MOUNTAIN PINE BEETLE ECOLOGY PROGRAM

RESEARCH THEME NO. 2

HYDROLOGICAL IMPACTS OF MOUNTAIN PINE BEETLE

Importance of Research Theme

Mountain Pine Beetle infestation is one additional risk to water and water-associated values in a changing landscape. In many cases, MPB management may challenge traditional rules of thumb for watershed-level disturbance (e.g., 15% increase in modelled annual water yield, 30% area disturbed, change to sensitive areas such as riparian habitat, high road densities), and the result in the eastern slopes and foothills is unknown. Most MPB research to date has focused on understanding how MPB affects stand-level processes relative to healthy stands and salvage logged stands. Research has shown that ecological functions within MPB-killed stands are intermediate between healthy stands and salvage logged stands (e.g. more snow, faster melt, decreased interception). Although there are additional effects following salvage logging, there is an arguable benefit of faster hydrological recovery.

The scientific literature demonstrates that disturbance plays an integral role in maintaining ecological systems. What we do not know, but are in the process of learning, is the extent to which MPB-associated disturbance affects ecological resiliency. Ecological resilience is the ability of ecosystems to withstand perturbations (both natural and anthropogenic) without switching to an alternate (less desirable) state. Management decisions must be informed by an understanding of ecological resiliency and the different watershed and riparian values that are at risk. Moreover, the hydrological function of watersheds must be understood within the context of contributing to ecological resiliency.

In a Mountain Pine Beetle environment, management decisions need to be made at a watershed scale to ensure balanced management of multiple values. One common approach to deal with decisions in watersheds with multiple pressures is to conduct watershed assessments to help inform difficult decisions on trade-offs amongst social, economic and environmental values. To be effective, assessments have to account for: i) values (e.g., fish and fish habitat, drinking water, regional water supply, flood risk, natural range of variability), ii) watershed processes (e.g., hydrological, sediment, riparian ecosystem function),

and, iii) all pressures (roads, past forestry, wildfire, etc.). These assessments rely on professional judgment.

To interpret the best available scientific knowledge of watershed processes and response to disturbances. The presence of MPB makes this assessment process difficult because infestations cause unique and significant changes to vegetation, which over time, is in a dynamic state of recovery. Recovery may assume a myriad of trajectories that may be naturally initiated or may arise from salvage logging with or without subsequent intervention by planting. In any case, the scale of the disturbance pushes the boundaries of current knowledge on the interaction of vegetation and hydrology within a context of disturbance by Mountain Pine Beetle. We can extrapolate to plausible outcomes based on observation of situations occurring elsewhere (e.g. BC), but ultimately, research needs to be conducted in Alberta watersheds to determine thresholds of disturbance that minimize risk to values.

Over the last few years, watershed research has shifted focus to understanding the potential impact of MPB infestation on various watershed processes at a stand and watershed scale. Most of this research was conducted in BC, where the information found its way into well-established watershed assessment procedures. In Alberta, some vital research has recently provided an understanding of how MPB will affect watershed processes on the eastern slopes and foothills. However, we lack the assessment procedures (or comparable procedures) to implement this knowledge in changing landscapes. Unless such procedures are developed, management strategies will be ill-informed, and the risk to resource values will be high.

Implications if information needs are not addressed

While a full understanding of the effects of Mountain Pine Beetle on watershed will not be known, the apparent issue in hydrological impact is manifested in parameters such as water yield, peak flows, channel morphology dynamics, water quality, change in aquatic habitat, erosion potential, etc. Enhanced understanding of the change in watershed features resulting from broad-scale Mountain Pine Beetle disturbance is critical for all management decisions. Post beetle silviculture strategies set the stage for watershed recovery, and either the procedure will be useful or not. Addressing the information needs noted above will provide a basis for informed decision making to ensure adequate opportunities to achieve social, economic and ecological outcomes.

Economic, social and ecological benefits derived from addressing information needs

If it is assumed that an unaffected watershed provides a continuous flow of ecological services, which provide economic and social benefits, a decline in the flow of these services will have a variable and negative impact. Quantification of these impacts is difficult, but by adopting outcomes from other jurisdictions such as a decline in water quality due to sedimentation and organic matter contamination, the additional costs for water treatment can be high. Moreover, it can negatively affect aquatic habitats and biodiversity. Such outcomes are unacceptable to the general public, which enjoy their environment, or just knowing that watershed ecologies are and remain intact.

Urgency of addressing information needs

At present, watershed assessment procedures and the interaction of all the variables at play on the Mountain Pine Beetle affected landscape are far from being understood. Managers face making decisions. Delays in addressing information needs will relegate management decision making to experience and extrapolated research from unlike terrain, eco-regions, and eco-sites. Science-based knowledge is needed in the short term. The need is urgent.

Priority Research Questions

October 31, 2019

Research Theme 2: Hydrological Impacts of Mountain Pine Beetle	
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	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?

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