mass-attacked trees are present in this area in 2015. Along the Alberta/Saskatchewan border, MPB was largely absent in 2014 (2% of baited sites) though activity increased in 2015 (25% of baited sites). A single tree was mass-attacked in this region in 2015.

Aerial surveys are conducted annually in late summer and early fall to determine the number of red-crowned pine symptomatic of MPB infestation. The number of red trees detected in 2015 was 71,740, representing a 29% decrease from 2014 (Fig. 3). Small isolated infestations continue to be detected in the Rocky Mountain House and Calgary Forest Areas.

Green to red ratio surveys are conducted each fall to assess the relative success of MPB and potential for their spread. These surveys are based on a ratio of green attack (trees with current year attacks, retaining green crowns) to red attack (trees with red crowns, attacked the previous year). Surveys were carried out in the early fall of 2015 at 416 plots (Fig. 4). The majority of plots predicted low population growth in 2015 (67%) while relatively few plots predicted high population expansion (11%). This was similar to the trend observed in 2014.

Ground surveys to assess the number of trees for management are completed annually in late fall and early winter. Single tree cut and burn control operations this past winter were conducted between mid-October and mid-March. This work was completed almost exclusively by survey and control contractors. During operations, 89,036 trees were controlled which was a decrease of 31% over 2014 numbers. Between 2006 and 2015, AAF has controlled approximately 1.12 million MPB-infested pine trees.

Considering that the survey and control work completed over the past 2 year took place over the same geographic area, it is encouraging that the number of control trees decreased. On average, there were 1.6 fewer MPB-attacked trees/site in 2015/16 compared to 2014 (7.9 trees/site). Although this information is promising from a population management perspective, the mild temperatures in Alberta this past winter will likely not have caused significant over-winter beetle mortality.

In an effort quantify the cumulative impact of MPB in Alberta since 2005, an imagery/remote sensing-based pine mortality assessment was initiated in 2014. The goal was to quantify the MPB-attributed mortality in townships fitting specific criteria. This information would establish a spatial record to enable strategic, informed rehabilitation decisions; to assess cumulative potential impact on timber and non-timber values; to quantify forest fuel changes; and to provide a historical record. The results reveal varying rates of mortality across northwestern Alberta. A significant amount of area has been affected by low to moderate levels of mortality and specific areas of high mortality but the overall rate of pine death are less than that anticipated. While there are exceptions, complete in-stand death is quite rare. The disaster scenario anticipated in 2006 has not come to fruition at this point in time.

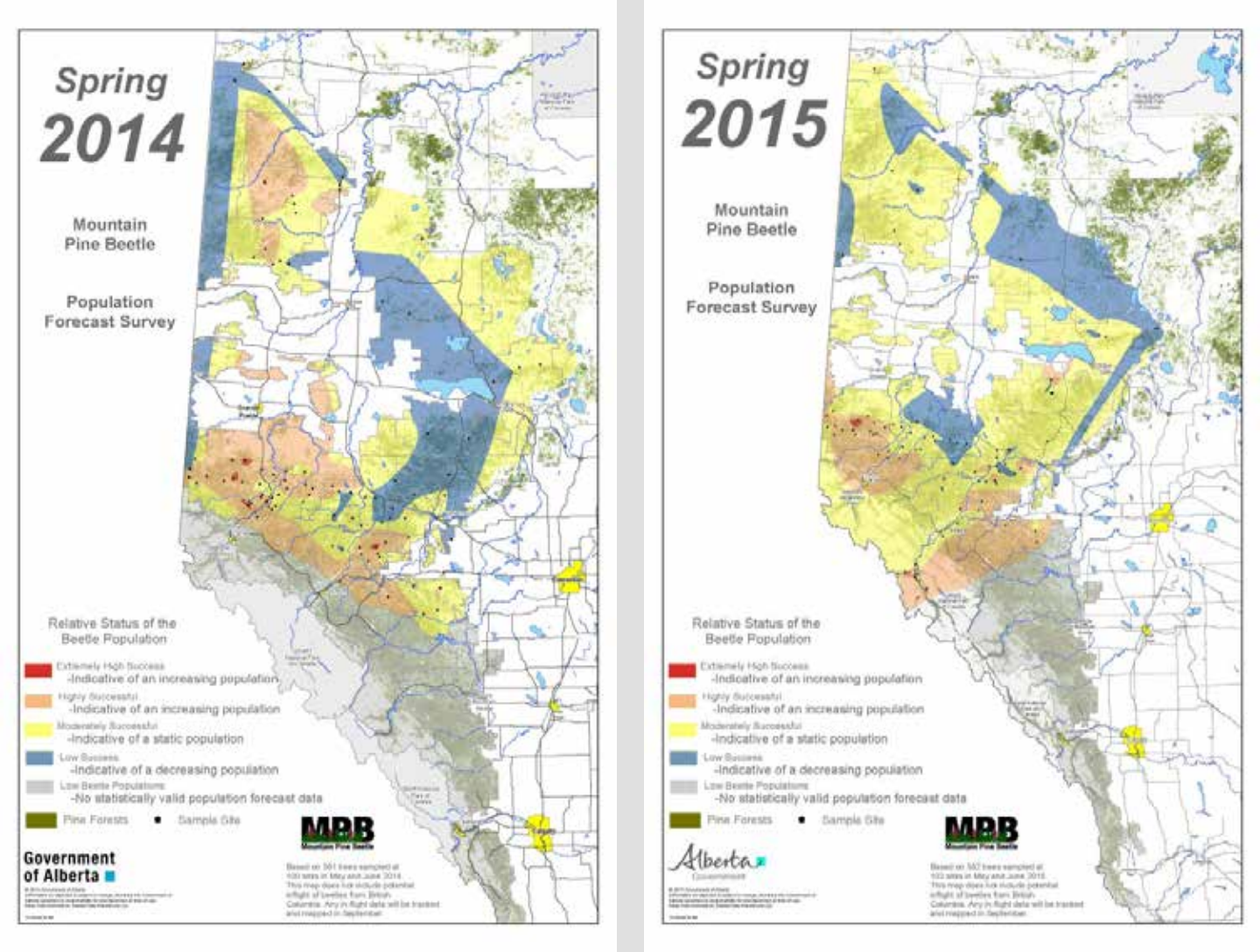


Figure 1. Relative overwintering success of mountain pine beetle across Alberta based on the results of R-value surveys carried out in the spring of 2014 and 2015.

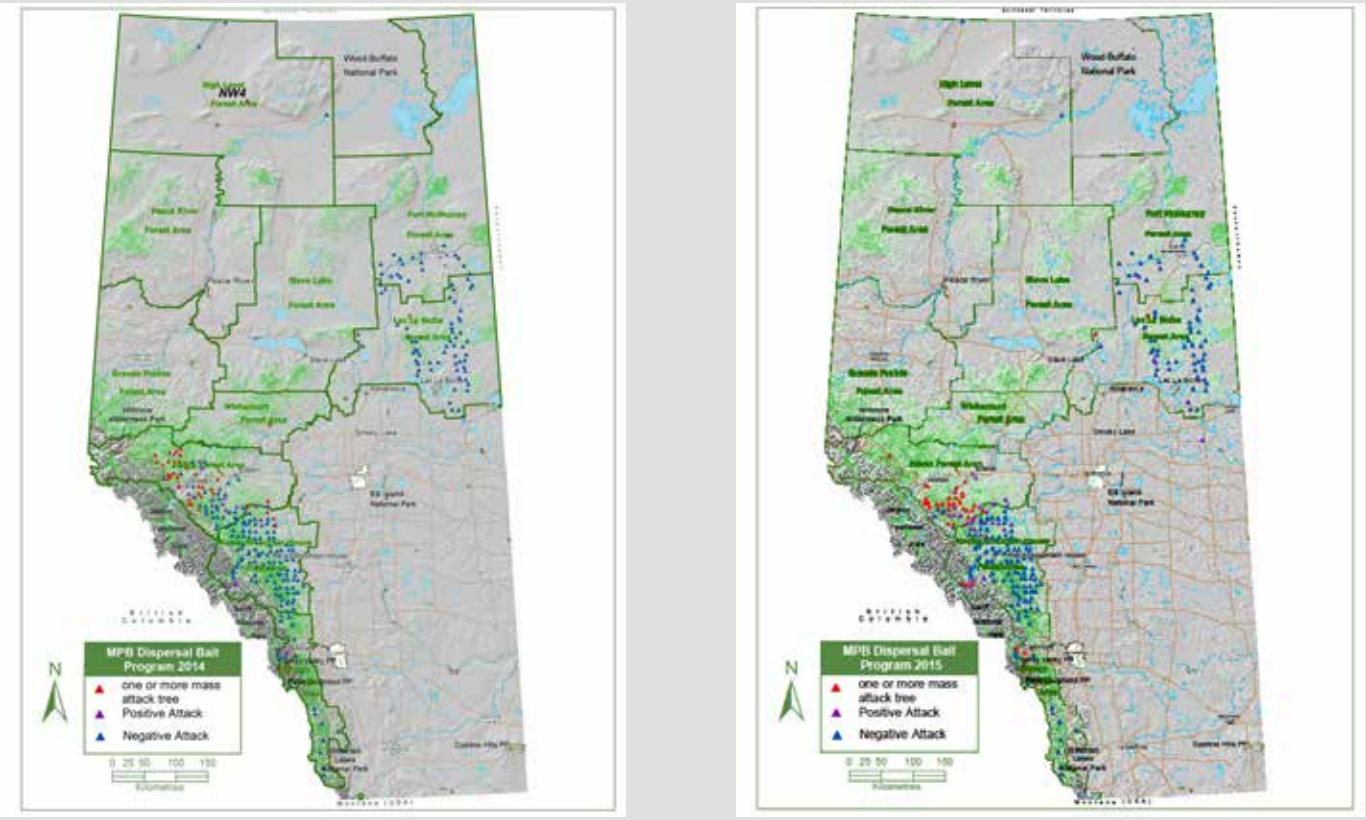


Figure 2. Results of the mountain pine beetle long-distance aerial dispersal baiting survey carried out from July to September in 2014 and 2015.

