



MOUNTAIN PINE BEETLE ECOLOGY PROGRAM

RESEARCH PROSPECTUS


Introduction

The devastation caused to western Canadian pine forests by the Mountain Pine Beetle (*Dendroctonus ponderosae* Hopkins) (MPB) is unprecedented in modern times. As an integral component of the pine forest ecosystem, the MPB has played an essential role in maintaining dynamic pine forest landscapes on local and regional scales in south central BC and southern Alberta and is now set to do likewise in north-central and eastern Alberta. Coincidentally, throughout Western Canada, pine stands have been allowed to expand and reach maturity over much of its range as a result of fire exclusion policies to ensure promoting forest economies and to protect private property and infrastructure. Coupled with climate warming and absence of killing frosts MPB populations have increased to epidemic proportions throughout its historical range and is now moving into novel habitats in Northern Alberta, BC, and the Yukon and NWT and resides at the doorstep of Saskatchewan.

British Columbia was the first western province to experience the impact of the mountain pine beetle. By 2001 approximately 800,000 hectares of pine forest were damaged with the loss of 710 million cubic metres of commercially valuable timber¹. Early estimates of total loss of 80% of the province's pine volume by 2021 have since been revised downward to 57%. The loss to the provinces' economy is significant.

The Mountain Pine Beetle has been variably present in southern pine forests of Alberta, which has enjoyed the barrier provided by the Rocky Mountains. However, the most recent beetle infestations in northern Alberta began with the detection of small populations along the border with British Columbia in 2001 and has since grown exponentially. Strong winds during beetle emergence in 2006 and 2009 carried them more than 400 kilometers from central British Columbia to as far as north-central Alberta and north to the NWT. The damage to Alberta's pine resource since then has been significant and continued to expand, but concerted management efforts by government and industry have had a considerable impact on the rate of spread.

¹ Anon. 2012. A History of the Battle Against the Mountain Pine Beetle: 2000 to 2012. http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/Pine%20Beetle%20Response%20Brief%20History%20May%2023%202012.pdf 12p.



Support to these efforts has benefited from past experiences of BC forest managers and research that has been conducted over the past 10-15 years. However, Alberta's residual pine resource remains at risk. Adding to the concern is that Alberta remains the last opportunity in preventing the MPB from spreading into Saskatchewan and possibly, the rest of Canada through the Boreal Forest.

Alberta must remain alert for innovative management strategies supported by strong science. The province, while fighting the beetle, must also be prepared to undertake managing affected landscapes following the beetle attack. Forests will need to be restored, and watersheds protected in the face of fire and salvage operations. Wildlife will require special consideration as their critical habitat will be drastically altered.

Establishment of the Mountain Pine Ecology Program

In 2006-07, the Foothills Research Institute (FRI) established the Mountain Pine Beetle Fire Ecology Program and adopted as its primary objective to satisfy the information needs to inform decision-making and support policy development. This broad objective embraces the growing concern over the interaction of wildland fire threat and landscape conditions wrought by the MPB. With the growing threat of the MPB, the focus of the program shifted to address MPB biology and management procedures for control. Hence, in 2007-08 the program was renamed to the Mountain Pine Beetle Ecology Program. Issues related to fire and Wildland Fire Management require specialized expertise that is now available from the Western Partnership for Wildland Fire Research at the University of Alberta. The change in the program's name serves to focus on the management and control of MPB. However, the program is taking steps to address critical information needs to ensure the rehabilitation of beetle-affected landscapes. The Program realizes that traditional silviculture may be satisfactory in regenerating new stands, but may require support from science-driven innovation to address drastically altered ecologies. Many forest values will change as will ecological services and the social and economic benefits they provide.

With the MPBEP focused on addressing questions posed by partners and regional planning groups, it strives to be the trusted source of knowledge and a body enabling the research community to provide science-based information to practitioners and policy-makers. Using the set of thematic priorities established by a multi-stakeholder group in 2007 the Program began supporting research. For the five years following the identification of the first set of priorities numerous research projects provided valuable scientific insights into the population dynamics of MPB. During this same period, the MPB expanded its range by migrating eastward and northward lending strength to the notion that the research program needs to be expanded to address new conditions and shifts in behavioural patterns expected in novel habitats. As the range of the MPB expanded so did the area of damaged pine forests requiring rehabilitation and future forest management strategies will need to be adjusted to manage what now will be endemic beetle populations.

Future Challenges

Alberta faces unusual challenges in the management and control of the beetle as the beetle moves into novel habitats and benefits from climate change and perhaps other factors, which collectively, could enable the bridging of the beetle into Boreal pine forests. The next thrust of the MPBEP will be to take



stock of its current accumulated knowledge, assess it against changing landscape conditions and take intentional action to support outstanding information needs. To facilitate this strategy, the MPBEP confirmed the categorizations of its information needs into broad Research Themes, within which strategic research questions were articulated to guide its research investments (Table 1). Table 1 was recently amended to include the number of projects addressing each critical question (refer to the Annotated Bibliography, 2021).

