MOUNTAIN PINE BEETLE ECOLOGY PROGRAM

RESEARCH THEME NO. 3

LANDSCAPE AND STAND DYNAMICS FOLLOWING MPB

Importance of Research Theme

The growing mountain pine beetle (MPB) infestation in Alberta provides significant challenges for forest managers. While controlling MPB spread is the priority, forest managers are 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 from trajectories followed after fire or timber harvest disturbance. Different climate and site conditions in Alberta may result in different post-MPB successional pathways 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 on 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 profitably and, therefore, reforestation will not occur promptly. Research to date (Lewis and Hrinkevich 2013) demonstrates that timber quality declines quickly following the red attack stage with a corresponding 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 wildfire.

Rehabilitation of selected MPB impacted pine stands is required to mitigate risk to ecosystem services and to restore ecosystem function. There is a suite of silviculture tools that 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 is achieved, particularly at the landscape-level. Thus, developing an understanding of the impacts of stand-level treatments at the landscape-level is vital. 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 wildfire threat and climate change. While not affecting pine forest succession initially, the occurrence of wildfire in MPB killed pine stands will be very problematic. The availability of fine fuels and the low moisture content of standing dead trees could result in increased fire intensity and rates of spread. Under these circumstances, this could lead to the consumption of the LFH layer, degradation of soil structure and loss of carbon, biota, mycorrhizae, and increased soil erosion due to hydrophobicity. As a result, 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 period. For industry, this consequence may make timber flow forecasts inaccurate.

Implications of not addressing information needs

Little known about forest succession following beetle pine attack and this lack of understanding can easily translate into poor management decisions. 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 be valuable 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, the long-term natural succession may eventually result in a productive forest.

What are the direct economic, social and ecological benefits of addressing this theme?

Addressing these questions and information needs presented 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 vital ecological drivers of change. Also, modelling forest growth will be critical in addressing mid-term timber supply issues, understanding future forest conditions, and mitigating risks from fire and loss to ecosystem services. Knowledge gained under this Research Theme will enhance the decision-making capacity of forest managers.

Constraints in addressing information needs?

Alberta is currently twelve years into the MPB infestation resulting in thousands of hectares of dead and dying pine stands. Decision-makers have an immediate need to understand the current state of these forests, allowing for the determination of priorities for rehabilitation to mitigate risks to wildfire and loss of ecosystem services. However, forest managers face a conundrum. Immediate decision-making need requires information that is long-term in nature. The development of strategies 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.

Priority Research Questions
October 31, 2019

Research Theme 3: Landscape and Stand Dynamics Following MPB	
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 stands more resistant to beetle attack?
2	How is soil chemistry and soil biology altered following MPB attack and how do these changes influence stand rehabilitation?
3	To achieve future site objectives, what terrestrial and aquatic parameters ought to be evaluated to determine candidacy for treatment (including salvage, planting) versus those that ought to be left for natural succession (including assisted natural regeneration by site scarification)? 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?
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?
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?
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?
8	How is population behavior of species at risk such as grizzly bear and caribou affected by MPB induced habitat change?
9	How does fire risk and fire behaviour change following MPB?
10	How will the anticipated increase in soil water following MPB affect the choice of silviculture options for rehabilitation? How will the flow of ecosystem services be affected?
11	What are the ecological impacts of the MPB across eco-sites? Will site ecologies 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?
12	What is the impact of managing net down areas versus no management to the spread of the beetle (scenario analysis / risk determination)?
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?
14	Can effective models be developed to guide silviculture strategies following MPB?

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