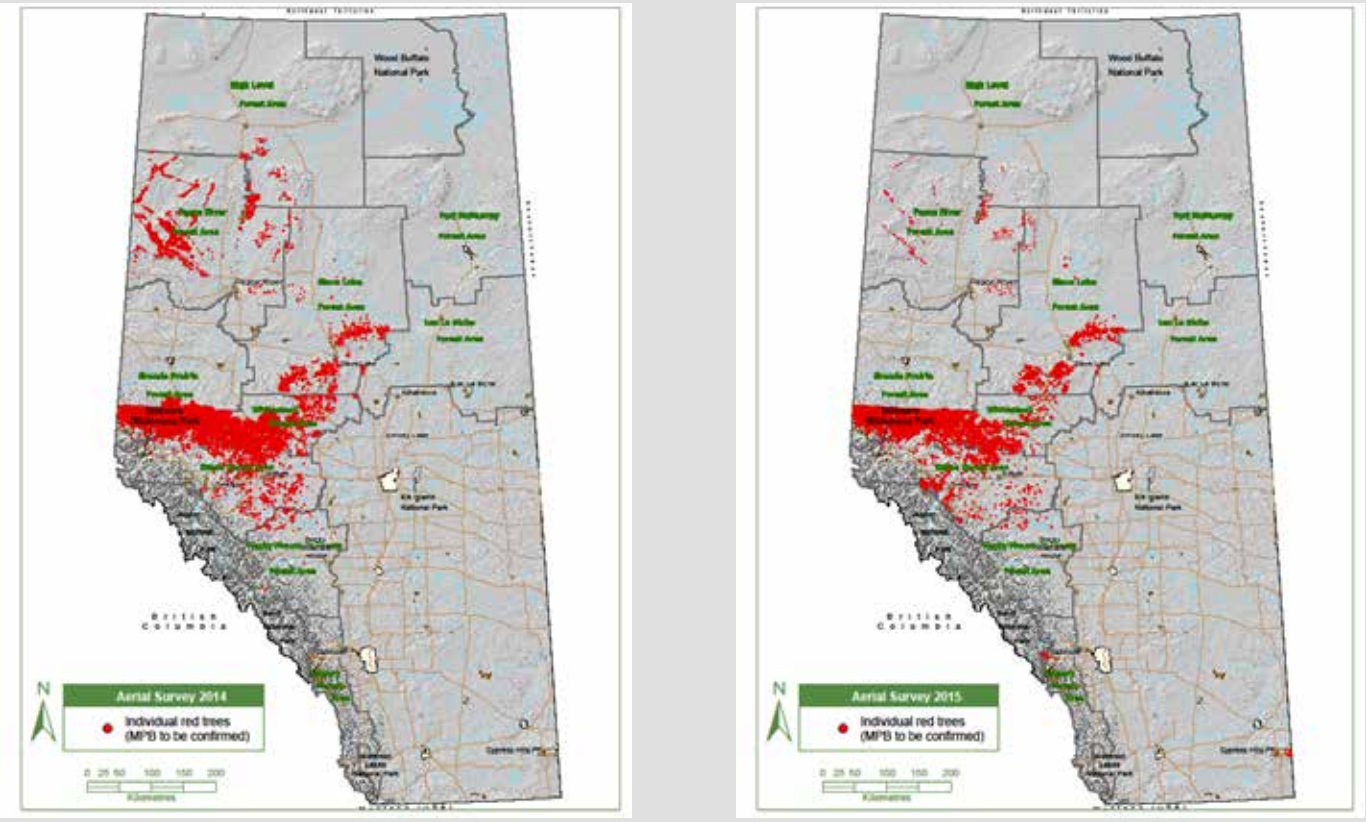


Figure 3. Locations of pines with red crowns suspected of being attacked by mountain pine beetle detected during aerial surveys in August and September 2014 and 2015.

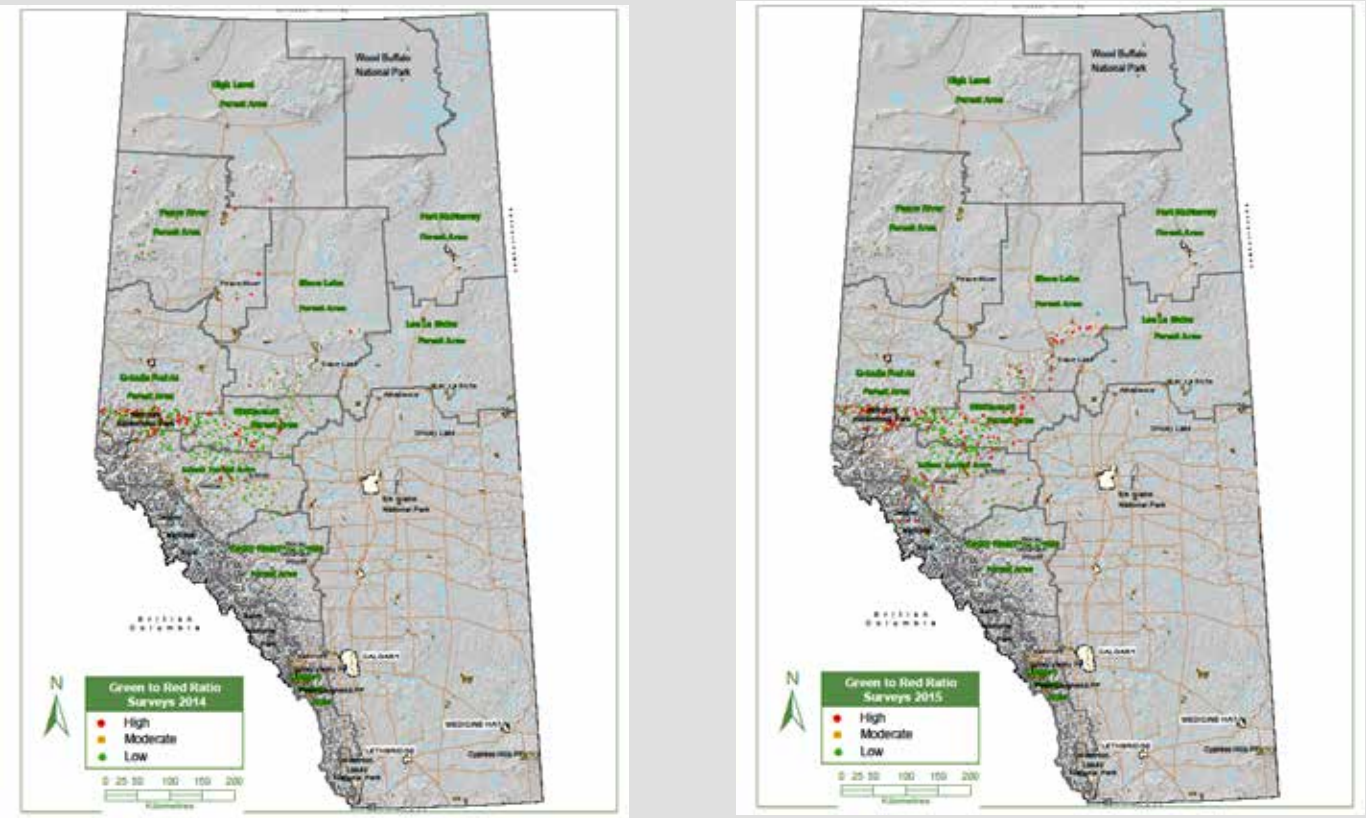


Figure 4. Map showing green to red ratio results from 2014 and 2015 during aerial surveys.

Kevin Buxton, BC Ministry of Forests, Lands, and Natural Resource Operations

2015 Mountain Pine Beetle Status Update for Saskatchewan

Prepared by Dr. Rory McIntosh, Provincial Forest Entomologist and Pathologist, Forest Service Branch, Ministry of Environment, Government of Saskatchewan

Biographical Sketch

Dr. Rory McIntosh, Provincial Forest Entomologist and Pathologist, Forest Service Branch, Ministry of Environment, Government of Saskatchewan

Rory McIntosh has been involved in forest entomology since 1978. Rory has worked in entomology research across Canada, graduating from the University of New Brunswick and completing graduate work at the University of British Columbia and post-doctoral research at Simon Fraser University. Currently, Rory is the Provincial Forest Entomologist and Pathologist in Saskatchewan Ministry of Environment's Forest Service. Based in Prince Albert, he leads the provincial insect and disease program. In addition to his work for Saskatchewan Ministry of Environment, Rory serves as an adjunct professor in the Department of Entomology at the University of Manitoba.

The risk of mountain pine beetle (MPB) spreading eastwards and establishing in Saskatchewan's boreal jack pine forests continues to be the primary forest health concern. In 2015 the Government of Alberta reported beetles were found in baited traps in the Cold Lake air weapons range (CLAWR) in Alberta, within 50 km of the AB/SK border. Currently in Saskatchewan, the MPB outbreak persists in the Cypress Hills Inter-provincial Park in southwestern Saskatchewan.

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

Central to Saskatchewan's strategic approach is to focus on aggressive fall and burn operations in the leading edge in Alberta to prevent or slow the spread of mountain pine beetle into the boreal forest and across Canada. 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. In December 2014, the agreement was renewed for an additional three-year term.

The provincial surveillance program is divided into two components: the Northern boreal forest and the Cypress Hills Inter-provincial Park (CHIPP).

Cypress Hills Inter-provincial Park (CHIPP)

YEAR	WEST BLOCK	CENTRE BLOCK	TOTAL
2006	2	0	2
2007	4	0	4
2008	34	0	34
2009	181	1	182
2010	238	19	257
2011	276	2	280
2012	394	23	417
2013	411	33	444
2014	238	49	287
2015	221	39	260

Table 1. Annual removals of infested trees in the Cypress Hills, Saskatchewan

Saskatchewan Ministry of Environment has been monitoring MPB in the CHIPP since the last outbreak declined in 1985/86. Aerial overview surveys are used to locate all red trees. These observations are then verified by detailed and systematic ground surveys. Each year, all trees verified during the ground surveys and marked for removal are removed. In 2006 only two trees were identified however, this number started to increase in 2008-09 reaching a peak in 2013. In 2014 and again in 2015, the total number of trees removed declined (Table 1).

Northern Boreal Forest Surveys

The Ministry of Environment conducts systematic monitoring in the northwestern Alberta-Saskatchewan border region, with a focus on areas of highly susceptible jack pine. In collaboration with Alberta, a stand susceptibility Index was developed and mapped. This helped to focus surveys and attention to potential spread pathways.

In 2012, the ministry expanded ground monitoring capacity by extending the leading edge tree-baiting monitoring network, currently in place in Alberta, into Saskatchewan. To provide access, heli-landing areas were cut in pine and pine-/leading stands. To date, no MPB have been found in the northern boreal pine, however the 2015 finds in CLAWR in Alberta increase concerns that the spread pathway might be through the Range or to the south through Meadow Lake Provincial Park. In 2016, the Ministry will expand ground monitoring sites in Saskatchewan south of the CLAWR to enable rapid detection and response.