Connecting MPBEP Terms of Reference and Research Prospectus

This Research Prospective is intended to be a companion document to the MPBEP Activity Team's Terms of Reference. This Research Prospectus is dynamic and will be revised, as research priorities are addressed and new ones are identified. This document will also serve as an aid in broadly communicating research priorities to the scientific community and to others who have a general interest in how science is serving the achievement of provincial goals and objectives to maintain a healthy and economically viable forest resource.



Table 1. Research Themes, Priority Questions and the number of research studies that have addressed each Specific Critical Question. Readers of this Research Prospectus are urged to refer to the MPB Annotated Bibliography to gain an appreciation of the scope of research undertaken within each Research Theme.

Research Theme 1 MPB Biology and Management		No. of studies that have addressed this Critical Question
1	What is the efficacy of current control measures applied to MPB in Alberta?	3
2	Can a composite spread model that incorporates key variables and is broadly applicable be developed that significantly improves spread predictions against a backdrop of climate change	5
3	What drives local and long distance beetle dispersal, promotes beetle establishment and affects population dynamics of MPB in novel host environments? Do indicators of stand susceptibility to beetle attack vary eastward and can they be exploited to curb expansion?	5
4	Can models / indicators of tree physiology be developed and incorporated in spread models?	1
5	What are the critical thresholds in terms of population dynamics of beetles that can be defined and used to guide operational management of infestations in novel habitats?	3
6	Detecting populations of MPB at low densities is a critical step in managing the beetle. Can baits and protocols for its placement with respect to endemic populations be developed and successfully deployed?	4
7	What can we expect from secondary injurious insect populations following MPB attack? Should we be concerned about residual pine and other species?	0
8	Demonstrate / evaluate the efficacy of genomic science to support management's response to mountain pine beetle (CF Research Theme No 3)	1



Research Theme 2 Hydrological Impacts of Mountain Pine Beetle		No. of studies that have addressed this Critical Question
1	What are the specific thresholds (forest cover, tree condition) in MPB affected watersheds that are indicative of pending negative conditions such as, changes in water quality and quantity, deterioration of aquatic habitats, flood potential?	
2	What is the range of hydrological impacts at stand and watershed levels from variable MPB attack; can hydrological recovery be effectively determined using indicators of real-time forest cover and stand condition against a backdrop of predicted climate change?	3
3	Can currently available watershed assessment procedures be refined to accurately reflect the state of Alberta's watersheds affected by the dynamic nature of MPB and allude to remedial management options to ensure the flow of ecological services? (*)	



Research Theme 3 Landscape and Stand Dynamics Following MPB		No. of studies that have addressed this Critical Question
1	What are the vegetation dynamics in managed and natural pine dominated stands across Alberta's ecosites following variable MPB caused mortality? Can interventions be applied to modify species compositions to make future stand more resistant to beetle attack?	6
2	How is soil chemistry and soil biology altered following MPB attack and how do these changes influence stand rehabilitation? (added May 6, 2016)	1
3	In order to achieve future site objectives what terrestrial and aquatic parameters 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?	1
4	What operational measures can be taken to restore landscapes severely altered by MPB to ensure the flow of ecosystem services?	1
5	Can genetic traits of Alberta's pine species be efficiently identified and captured operationally to promote the development of healthy forests following mountain pine beetle and its consequences?	2
6	What level of overstory mortality in a spatially defined area indicates a level of thermal loading detrimental to threatened cold water fish? What kind and level of intervention would mitigate against potential impacts?	3
7	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
8	How is population behavior of species at risk such as grizzly bear and caribou affected by MPB induced habitat change?	3
9	How does fire risk and fire behaviour change following MPB?	3
10	How will the anticipated increase in soil water affect choice of silviculture options and what are the potential implications to the flow of ecosystem services?	0
11	How will the site ecology of beetle killed stands change with respect to carbon fluxes? Is there a need to take mitigative action to achieve a desired forest future condition while minimizing carbon losses?	1



Research Theme 3 Landscape and Stand Dynamics Following MPB		No. of studies that have addressed this Critical Question
12	What is the potential impact of managing net down areas versus no management to the spread of the beetle (scenario analysis / risk determination)?	0
13	Can proactive measures, apart from harvesting, be taken to slow the spread of the beetle and how can the impacts of these measures be evaluated.	0
14	Can effective models be developed to guide silviculture strategies following MPB (Added Sept 13-18). See 246.02.	1

Research Theme 4 Social and Economic Implications of a Changing Landscape		No. of studies that have addressed this Critical Question
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?	1
2	How many years after MPB mortality does it take for a tree to become unmerchantable to sawmill or a pulp mill and what differences in duration exist across ecosite?	1
3	As a result of MPB in Jasper National Park, how do visitor perspectives and their behaviour influence local economies?	0
4	What is the range of perceptions regarding MPB?	1

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