Mountain Pine Beetle Ecology Program

Research Theme No. 3

Landscape and Stand Dynamics following MPB

Importance of Research Theme[1]

The growing mountain pine beetle (MPB) infestation in Alberta provides significant challenges for forest managers. While controlling MPB spread is a first priority, forest managers will be required to make decisions on how to manage pine dominated forests following extensive MPB caused mortality. These decisions will require an increased understanding of natural and managed stand development after the MPB infestation, and how these dynamics affect social, economic, and environmental values (ecosystem services), and what management strategies can be used to mitigate these impacts.

There are few historical MPB impacted areas in Alberta to guide our predictions of the current outbreak's outcomes. Successional pathways followed by pine dominated stands after beetle disturbance will likely be very different than pathways followed after fire or timber harvest disturbance. Different climate and site conditions in Alberta may result in different post MPB successional pathways being followed in Alberta from what has been observed in British Columbia. Information on natural stand development is currently lacking for Alberta, but is critical for decisions regarding timber salvage, timber supply analysis, fire risk assessment, hydrologic recovery, rehabilitation strategies, and wildlife habitat management. Forest managers in both government and industry require this information to mitigate and plan for the range of impacts the mountain pine beetle will create.

Impacts to ecosystem services will be significant. The rate of increase of dead and dying pine forests is likely to exceed forest industries' capacity to salvage dead timber in a profitable manner and, therefore, reforestation will not occur promptly. Research to date (Lewis and Hrinkevich 2013[2]) demonstrates that

[1] Based on: Stadt, J. and K. Greenway. 2007. Lodgepole Pine stand dynamics in Alberta Following Mountain Pine Beetle. Forest Management Branch. Alberta Sustainable Resource Development. 26p.

[2] Lewis, K. and K. Hrinkevich. 2013. Post mortality rate of wood degradation and tree fall in lodgepole pine trees killed by mountain pine beetle in the Foothills and Rocky Mountain regions of Alberta. Final Report submitted to the Foothills Research Institute, Mountain Pine Beetle Ecology Program. January 2013. Unpublished.

timber quality declines quickly following red attack with a commensurate decline in economic recovery. An equally troubling aspect of a rapidly increasing inventory of dead and degraded forests is that recovery (i.e., regeneration lag) could be delayed significantly posing risks to timber supply, watersheds, fish and wildlife habitat, recreation opportunities, and forest dependent community sustainability and risk of wild fire.

Rehabilitation of selected MPB impacted pine stands is required to mitigate risk to ecosystem services and to restore ecosystem function. There are a suite of silviculture tools than can be used to do rehabilitation at the stand-level. However, developing appropriate rehabilitation strategies and performance measures will be necessary to determine if the mitigation objective are achieved. This is largely demonstrated at the landscape-level. Thus, developing an understanding of the impacts of stand-level treatments at the landscape-level is key. The next step is then to develop an understanding of how these managed stands will develop into the future.

Exacerbating our lack of understanding of natural and managed pine stand dynamics in this MPB environment are the issues of wild fire threat and climate change. While not affecting pine forest succession initially, the occurrence of wild fire in MPB killed pine stands will be very problematic. The availability of lots of fine fuels and the low moisture content of standing dead trees could result in increased fire intensity and rates of spread, which could lead to consumption of the LFH layer, degradation of soil structure, carbon, biota, mycorrhizae, and increased soil erosion due to hydrophobicity. Under these conditions, any silviculture investments (i.e., underplanting) would be at risk of loss. Future climatic conditions will favour a narrow array of successional pathways, which may not lead to an acceptable economic outcome within a specified time span. For industry, this consequence may make timber flow forecasts inaccurate.

Implications if information needs are not addressed

There is much that is not known about post beetle pine forest succession and this lack of understanding can easily translate into poor decisions regarding management. The understory may be primarily non crop species and without considerable investment for control purposes, the site may not contribute to future timber supply, but the site may have value from a habitat and biodiversity point of view. In managed forests, tolerance of random succession that does not support long term wood flow objectives is inconsistent with current forest policy and goals of managing forests for the benefit of Albertans. However, over the long-term natural succession may eventually result in a productive forest.

Economic, social and ecological benefits derived from addressing information needs

Addressing these questions and information needs posed in this theme will increase our understanding and knowledge about post-MPB pine forest recovery at the site- and landscape-level. We will gain a better understanding of the system and the relationships with one of the key ecological drivers of change. In addition, modeling forest growth will be important in addressing mid-term timber supply

issues, understanding future forest conditions, and mitigating risks to ecosystem services and risk of wildfire. Knowledge gained under this Research Theme will enhance decision-making capacity of forest managers.

Urgency of addressing information needs

Alberta is currently six years into the MPB infestation and there are currently thousands of hectares of dead and dying pine stands. Decision-makers have an immediate need to understand the current state of these forests, so as to select and rehabilitate these forests to mitigate risks to ecosystem services and risk of wildfire. However, a conundrum is faced in that this immediate decision-making need requires information that is long-term in nature. Strategy development; therefore, will have to be based on a combination of targeted research on high priority information needs supplemented with science gathered from other areas. When these strategies are filtered / vetted through ecologists, wildlife managers and foresters, they can be implemented and outcomes monitored.

Critical Questions[3]

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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? (*)
2	How is soil chemistry and soil biology changed following MPB attack and how do changes influence stand rehabilitation?
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?
4	What operational measures can be taken to restore landscapes severely altered by MPB to ensure the flow of ecosystem services? (*)

[3] Critical Questions denoted by (*) were addressed in a previous Call for Proposal, 2013.

Critical Questions *continued*

5	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?
6	How are wildlife habitats for grizzly bear and caribou and other species at risk affected by landscape change due to MPB, and what rehabilitative measures can be taken to restore their critical habitat? (*)
7	How does fire risk and fire behaviour across ecosites change following MPB?
8	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?
9	How will site ecologies of beetle killed stands differ from fire killed stands with respect to net carbon fluxes and their trajectory over stand recovery? What actions are needed to achieve a desired forest future condition that favour seedling establishment to mitigate carbon emissions from decomposition of large additions of standing and downed dead wood?
10	What is the potential impact of managing net down areas versus no management to the spread of the beetle (scenario analysis / risk determination)?
11	Can proactive measures, apart from harvesting, be taken to slow the spread of the beetle and can the impacts of these measures be evaluated?