Currently no mountain pine beetles are found in Saskatchewan's boreal forest

Photo Credit: Kathy Bleiker, Canadian Forest Service

Adaptive management for uncertain times: Alberta's future with the mountain pine beetle

Dr. Allan Carroll, Professor and Director, Forest Sciences Undergraduate Program, Department of Forest and Conservation Sciences, University of British Columbia, Vancouver, BC

Abstract

Since the late 1990s mountain pine beetle (MPB) populations have erupted and spread across the pine forests of western North America. In less than a decade, the beetle had expanded its range north and east into previously unoccupied pine forests, and ultimately breached the northern Rocky Mountains. Following its establishment in Alberta, the rate of spread and impacts by MPB have exceeded expectations. Emerging evidence indicates that the form of the interaction of MPB with novel host-tree populations and species differs due to a lack of evolutionary exposure of these host types to beetle impacts. However, the ramifications of these altered interactions to the dynamics, spread and impacts of MPB in Alberta pine forests are not yet entirely understood. Effective management of MPB in novel habitats requires that strategies and tactics are sufficiently (i) flexible to integrate emerging knowledge regarding altered beetle dynamics, (ii) predictive to incorporate transformational ecosystem changes expected under climate change, and (iii) adaptable to accommodate unpredictable outcomes. These requirements present a daunting challenge to sustainable resource management. This presentation will review the current state of knowledge regarding the dynamics of MPB in novel pine forests, and present a framework for the integration of that knowledge into a flexible and adaptive suite of tactics for the management of MPB in the short and long term in Alberta under climate change.

Biographical Sketch

Allan is a Professor of Insect Ecology, and Director of the Forest Sciences Program in the Department of Forest and Conservation Sciences of the Faculty of Forestry at the University of British Columbia. Allan's current research interests centre on the impacts of climate change on the dynamics of eruptive forest insect populations. The main focus of his research during the past 15 years has been on the population dynamics, impacts and management of the mountain pine beetle.

SPEAKERS

Corralling the beetle: detection, predicting spread, spread factors, management actions and outcomes

MODERATOR

Erica Samis, Director - Forest Health & Adaptation, Forest Management Branch, Alberta Agriculture and Forestry

Biographical Sketch

Erica Samis began working seasonally for what was ESRD (now Alberta Agriculture and Forestry) in 1997. She became permanent in 1998 as the Forest Health Officer for the then Northern East Slopes Region which is approximately the Upper Athabasca Region now. In 2006 she moved to Provincial Headquarters in Edmonton to work on developing the Provincial MPB Program. She became the Director of the Forest Health and Adaptation Section in fall of 2014.

Photo Credit: Brooks Horne, Environment and Sustainable Resource Development

Development of monitoring tools to detect mountain pine beetle at low densities on the eastern and northern edge of beetle expansion into Saskatchewan and Northwest Territories in Canada

Dr. Nadir Erbilgin, Associate Professor and Canada Research Chair - Forest Entomology and Chemical Ecology, Department of Renewable Resources, University of Alberta, Edmonton, AB

Abstract

We baited 3, 4 and 6 live lodgepole pine trees in triangle, square, and rectangle formations using a newly developed mountain pine beetle lure. The distance between two baited trees was 50 m. Each trap-tree formation was repeated 3 times at each of 1, 4 and 8 km distances. A total of 351 trees were baited. We quantified the number of baited and unbaited trees attacked and beetle attack density. We concluded that the square formation performed better than the other two formations because it had relatively higher number of mass attacked trees and had the least spill-over effect on unbaited trees.

Biographical Sketch

Since 2007, Nadir has worked, taught, and interacted with academic staff and students at the University of Alberta. His program explores questions of broad relevance to invasion biology and chemical ecology of forest insects and diseases. His group primarily focuses on characterization of tree chemical defenses to assess tree suitability to a suit of organisms including insects and diseases. They investigate if species-specific differences in composition and concentrations of tree defense chemicals influence the choice of host plants by forest insects and diseases. They also characterize the temporal and spatial changes in tree chemical defenses due to differences in genetics, environment, and genetics x environment interactions.

Risk of mountain pine beetle spread to eastern pine forests: what can we predict?

Dr. Barry Cooke, Research Scientist - Canadian Forest Service, NRCan, Edmonton, AB and Dr. Allan Carroll, Professor and Director - Forest Sciences Undergraduate Program, Department of Forest and Conservation Sciences, University of British Columbia, Vancouver, BC

Abstract

Since the mountain pine beetle (MPB) breached the Rocky Mountains and first appeared in Alberta in alarming numbers in the summer of 2005, it has spread eastward across Alberta at an average rate of 80 km/year. In the absence of aggressive control, the beetle will undoubtedly continue to spread eastward. The spread rate is expected to slow as the leading edge invasion front moves further from significant population sources in the dense pine of the Rocky Mountain foothills into the scattered pine of the boreal plains region. However, the realized rate of spread is uncertain, as it will be regulated by a number of factors, some of which are uncertain (e.g. how an insect behaves in a novel environment), inherently unpredictable (e.g. weather), or under human control (e.g. spread control effort). Whereas previous studies have examined factors affecting spread individually, we present a synthetic framework that models future spread rates as a function of coupled nonlinear recruitment dynamics and correlated thermal response functions. We analyzed the model's behavior under two climatic driving scenarios (drying climate and warming climate) and one forest health scenario (an increase in the ratio of unhealthy to healthy trees), with the hypothesis that these scenarios would produce considerable surprise in the severity and timing of beetle outbreaks. Our results showed a classic "tipping-point" model capable of generating sudden, unanticipated, violent behavior, demonstrating that MPB populations may respond very strongly to small changes in climate. This raises the question of whether the MPB system is representative of other forest pest systems or anomalous. The MPB may be the first of many systems to behave in unprecedented ways. The model makes clear that the eastward rate of spread will depend on whether, when, and where the system transitions from the current epidemic state to a new endemic state. However, major uncertainties in the system limit our ability to make robust predictions of spread under natural conditions. The integrating framework presented here provides insight into scientific uncertainties worth targeting for applied research into spread management. In the absence of ability to predict beetle spread, forest management should continue to explore ways of coping with unpredictable disturbances, including adaptive capacity to adjust to transformational ecosystem changes expected under climate change.

Biographical Sketches

Dr. Barry Cooke specializes in important topics related to pest management especially mountain pine beetle and spruce budworm. His research contributes to the understanding of population dynamics, forest insect disturbance ecology and its links to ecosystem function, modeling insect outbreak processes and patterns, pest management decision support modeling, comparative dynamics of boreal forest insects, risk analysis, field validation of model predictions, and quantitative analysis. Barry has a B.Sc.F. from University of Toronto, a M.Sc. in Entomology from University of Laval and a PhD in Ecology and Evolution from the University of Alberta.

See Dr. Allan Carroll's biographical sketch on the page 18.

Temperature 365: What MPB cold tolerance and seasonality means for beetle success in Alberta and beyond

Dr. Katherine Bleiker, Research Scientist - Bark Beetle Ecology and Greg Smith, Forestry Officer, Bark Beetle Ecologist, - Canadian Forest Service, NRCan, Victoria BC

Abstract

Given the presence of a suitable food source, temperature likely has the largest overall impact on mountain pine beetle's (MPB) distribution and population fluctuations. Winter is usually the largest single source of mortality even in benign climates like southern British Columbia. Weather during the growing season affects development and MPB needs to maintain an adaptive seasonality – a synchronous one-year life cycle with the most hardy life stage entering winter – to be successful in regions with cold winters. The beetle's response to temperature 365 days a year will be discussed.

Biographical Sketches

After earning a BSc from the University of Victoria, Kathy worked with the BC Forest Service and then as a forest health consultant for a number of years before returning to school to earn a MSc in Natural Resource Management from the University of Northern British Columbia and a PhD in Forestry from the University of Montana. Kathy is also a Registered Professional Forester in BC. She has been a Research Scientist in Bark Beetle Biology and Ecology with the Canadian Forest Service, Pacific Forestry Centre, Victoria, BC since 2010.

Greg is a Forestry Officer with the Canadian Forest Service. He earned his B.Sc. at the University of Victoria and then completed his M.Sc. at the University of Northern British Columbia in Natural Resource Management. He has been working with the mountain pine beetle research group at the Pacific Forestry Centre in Victoria for over 12 years.

Photo Credit: Derek Sidders, Canadian Wood Fibre Centre

SPEAKERS

What is changing at the landscape/ecosite level: what is benefiting, what is suffering?

MODERATOR

John Stadt, Provincial Forest Ecologist, Forest Management Branch, Alberta Agriculture and Forestry

Biographical Sketch

John Stadt is the Provincial Forest Ecologist for Alberta Agriculture and Forestry in Edmonton where he provides ecological expertise to decision makers and also collaborates on a wide range of forest management related projects dealing with biodiversity, mountain pine beetle, climate change, caribou and grizzly bear. Previous work has included a stint as a research biologist with the Canadian Forest Service in Edmonton followed by nine years with BC's Fish and Wildlife Branch in Burns Lake BC. Currently John is working with the fRI Research on mountain pine beetle and fire regime research projects, with the EMEND experiment on biodiversity projects, and is contributing to the development of the Biodiversity Management Framework. John has degrees from the University of Victoria and the University of Alberta.

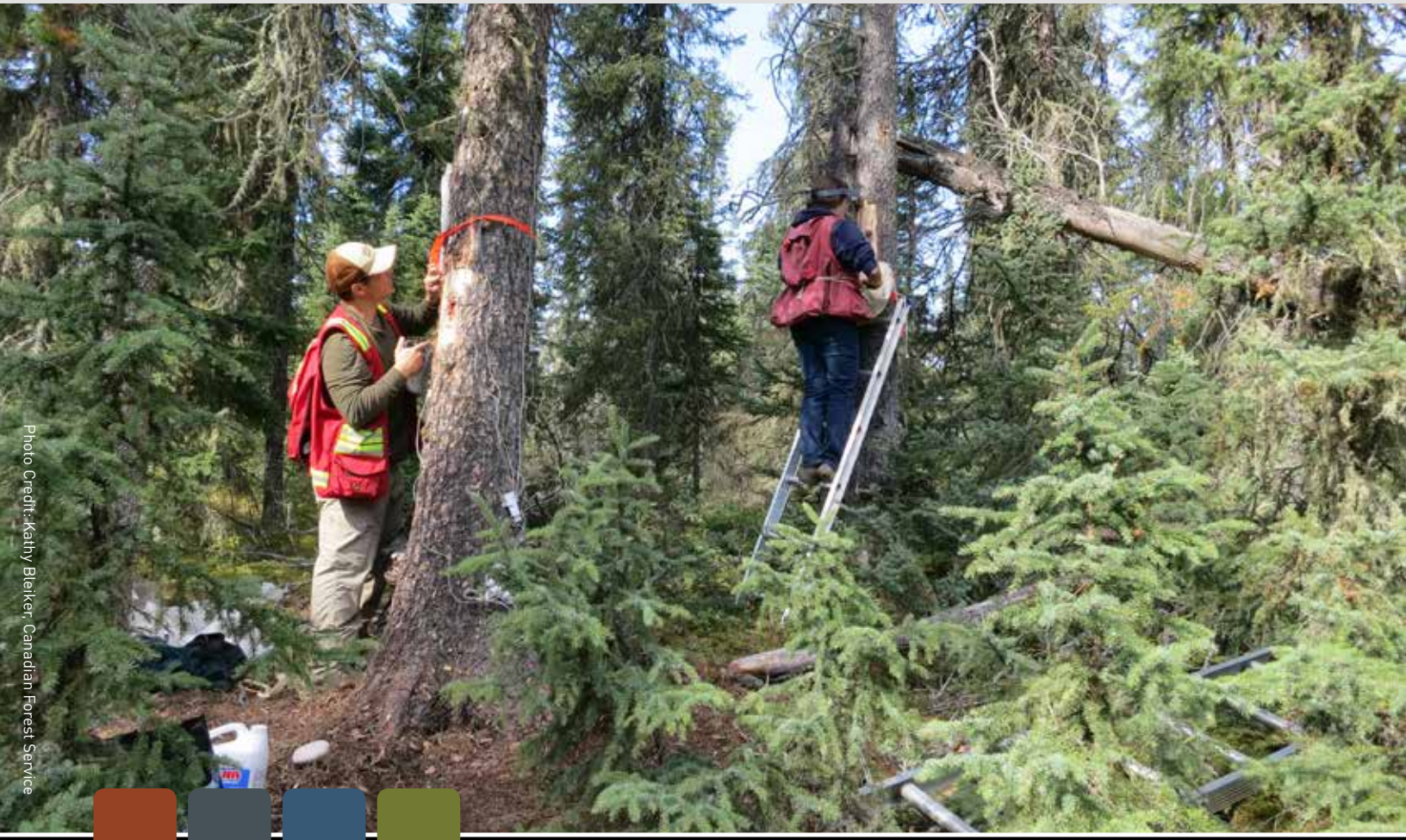


Photo Credit: Kathy Bleiker, Canadian Forest Service

Science to support the assessment of MPB impacts to Albert Foothills Watershed values

Dr. Axel Anderson, R.P.F., P. Eng., Program Lead - Water Program, fRI Research, Amy Goodbrand, PhD Student, and Dr. Uldis Silins, Professor, Forest hydrology and Watershed Management, Department of Renewable Resources, UofA

Abstract

The linkage between forest disturbance and impact to watershed values has been studied for decades. Most of this work was initiated in the 70's in the form of paired catchment studies. New disturbances such as MPB provide a new challenge to forest hydrologists, as we try to understand the short and long term impact at the site- and watershed-scale. In this project we are using the intensely monitored watersheds at Tri-creeks to calibrate a watershed-scale hydrological model. We can then use this mode; with stand level data from Robb to understand what might be the likely impact of MPB and forestry on hydrological parameters that are relevant to fish and other values. These methods provide information on Tri-creeks, and also the foundation to build a system that can be used to assess other watersheds in the Foothills region.

Biographical Sketches

Dr. Axel Anderson is a forest hydrologist with the Government of Alberta, Forest Management Branch, and an assistant professor at the University of Alberta, Renewable Resources. His current assignment is as the lead of the Water Program at fRI Research.

Amy is a hydrology PhD student in the Department of Renewable Resources, University of Alberta. She is studying the impact of MPB at the stand level and testing ideas on how to incorporate the new knowledge into forest management in the Alberta Foothills region. She completed her M.Sc. thesis at the University of Saskatchewan, which focused on surface water-groundwater connectivity within the Saskatchewan Boreal Plain. Amy has worked on a diverse range of surface water and groundwater projects across Saskatchewan, Alberta, and British Columbia with various agencies and consulting companies.

Dr. Uldis Silins is Professor of Forest hydrology and watershed management in the Department of Renewable Resources, University of Alberta. In the past decade, his research has primarily focused on impacts of natural disturbance by wildfire and Mountain Pine Beetle on hydrology of Alberta's eastern slopes forests. Apart from receiving recognition awards for teaching, the Southern Rockies Watershed Project for which Dr. Silins is a lead investigator won a 2014 Emerald Award.

Effects of Mountain Pine Beetle attack on understory vegetation of lodgepole pine stands

Dr. Ellen Macdonald, Professor - Forest Ecology, Julie Steinke, and Lori Schroeder, Graduate Students - Department of Renewable Resources, and Dr. Anne McIntosh - Assistant Professor, Augustana Campus – University of Alberta, Edmonton, AB

Abstract

We implemented a controlled experiment in which we simulated the effect of Mountain Pine Beetle attack on lodgepole-pine dominated forests in west-central Alberta by means of stem injection of herbicide. In the first two years post-treatment the trees transitioned to the "red attack" stage and we saw some evidence of increased soil moisture and nutrient availability. However, because the needles are still retained at this stage there was no effect on canopy cover and few responses in the understory vegetation. By five years post-treatment the trees were transitioning to the "grey attack" stage and needle loss was accompanied by a reduction in canopy cover. Increased light to the forest floor resulted in increased cover of understory herbaceous vegetation. We will assess these sites again in 2016 (seven years post-treatment). It seems that increased abundance and a change in composition of understory vegetation following MPB attack in lodgepole pine dominated stands will be an important factor driving tree regeneration and future successional development of these forests.

Biographical Sketches

Dr. Ellen Macdonald is a Professor of Forest Ecology in the Department of Renewable Resources at the University of Alberta. She obtained her BSc in Environmental Biology and PhD in Plant Ecology from the University of Calgary. For the past 25+ years her research has focused on the ecology of northern forests - particularly forest regeneration, stand dynamics, understory plant communities and relationships among these. Much of her work has examined the impacts of natural and anthropogenic disturbance.

Julie Steinke is currently a M.Sc. student with Dr. Ellen Macdonald and Dr. Vic Lieffers at the University of Alberta. After residing on the east coast of Canada and in the Middle East, Julie came to Alberta where she received her B.Sc. in Conservation Biology from the University of Alberta. She currently serves on the planning committee for CONFORWest, a non-profit that organizes annual graduate student conferences. Julie has a strong passion for forest-related ecology. After researching the effects of reforestation on reptiles and amphibians in coastal Ecuador during her B.Sc., Julie has now transitioned to her current focus on pine regeneration, both natural and facilitated, after mountain pine beetle attacks in Alberta.

Lori Schroeder has worked as a botanist and environmental educator in the Yukon for over 20 years. She is currently working as a research assistant in forest ecology at the University of Alberta while pursuing her masters in Conservation Biology.

Dr. Anne McIntosh is an ecologist with over 16 years of experience conducting research in a diverse range of ecosystems. Anne received her Bachelors of Science (Honours) in Biology and Chemistry from University of British Columbia, her Master of Science in Forest Science from Oregon State University, and her PhD in Forest Biology and Management from University of Alberta. Anne joined the Augustana Faculty of University of Alberta as an Assistant Professor of Biology in July 2014. Her research focuses on recovery of forested and grassland ecosystems after both natural and anthropogenic disturbance.

Modeling food resources for two species at risk in Alberta: implications for mountain pine beetle management where caribou and grizzly bear co-occur

Dr. Laura Finnegan, Research Scientist and Caribou Program Lead, Terrance Larsen, Research Biologist, Dr. Karine Pigeon, Research Biologist and Gord Stenhouse, Research Scientist and Grizzly Bear Program Lead - fRI Research, Hinton, AB

Abstract

How mountain pine beetle management will affect wildlife habitat caribou and grizzly bear is largely unknown. For this project our objectives were: 1) inventory caribou and grizzly bear food resources in uncut, harvested, MPB kill, MPB control, and burned (wildfire) stands; and (2) develop predictive species level models to map caribou and grizzly bear foods across caribou ranges in Alberta. We used a stratified random design and chronosequence approach to sample key caribou and grizzly bear food in 724 plots distributed across pine dominant and co-dominant stands, and along a time since disturbance gradient. For preliminary data analysis we modelled the distribution of two caribou foods and two grizzly bear foods as a function of spatial covariates and site specific environmental conditions to generate maps of the probability of occurrence for each food resource. Understanding and mapping these relationships are essential to concurrent management of habitat from a food perspective. We will discuss the results of our current modeling work, and the potential implications for forest management decisions related to MPB control.

Biographical Sketches

Dr. Laura Finnegan has been the lead researcher at the fRI Research Caribou Program since 2013. She completed her B.A and PhD at Trinity College Dublin, where her research was focused on red squirrels, and her postdoctoral research at Trent University where she worked on conservation genetics research questions related to moose, geese, wood turtles and caribou. At fRI Research the Caribou Program is involved in a number of research projects related to habitat restoration, caribou and predator movements in west-central and north-west Alberta, caribou health and causes of mortality, and the research she is speaking about today; the effect of forest harvesting and mountain pine beetle management on habitat quality for caribou and grizzly bears.

Terrance Larsen is a research biologist with the fRI Grizzly Bear Program with over 14 years of wildlife research experience. He received his MSc in Ecology from the University of Alberta in 2012. His thesis research was focused on the potential effect of MPB control harvesting on grizzly bear habitat in west-central Alberta. Some of his expertise includes designing and implementing research projects focused on assessing the impacts of forest harvesting on grizzly bear habitat, particularly vegetation, and in developing models of species distribution and abundance.

Dr. Karine Pigeon is a research biologist with 12 years of experience in wildlife research, management and conservation. Karine has been employed by fRI Research since 2004 as part of the Grizzly Bear Program, and since 2013 as part of the Caribou Program. Karine has extensive experience as a field and laboratory technician, and as a biologist. Karine obtained her PhD (2015) in Biology from l'Université Laval, Québec, her BSc (2005) in Environmental Science from the University of Lethbridge, Lethbridge, Alberta, and a diploma (2002) in Recreation, Fish and Wildlife Technology from Selkirk College, Castleguard, British-Columbia. Her PhD focused on the behavioural plasticity of grizzly bears in the context of climate change. As part of the fRI caribou program, Karine has helped with the successful completion of three projects for Environment Canada under the Habitat Stewardship Program. Karine is a member of the Wildlife Society.

Gord Stenhouse is a research scientist and the leader of the fRI Research Grizzly Bear Program. This research program began in 1998 and has grown to be one of the largest and most comprehensive bear research programs in North America. There are now over 1000 scientific papers published by members of the research team over the past 15 years.

Gord received both his Bachelors and Masters Degree from the University of Manitoba. After graduating he moved to the NWT where he worked as a wildlife biologist for the Northwest Territories government. During this time he focused primarily on polar bear research.

Gord is on secondment from the Alberta Environment and is an adjunct professor at the Western College of Veterinary Medicine at the University of Saskatchewan. He is also the past chairman of the Alberta Grizzly Bear Recovery Team.

Rehabilitation of beetle-killed stands by improving pine seedling performance with mycorrhizal fungi

Drs Justine Karst, Assistant Professor - Restoration , and Dr. Nadir Erbilgin, Associate Professor and Canada Research Chair - Forest Entomology and Chemical Ecology, Department of Renewable Resources, University of Alberta, Edmonton, AB

Abstract

Ectomycorrhizal fungi are critical for pine survival and performance, and species of fungi vary in benefits conferred to hosts. Our previous research demonstrates that fungal communities in soils change following beetle-induced stand mortality with consequences for pine seedling survival and performance. This next stage of research will investigate how communities of fungi in soils of beetle-killed stands vary by ecosite, and whether inoculation of pine seedlings with fungi from unattacked pine stands can offset the effects of detrimental fungi occurring in soils of some beetle-killed stands. This research will assess the efficacy of triaging beetle-killed stands based on soil fungi.

Biographical Sketches

Dr. Justine Karst is a newly appointed Assistant Professor in restoration ecology at the University of Alberta. Justine studies linkages between above and belowground components of forests. Her interests include mycorrhizal ecology, community ecology, disturbance ecology, rhizosphere carbon dynamics and molecular biology.

See Dr. Nadir Erbilgin's biographical sketch on page 19

The implications to the forest industry of MPB affected stands and associated volume in the Grande Prairie Region

Rob McLaughlin, RPFT, Operations Superintendent – Canfor Corporation, Grande Prairie, AB

Abstract

The effects of the Mountain Pine Beetle (MPB) on Canfor's business have been extensive and include: increasing amounts of merchantable waste, reduction in the quality of lumber and production related impacts in sawmill and planer facilities. Canfor has been managing for the effects of MPB in our British Columbia operations for more than 18 years, giving our Alberta operation the competitive advantage of being able to anticipate potential impacts and solutions arising from addressing MPB impacted fiber. On the other hand, the tenure system in Alberta is significantly different than in BC, thus posing significant challenges in addressing fiber supply and utilization.

Biographical Sketch

Rob is a Registered Forest Professional and is currently Operations Superintendent with Canfor, Grande Prairie, Alberta. Dwight has worked in the forest industry for 20 years. He began his career after graduating from Algonquin College, Pembroke Campus in 1996. Rob has worked in southern BC in a consulting capacity and has since supervised logging in the Alberta Peace from 2004 to 2010 following which he joined Canfor. Rob enjoys hunting and fishing and most sports and interestingly enjoys investing in the stack market.

MPB impact to date, possible effects on mid-term wood supply/ecosystem function and the need for mitigative efforts

Brooks Horne, R.P.F., Senior Forester – Forest Rehabilitation, Forest Management Branch, Alberta Agriculture and Forestry

Abstract

There are areas in NW Alberta killed by the 2006 and 2009 in-flights that are no longer being actioned through level 1 control and are increasingly less likely to be harvested by industry. These predominately grey attack areas constitute the target for the rehabilitation program.

Before we can create specific objectives for mitigative efforts in killed stands there are foundational pieces of information which have been obtained over the past year. The spatial picture of where and how much MPB caused pine mortality has occurred and what specific, identified ecological goods and services may be at risk has now been obtained. Additionally, the effects of MPB on the pine resource has also been quantified providing a current snapshot of risk to mid-term timber supply.

In addition to baseline mortality data, the initiation of a PSP program to track stand dynamics post-MPB and the creation of a Decision Support Tool has been created for consolidation of all currently known pine mortality and stand information to begin prioritization for rehabilitation.

Biographical Sketch

Brooks is the Rehabilitation Forester for Alberta Agriculture and Forestry in Edmonton. With the GOA since 2006, he worked with the Forest Health Section as a field Forest Health Officer in the Hinton, Edson and Grande Cache before moving into his current position 2 year ago. His previous responsibilities included the detection, monitoring and management of all biotic tree pests and diseases. His focus is now on the rehabilitation of Alberta's beetle affected landscape and is enjoying the challenge with lots of fun projects ongoing. Brooks holds a diploma in Natural Resource Management from BCIT as well as BSc degree from the University of Alberta. Prior to working for the GOA, Brooks spent 15 years in the forestry industry throughout British Columbia.

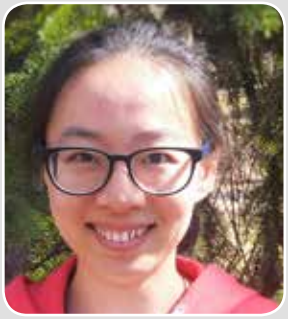
Photo Credit: Dr. Nadir Erbilgin, University of Alberta

Beyond Beetle: Facilitated and natural regeneration of conifers in lodgepole pine forests following MPB attack

Dr. Ellen Macdonald, Professor - Forest Ecology, Dr. Vic Lieffers, Professor and Department Chair - Silviculture and Forest Ecology, Dr. Nadir Erbilgin, Associate Professor and Canada Research Chair - Forest Entomology and Chemical Ecology, Julie Steinke, and Lori Schroeder, Graduate Students and Shiyang (Violet) Zhao, PhD Candidate - Department of Renewable Resources, University of Alberta, Edmonton, AB

Abstract

The unprecedented outbreak of mountain pine beetle (MPB) in Alberta presents government and industry with the challenge of deciding upon post-attack management for lodgepole pine stands which represent a diversity of ecosite types and which have experienced varying intensities of mortality due to MPB. Knowledge of the potential for successful lodgepole pine regeneration in these forests is critical to understanding their successional future, and to deciding upon management options for them. Many Alberta lodgepole pine forests have relatively little in the way of advance regeneration of shade tolerant species that can play an important role in future fibre supply in attacked stands. Dry climatic conditions, limited release of seed from serotinous cones, and a lack of suitable regeneration microsites, post severe limits to natural regeneration of conifers in lodgepole pine stands post-MPB. Further, there is considerable variability in the level of MPB-caused mortality in lodgepole pine stands in Alberta. Trees that survive the initial attack could make an important contribution to future fibre supply of these stands as well as their future successional dynamics. These trees are, however, subject to on-going attack by MPB or other forests insects or diseases which could hamper their growth and even lead to mortality. Extensive surveys in west-central Alberta of lodgepole pine dominated stands post-MPB attack demonstrate that there is very little natural regeneration of lodgepole pine or other conifers in these stands in the first eight years following MPB attack. Drier and poorer ecosites had higher levels of natural regeneration than did moister and richer ecosites. The latter were characterized by heavy herbaceous and shrubby understory vegetation which likely exerts substantial competitive pressure on any germinating conifer seedlings. Further, a relatively high proportion of residual live lodgepole pine in post-MPB stands had been affected by other insect pests. The future regeneration and successional development of these stands is still uncertain but it seems very unlikely that they will regenerate to conifer in a timely fashion.



Biographical Sketches

See Dr. Ellen MacDonald's biographical sketch on page 24.

Dr. Victor Lieffers is the Chair of the Department of Renewable Resources at the University of Alberta, where he has been a professor since 1983. He is a member of Alberta's Registered Professional Forester Association. He has published extensively in the areas of forest regeneration, forest ecology and silvicultural practices and policies.

See Dr. Nadir Erbilgin's biographical sketch on page19.

See Julia Steinke's biographical sketch on page 24.

Shiyang Zhao is a PhD student from University of Alberta working with Dr. Nadir Erbilgin. Her currently research is focusing on residual overstory lodgepole pine health conditions in post-mountain pine beetle stands and how resin duct-based defense relates to residual overstory lodgepole pine. She achieved her Master's degree in Entomology from Harper Adams University in the UK, where she was working on the trade-off between resistant aphids and parasitoids. When she is not glued to her laptop and microscope, she really enjoys outdoor activities and travelling.

See Lori Schroeder's biographical sketch on page 24.

Fire risks following MPB and how will they change with time

Dr. Mike Flannigan, Professor, Wildland Fire and Director of the Western Partnership for Wildland Fire and Hugh Wallace, MSc Student - Department of Renewable Resources, University of Alberta, Edmonton, AB

Abstract

As part of the Beyond Beetle Project, this project aims to assess the influence of partial harvesting on fire probability as indicated by fuel moisture. As a newly developed technique in Pine Beetle management, there is a necessity to determine whether alteration of the stands will result in a change in fire occurrence. Research plots were established in undisturbed, thinned and cleared areas. Effects of the harvesting were examined by taking physical duff samples as well as digital temperature and water content measurements. First season results show limited effects of treatments on fuel moisture content during medium fire hazard periods. While the undisturbed control site was most resistant to both wetting and drying, the cleared site was predictably the most reactive to wetting and drying cycles. As the majority of fire ignitions and major events occur under high and extreme hazard conditions, second season sampling aims to examine treatment effects under these hazard conditions.

Biographical Sketches

Dr. Mike Flannigan is a professor with the Department of Renewable Resources at the University of Alberta and the director of the Western Partnership for Wildland Fire Science. He received his BSc (Physics) from the University of Manitoba, his MS (Atmospheric Science) from Colorado State University and his PhD (Plant Sciences) from Cambridge University. Dr. Flannigan's primary research interests include fire and weather/climate interactions including the potential impact of climatic change, lightning-ignited forest fires, landscape fire modelling and interactions between vegetation, fire and weather.

Hugh Wallace is an MSc candidate in Wildfire Research at the University of Alberta. Originally from BC, Hugh worked as a crew leader and faller in the BC Wildfire Service. His research focusses on the effects of mechanically thinned fuel treatments on fire probability and behavior. Outside of work and school Hugh pursues a wide variety of hobbies such as rock climbing, fishing, and blacksmithing.

Photo Credit: Derek Sidders, Canadian Wood Fibre Centre

Innovative Stand Enhancement and Regeneration Systems to Recover Value, Reduce Risk and Rehabilitate Mountain Pine Beetle Affected Stands in the Alberta Boreal Plains Ecozone.

Derek Sidders, Regional Coordinator and Program Manager, and Tim Keddy, Wood Fibre Development Specialist – Canadian Wood Fibre Centre, NRCan, Edmonton, AB

Abstract

The Canadian Wood Fibre Centre (CWFC) has partnered with CanFor and the University of Alberta in the establishment of a demonstration site and long-term research study to assess the impact of innovative partial harvest and regeneration systems on value recovery, risk reduction, and stand rehabilitation of Mountain Pine Beetle (MPB) affected stands. This project began in 2014 with the harvesting of 310 hectares of mixed MPB affected stands that had greater than 50% lodgepole pine crown composition and are greater than 15 m in height. The stands were comprised of a mixture of green (active attack and not affected), red and grey lodgepole pine as well as white spruce and aspen. The harvest system selectively removed active attack trees, green lodgepole greater than 20cm DBH and spaced small dense green lodgepole. Selective site preparation techniques were deployed to establish both Lodgepole Pine and White Spruce seedlings in the harvested stands. Replicated research plots comparing the regeneration methods were established in partnership with the University of Alberta.

This presentation will describe the completed harvest operations and values recovered, and present the reforestation practices and related research studies that were installed. The field tour on May 12th will explore the field rehabilitation site with selected tour stops to view the untreated candidate stands, harvest techniques and patters, biomass recovery results, site preparation and planting microsites and research plots established for long-term biological response monitoring.

Biographical Sketches

Derek Sidders is the Program Manager and Regional Coordinator of the Canadian Wood Fibre Centre for the Prairie Provinces and Northwest Territories. Derek graduate from Lakehead University in 1977 before beginning his career in Northwestern Ontario with the Ministry of Natural Resources. He has thirty-eight years of experience in forest management and afforestation operational development, applied research and technology transfer in Boreal Plains and Boreal Shield ecoregions of Canada. Derek has worked for the Canadian Forest Service since 1985 and for the Canadian Wood Fibre Centre since its inception in 2006.

Derek has spent the last 15 years developing, testing and demonstrating novel mixedwood forest partial harvesting and regeneration systems for the Boreal Plains and leads a national group that develops woody biomass feedstock options for an evolving Bioenergy industry in Canada.

With over 30 yearrs of experience in the forest industry, Tim Keddy has acquired a broad range of forest management and applied research skills working across Canada for private forest industry and various government agencies. He presently works for the Government of Canada with the Canadian Wood Fibre Centre (CWFC) as a Wood Fibre Development Specialist. His responsibilities include the operational coordination of the National SRWC Program and the National Innovative Woody Biomass Systems Development Program.

Photo Credit: Derek Sidders, Canadian Wood Fibre Centre

FRIAA – Mountain Pine Beetle Forest Rehabilitation Program

Byron Grundberg, MF, R.P.F.,
Consulting Services – MNP

Abstract

The presentation will outline FRIAA's Mountain Pine Beetle Forest Rehabilitation Program – a program intended to address forest stands that have been negatively impacted by mountain pine beetle infestation and are unlikely to be rejuvenated in a timely manner without management intervention. It will focus on: the underlying need for a rehabilitation program; eligible activities; project activities to date and future challenges.

Biographical Sketch

Byron's background includes work as a professional forester in both B.C. and Alberta, as well as, mixed grain and beef farming in central Alberta. For the past 20 years, Byron has worked as a consultant, providing managed services for the Forest Resource Improvement Association of Alberta helping deliver programs in reforestation, forest improvement, mountain pine beetle control and rehabilitation and FireSmart. He has also conducted forest practices and certification audits for forest industry and policy work with respect to private forest land management and is a Past-President of the Woodlot Association of Alberta.

Byron has a bachelor's degree in forestry and master's degree in agroforestry. He is Registered Professional Forester and a Certified Environmental Auditor. He is currently a partner in MNP LLP, in advisory services.

Photo Credit: Dr. Nadir Erbilgin, University of Alberta

Host defense: productivity and spread of mountain pine beetle in novel jack pine habitats

Atlaf Hussain, PhD Student, Forest Biology and Management - Department of Renewable Resources, University of Alberta, Edmonton, AB

Abstract

Mountain pine beetle (Dendroctonus ponderosae Hopkins; MPB) success is linked to overcoming host tree defenses. The eastward expansion of MPB brings it into interaction with boreal jack pine (Pinus banksiana Lamb.) which is naïve to MPB. Jack pine is often faced with droughts and nutritional deficiencies. MPB however, is known to prefer stressed and weak trees. Building on these facts, this research explores how host defenses vary through different growing conditions and how MPB host colonization and dispersal are subsequently affected. Preliminary results show that Grosmannia clavigera, a MPB associated fungus produces longer lesions in trees on dry sites. Chemical analyses of phloem tissues will further validate how such gradients affect the balance among different chemical defenses and how nutrients and carbohydrate reserves are utilized in mediating these responses. Simulating MPB, different inoculation densities of G. clavigera will be used to determine why some trees succumb to a limited number of beetles. Spatial patterns in pine defense mechanism will be studied by investigating induced defenses. The study will contribute to understanding if trees in certain growing conditions are more vulnerable, if some trees are phenotypically more resistant and if inducible responses and volatile signaling can be used as vulnerability signatures.

Biographical Sketch

Altaf Hussain is a PhD student in Forest Biology and Management at the University of Alberta. Altaf's research interests include plant and insect interactions, invasion biology of mountain pine beetle, chemical ecology and ecological footprint assessment. He received his master's degree in Agroecology at the Swedish University of Agricultural Sciences, where he studied how different odor signals from host and non-host plants affect the reproductive behavior of polyphagous herbivores. Altaf also worked as a project coordinator for Worldwide Fund for Nature (WWF) where he assessed the ecological footprint of different agricultural systems.

Release response of black spruce and white spruce due to overstory lodgepole pine mortality following mountain pine beetle attack

Felix Oboite , PhD student and Phil Comeau, Professor - Department of Renewable Resources, University of Alberta, Edmonton, AB

Abstract

Mountain Pine Beetle (MPB) can alter the growth patterns of advance regeneration in many lodgepole pine dominated stands in Alberta. Understanding the growth response of advance regeneration to the changes that occur in these stands is needed to effectively manage them. This study was designed to quantify the diameter and height growth responses of black and white spruce to lodgepole pine mortality and how they are influenced by factors like live and dead tree density, density (tree/ha), basal area, initial tree size, site index and pre-release growth. Sample trees of black and white spruce advance regeneration were selected from five lodgepole pine dominated stands that were attacked by MPB but left unharvested. Diameter, height growth and competition measurements were taken for all sample trees. Preliminary result revealed that there was an increase in both diameter and height growth after MPB attack; however, growth was delayed for about four years. In addition, the growth of both spruce species after MPB was influenced by density, pre-release growth, and initial size. This study will help to quantify the impact of mountain pine beetle attack on advance regeneration, and improve forecast of mid-term timber supply projections.

Biographical Sketch

Felix Oboite is a PhD student working with Dr. Phil Comeau at the Department of Renewable Resources, University of Alberta. He obtained his M.Sc. in forest biometrics from the University of Ibadan, Nigeria and worked with the University of Benin as an Assistant Lecturer before starting his PhD program in January 2015. His current research is focused on the growth response of understory black and white spruce in mountain pine beetle infested stands and calibration and validation of the Mixedwood Growth Model (MGM) for black spruce. When Felix is not doing research, he enjoys writing poems and spending time with friends.

Hydrologic resilience of a Canadian Foothills watershed to forest harvest

Amy Goodbrand, PhD Student – Forestry Hydrology and Watershed Management, Department of Renewable Resources, University of Alberta, Edmonton AB, and Dr. Axel Anderson, RPF, P Eng., Program Lead - Water Program - fRI Research, Hinton, AB

Abstract

Recent investigations of long-term hydrometeorological, groundwater, and streamflow data from watersheds on the eastern slopes of the Canadian Rocky Mountains showed the streamflow regime was resilient to forest harvest. These watersheds had low levels of harvest relative to their size and a large area of sparsely vegetated alpine talus slopes and exposed bedrock; an area shown to generate the majority of runoff for streamflow. In contrast, watersheds located in the foothills of the Rocky Mountains are of lower relief and typically have harvestable timber throughout the watershed; therefore, these watersheds may be more sensitive to forest disturbance and have increased potential for streamflow response. This project assesses the hydrologic resilience of an Alberta Foothills watershed to forest harvest using a 23-year dataset from the Tri-Creeks Experimental Watershed (Tri-Creeks). Tri- Creeks has been the site of intensive streamflow, groundwater, snow accumulation, and precipitation observations from 1967 – 1990. During the early 1980s, forestry experiments were conducted to compare the effects of timber harvest and riparian buffers, and the effectiveness of timber harvesting ground rules in protecting fisheries and maintaining water resources within three sub-watersheds: Eunice (16.8 km2; control); Deerlick (15.2 km2; 36% streamside timber removal); and, Wampus (28.3 km2; 37% clear-cut). Statistical analyses were used to compare the pre-and post-harvest ratios of treatment to control sub-watershed runoff for: water year, monthly (April – October), snowmelt peak flow, and low flow (10th percentile streamflow) periods as an assessment of hydrologic resilience to forest harvest. The only significant post-harvest change was an increase in water yield during May at Wampus (Mann-Whitney (MW), $p<0.05$) and Deerlick (MW, $p<0.1$) Creeks. The lack of change in snowmelt peak flow timing or magnitude was not expected, particularly in Deerlick, which had 36% streamside timber removal.
The streamflow regime of Tri-Creeks displayed remarkable resilience to forest harvest. We hypothesize on the processes and characteristics that result in this watershed to exhibit greater resilience compared to other forested watersheds.

Biographical Sketches

Amy is a hydrology PhD student in the Department of Renewable Resources, University of Alberta. She is studying the impact of MPB at the stand level and testing ideas on how to incorporate the new knowledge into forest management in the Alberta Foothills region. She completed her M.Sc. thesis at the University of Saskatchewan, which focused on surface water-groundwater connectivity within the Saskatchewan Boreal Plain. Amy has worked on a diverse range of surface water and groundwater projects across Saskatchewan, Alberta, and British Columbia with various agencies and consulting companies.

Axel is a forest hydrologist with the Government of Alberta, Forest Management Branch, and an assistant professor at the University of Alberta, Renewable Resources. His current assignment is as the lead of the Water Program at fRI Research.

The effect of forest disturbance on the streamflow regime and fish recruitment in the Alberta Foothills

Amy Goodbrand, PhD Student - Forest hydrology and Watershed Management, Department of Renewable Resources, University of Alberta, Edmonton AB, Dr. Axel Anderson, RPF, P Eng., Program Lead - Water Program - fRI Research, Hinton, AB, and Dr. Uldis Silins, Professor - Forest Hydrology and Watershed Management, Department of Renewable Resources, University of Alberta, Edmonton, AB

Abstract

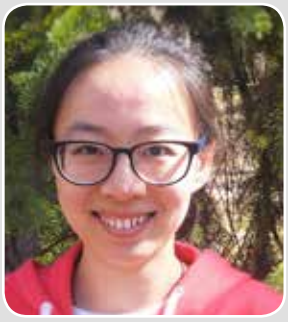
Forests in Alberta's Foothills region face diverse forest management issues including timber harvest and Mountain Pine Beetle (MPB) attack. Forest cover change directly influences the amount of water delivered to a stream. Stand-level hydrologic effects provide process understanding of streamflow generation and likely hydrologic response from forest disturbance at the watershed-scale. This project will build on existing stand and watershed-scale investigations on the hydrological effect of MPB-attack and harvest in the Foothills. The goal of this research is to develop quantitative relationships between forest disturbance, streamflow response, and Athabasca rainbow trout (Oncorhynchus mykiss) recruitment using a field study and hydrological modelling to inform forest management. The transfer of quantitative relationships to other Foothills watersheds will be explored to anticipate the expected hydrologic and rainbow trout response to forest disturbance. This information will also provide direct input to Alberta's MPB Rehabilitation Decision support tool to refine disturbance thresholds to guide forest management planning.

Biographical Sketches
See Amy Goodbrand's biographical sketch on the previous page.

See Dr. Axel Anderson's biographical sketch on the previous page.

Dr. Uldis Silins is Professor of Forest Hydrology and Watershed Management in the Department of Renewable Resources, University of Alberta. In the past decade, his research has primarily focused on impacts of natural disturbance by wildfire and Mountain Pine Beetle on hydrology of Alberta's eastern slopes forests. Apart from receiving recognition awards for teaching, the Southern Rockies Watershed Project for which Dr. Silins is a lead investigator won a 2014 Emerald Award.

Source or Sink: functional role of residual overstory lodgepole pine (Pinus contorta) trees in post-mountain pine beetle (Dendroctonus ponderosae) stands



Shiyang (Violet) Zhao, PhD Student and Dr. Nadir Erbilgin, Associate Professor and Canada Research Chair - Forest Entomology and Chemical Ecology, Department of Renewable Resources, University of Alberta, Edmonton, AB

Abstract
Since its first invasion of Alberta in 2006, mountain pine beetle (Dendroctonus ponderosae) have killed millions of trees and left a range of tree mortality from 10% to 100%. Whether such variation in tree mortality rate affects forest structure, soil chemistry, and seed sources is not known. In particular, it will be important to know if residual overstory pine trees that have survived mountain pine beetle attacks will be affected by the sudden changes in forest stand structure as these trees will likely be the seed source for the next generation of pine. For example, residual overstory trees could be weakened by the sudden structural changes and targeted by various other insects and diseases. This could have serious implications for the sustainability of pine trees in western Alberta. In fact, in my 2015 field studies, I found that some portion of the residual pine trees were attacked by secondary bark and woodboring beetles along with a number of diseases, including western gall rust. I will present my preliminary results and discuss the upcoming 2016 and 2017 field studies that further investigate the condition of the residual overstory pine trees in post-mountain pine beetle stands in Alberta.

Biographical Sketches
Shiyang Zhao is a PhD student from the University of Alberta working with Dr. Nadir Erbilgin. Her current research is focusing on residual overstory lodgepole pine health conditions in post-mountain pine beetle stands and how resin duct-based defense relates to residual overstory lodgepole pine. She achieved her Master's degree in Entomology from Harper Adams University in the UK, where she was working on the trade-off between resistant aphids and parasitoids. When she is not glued to her laptop and microscope, she really enjoys outdoor activities and travelling.

Since 2007, Nadir has worked, taught, and interacted with academic staff and students at the University of Alberta. His program explores questions of broad relevance to invasion biology and chemical ecology of forest insects and diseases. His group primarily focuses on characterization of tree chemical defenses to assess tree suitability to a suit of organisms including insects and diseases. They investigate if species-specific differences in composition and concentrations of tree defense chemicals influence the choice of host plants by forest insects and diseases. They also characterize the temporal and spatial changes in tree chemical defenses due to differences in genetics, environment, and genetics x environment interactions.

Natural lodgepole pine regeneration after mountain pine beetle attacks in west-central Alberta

Julie Steinke and Lori Schroeder, MSc Students - Department of Renewable Resources, Faculty of ALES, University of Alberta, Edmonton, AB

Abstract
Mountain pine beetle (MPB) is expanding into unprecedented areas at higher elevations and further east into west-central Alberta, where lodgepole pine forests differ in composition, hydrology, and climate from historical MPB habitat. It is currently unknown how forests in Alberta will respond, so we assessed the potential for natural lodgepole pine regeneration in MPB-killed stands in Alberta. Sites that were >70% pine, >50% grey attack phase, and < 400 stems per hectare of advanced regeneration with no management were selected throughout west-central Alberta. The amount of advanced regeneration, seedlings, understory vegetation, groundcover, and ecosite type were recorded at each site. Out of 30 sites, only 12 sites had pine seedlings and 13 sites had pine advanced regeneration. Comparisons of pine seedlings among ecosite types indicate a significant association between site quality and pine seedling presence. Seedlings were most common in nutrient and moisture poor ecosites (a, b, c) and were uncommon in more nutrient and moisture rich ecosites (d, e, f). Overall, natural regeneration of pine in Alberta post-MPB appears to be limited. Further research is needed to understand what is behind this limited regeneration potential in Alberta to ensure the continued success of lodgepole pine on Alberta's landscape.

Biographical Sketches
Julie Steinke is currently a MSc student with Dr. Ellen Macdonald and Dr. Vic Lieffers at the University of Alberta. After residing on the east coast of Canada and in the Middle East, Julie came to Alberta where she received her BSc in Conservation Biology from the University of Alberta. She currently serves on the planning committee for CONFORWest, a non-profit that organizes annual graduate student conferences. Julie has a strong passion for forest-related ecology. After researching the effects of reforestation on reptiles and amphibians in coastal Ecuador during her B.Sc., Julie has now transitioned to her current focus on pine regeneration, both natural and facilitated, after mountain pine beetle attacks in Alberta.

Lori Schroeder has worked as a botanist and environmental educator in the Yukon for over 20 years. She is currently working as a research assistant in forest ecology at the University of Alberta while pursuing her masters in Conservation Biology.

Assessing the resilience of forestry-based communities through network analysis of mountain pine beetle adaptation efforts

Rodolphe Gonzalès, Postdoctoral Research Technician - Complex Environmental Systems Lab, University of British Columbia, Vancouver, BC

Abstract
The mountain pine beetle outbreak in British Columbia has shown how a lack of resilience towards sudden disturbances can negatively affect communities relying on forest resources, harming both their social and economic fabric. As mountain pine beetle infestations are migrating east, forest-dependant communities in Alberta and Saskatchewan may see their resilience challenged as well. In such times of environmental disturbances, stakeholders (from within a diversity of companies, agencies or citizen groups) may share knowledge about the nature and extent of the disturbance, and collaborate to plan adaptation and coping strategies. Each group of stakeholders holds specific knowledge, values, objectives and skill sets, all of which are potentially important to tackle complex problems. From repeated collaboration between stakeholders emerges complex collaboration networks, the structures of which have been shown to influence community resilience. Our objective is to map the relationships between stakeholders involved in the acquisition and exchange of local ecological knowledge about environmental disturbances (anticipation, outbreak and aftermath management) in a selection of forest-dependent communities. From these representations of community collaboration networks, we will conduct social network analysis and propose steps which may be taken to enhance resilience in communities which haven't yet been impacted.

Biographical Sketch
Rodolphe Gonzalès earned his MSc and PhD in geography from the University of Montréal. He is presently a postdoctoral research technician at the University of British Columbia, in the Complex Environmental Systems lab. Rodolphe primarily works with network theory as a tool to model and quantitatively describe complex natural and social systems.

Quantitative analysis of network indices to measure resilience in a dynamic social-ecological network (SEN)

Mathias Bass, PhD Student, Dr. Lael Parrot, Associate Professor, Complex Environmental Systems Laboratory, and Dr. Rebecca Tyson, Associate Professor, Mathematical Biology - University of British Columbia, Okanagan Campus, Kelowna, BC

Abstract
Large-scale disturbances, such as the mountain pine beetle (MPB) epidemic in British Columbia do not affect just the resilience of the ecological network, but also the resilience of the social network that is linked to the ecological network through resource-dependence. While models examining the ecological network or social network exist, there are no models that analyse the two together as a combined social-ecological network (SEN). In particular, it is unclear what dynamics will emerge within a combined network dynamics in response to large-scale ecological disturbances. Previous research has mainly focused on the identification and assessment of the ecological and social systems considered separately, and when represented as static networks. With the proposed model we introduce a novel tool to develop and explore a SEN as a single, dynamic system, and link the emerging network properties to the resilience of the system under introduced disturbances. We designed a generalized directed, weighted and dynamic SEN and analysed how network connectivity and clustering varies under different simulated disturbance impacts and network configurations. We anticipate the novel SEN model to inform and incorporate stakeholders and to significantly contribute to more resilient management practices under large-scale disturbances such as the recent MPB epidemic.

Biographical Sketch
Matthias Bass is a PhD student in the Complex Environmental Systems Laboratory under Dr. Lael Parrott at the University of British Columbia, Okanagan Campus. His research focuses on network modeling of the impact of the mountain pine beetle (MPB) epidemic in Western Canada at a social and ecological level and assessing and modelling the resilience of landscape-scale social-ecological systems to MPB outbreaks and disturbances in general.

He did his German Diploma in biology at the Technische Universitaet Kaiserslautern in Germany. His research expertise mainly focused on lichen ecology. If he is not writing codes in R or exploring packages, he is outdoors finding rare lichen species.

Mr. Matthias Bass can be contacted at: matthias.bass@ubc.ca

STOP 1 - Introduction to MPB affected immature stands

Derek Sidders, Regional Coordinator and Program Manager – Canadian Wood Fibre Centre, NRCan, Edmonton AB

Biographical Sketch

Derek Sidders is the Program Manager and Regional Coordinator of the Canadian Wood Fibre Centre for the Prairie Provinces and Northwest Territories. Derek graduate from Lakehead University in 1977 before beginning his career in Northwestern Ontario with the Ministry of Natural Resources. He has thirty-eight years of experience in forest management and afforestation operational development, applied research and technology transfer in Boreal Plains and Boreal Shield ecoregions of Canada. Derek has worked for the Canadian Forest Service since 1985 and for the Canadian Wood Fibre Centre since its inception in 2006.

Derek has spent the last 15 years developing, testing and demonstrating novel mixedwood forest partial harvesting and regeneration systems for the Boreal Plains and leads a national group that develops woody biomass feedstock options for an evolving Bioenergy industry in Canada.

STOP 2 - Innovative Partial Harvest Systems Design to recover value, reduce stand risk and enhance rehabilitation efforts - Block 674

Tim Keddy, Wood Fibre Development Specialist - Canadian Wood Fibre Centre, NRCan, Edmonton, AB and Dean Marshall, R.P.F., Vice President – Operations - Spectrum Resources Group Inc., Prince George, BC

Abstract

Spectrum fulfilled the role of service provider on the Stand Rehabilitation Project, carrying out the functions of planning, permitting, harvesting and silviculture operations.

Biographical Sketches

With over 30 years of experience in the forest industry, Tim Keddy has acquired a broad range of forest management and applied research skills working across Canada for private forest industry and various government agencies. He presently works for the Government of Canada with the Canadian Wood Fibre Centre (CWFC) as a Wood Fibre Development Specialist.

His responsibilities include the operational coordination of the National SRWC Program and the National Innovative Woody Biomass Systems Development Program.

He began his forestry career in 1992. From 2001 to 2014 Dean fulfilled a variety of roles for Canadian Forest Products in Vanderhoof, BC where he undertook a variety of progressively more challenging roles in silviculture, planning, permitting, certification, harvesting, and ultimately in woodlands management. Dean brings knowledge and expertise in forestry operations management. He holds a diploma in Forest Technology from Malaspina University College and is a Registered Professional Forester, (BC). Dean is a member of the Project Management Institute (PMI) and currently holds a Project Management Professional (PMP) designation.

STOP 3 - Reforestation applications to rehabilitate MPB affected stands - Block 674

Derek Sidders, Regional Coordinator and Program Manager -Canadian Wood Fibre Centre, NRCan, Edmonton, AB

Biographical Sketch.

See Derek Sidder's biographical sketch in previous column.?

STOP 4 - Reforestation research study: 4 microsites and 2 regeneration methods - Block 201S

Julie Steinke, Dr. Ellen Macdonald, Dr. Vic Lieffers and Lori Schroeder - Department of Renewable Resources, University of Alberta, Edmonton, AB, and Derek Sidders, Regional Coordinator and Program Manager – Canadian Wood Fibre Centre, NRCan, Edmonton, AB

Beyond Beetle: Opportunities for natural regeneration of lodgepole pine following partial harvesting of MPB-affected stands

Abstract

Availability of suitable regeneration microsites is likely the most serious limitations to natural establishment of conifers in pure pine stands that have been killed by MPB. Rehabilitative treatments such as partial harvesting and mechanical site preparation can create the thin organic and exposed mineral soil microsites needed for germination and initial establishment of lodgepole pine while increasing light penetration to the forest floor, which will stimulate growth of seedlings. This field

experiment was established through co-operation between the Canadian Wood Fibre Centre (Canadian Forest Service – Edmonton), Canadian Forest Products, and Alberta Agriculture & Forestry. Lodgepole pine stands which had experienced ~ 50% mortality due to MPB attack were partially harvested. Standing dead trees were left as a seed source and to serve as a future supply of coarse woody debris. Areas were treated with mechanical site preparation including: scalp, mix, mound and unprepared control. We sowed seeds in different microsites within each of these site preparation treatments and in different naturally-occurring microsites in un-site-prepared areas in partially harvested forest and in unharvested control. Germination and survival of seedlings will be examined as a function of partial harvesting and microsite.

Biographical Sketches

Dr. Ellen Macdonald is a Professor of Forest Ecology in the Department of Renewable Resources at the University of Alberta. She obtained her BSc in Environmental Biology and PhD in Plant Ecology from the University of Calgary. For the past 25+ years her research has focused on the ecology of northern forests - particularly forest regeneration, stand dynamics, understory plant communities and relationships among these. Much of her work has examined the impacts of natural and anthropogenic disturbance.

Dr. Victor Lieffers is the Chair of the Department of Renewable Resources at the University of Alberta, where he has been a professor since 1983. He is a member of Alberta's Registered Professional Forester Association. He has published extensively in the areas of forest regeneration, forest ecology and silvicultural practices and policies.

Julie Steinke is currently a M.Sc. student with Dr. Ellen Macdonald and Dr. Vic Lieffers at the University of Alberta. After residing on the east coast of Canada and in the Middle East, Julie came to Alberta where she received her B.Sc. in Conservation Biology from the University of Alberta. She currently serves on the planning committee for CONFORWest, a non-profit that organizes annual graduate student conferences. Julie has a strong passion for forest-related ecology. After researching the effects of reforestation on reptiles and amphibians in coastal Ecuador during her B.Sc., Julie has now transitioned to her current focus on pine regeneration, both natural and facilitated, after mountain pine beetle attacks in Alberta.

Lori Schroeder has worked as a botanist and environmental educator in the Yukon for over 20 years. She is currently working as a research assistant in forest ecology at the University of Alberta while pursuing her masters in Conservation Biology.

See Derek Sidders' biographical sketch on previous page.

Stop 5 – Wildfire research study on fuel moisture content and fuel composition, Block 201s

Dr. Mike Flannigan, Professor, Wildland Fire and Director of the Western Partnership for Wildland Fire, and Hugh Wallace, MSc Student - Department of Renewable Resources, University of Alberta, Edmonton, AB

Abstract

"The fire probability research sites seek to determine the effect of thinning on fuel moisture content. Litter and duff samples are taken and used to form a comparison to the predicted Fire Weather system indices. LAI, forest floor cover and fuel loading are also being assessed. Difficulties in conducting this research include limited drying periods and heterogeneity in sample quality and composition."

Biographical Sketches

Mike Flannigan is a professor with the Department of Renewable Resources at the University of Alberta and the director of the Western Partnership for Wildland Fire Science. He received his BSc (Physics) from the University of Manitoba, his MS (Atmospheric Science) from Colorado State University and his PhD (Plant Sciences) from Cambridge University. Dr. Flannigan's primary research interests include fire and weather/climate interactions including the potential impact of climatic change, lightning-ignited forest fires, landscape fire modelling and interactions between vegetation, fire and weather.

Hugh Wallace is an MSc candidate in Wildfire Research at the University of Alberta. Originally from BC, Hugh worked as a crew leader and faller in the BC Wildfire Service. His research focusses on the effects of mechanically thinned fuel treatments on fire probability and behavior. Outside of work and school Hugh pursues a wide variety of hobbies such as rock climbing, fishing, and blacksmithing.

STOP 6 - Integrated land use in MPB affected stands: oil and gas exploration and recovery, wildlife management and water protection - Block 576

Open Discussion

Stand Dynamics after MPB Attack

W.R. Dempster and S.D. Meredith - Forest Growth Organization of Western Canada

Abstract

The rationale for this project originated during a multi-agency tour of MPB affected areas in B.C. in July 2007. Managers attempting to mitigate the impact of mountain pine beetle disturbance on timber recognized the importance of retaining a monitoring network of undisturbed permanent sample plots and buffer areas that have been disturbed by MPB. These would provide the basis for answering questions around changes in stand composition and growth after MPB attack.

This project, which is being undertaken by the Forest Growth Organization of Western Canada, is a continuation of a project begun by the fRI Mountain Pine Beetle Ecology Program and the Foothills Growth and Yield Association 2008. 240 existing PSPs were reserved from harvest to allow monitoring for MPB attack. The current focus is on monitoring changes in 63 plots attacked by MPB in the Grande Prairie and Whitecourt forest areas before 2010. On these plots, post-attack development will have been assessed repeatedly over a 7-year-plus period by 2016.

Field measurements include: measurement of saplings and regeneration for all conifer and broadleaf tree species; assessment of shrubs, herbs, grass, floor mosses, ground lichens, un-decayed wood, bare ground, and important caribou and grizzly bear food species; ground cone counts and tree cone serotiny assessment; identification and condition assessment of attacked trees and trees that have died since the last measurement, including cause of death, level of attack, and fall-down; and assessment of arboreal lichens.

The information collected and analysed will be used to inform timber supply analysis and operational planning through the improved development of stand regeneration and growth models forecasting post-disturbance conditions.

Biographical Sketches

Dick Dempster graduated in forestry at the University of Wales in 1968 and obtained a Ph.D. there in 1972. He spent two years as a forester in Jamaica before immigrating to Canada in 1974, where he worked in forest management, industry, university teaching and government, before establishing his own consulting business in Alberta in 1981. He subsequently moved to British Columbia to work for a major international consulting firm, where his focus was providing technical leadership and advancing domestic and offshore business development. In 1999 he returned to Alberta to direct and undertake projects in forest growth and yield, planning, research and development. In 2007 he returned to live in the U.K., from where he continues to be involved in Alberta lodgepole pine growth and yield research.

Sharon Meredith attended the University of New Brunswick, completing a B.Sc.F in 1996 and an M.Sc.F. in 1999. She moved to Alberta in 2000, where she gained a variety of forestry experience, including work in industry, consulting and government. Since 2012 Sharon's work has focussed on management of growth and yield research programs.

NOTES

Photo Credit: Dr. Allan Carroll, University of British Columbia

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