



Ministry of Forests and Range
Mountain Pine Beetle
Stewardship Research Strategy





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The information contained in this report will help coordinate projects that resolve Mountain Pine Beetle (MPB) stewardship research issues. We relied on contributors for the identification and prioritization of the research needs to address the stewardship research issues.

We encourage the dissemination of this strategy providing the Research Branch is acknowledged. The strategy can be downloaded from the Research Branch website (see below), or obtained from the project sponsor, Gerry Still, at the address below.

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1. Foreword

This strategy identifies the research knowledge gaps that must be addressed to resolve the Mountain Pine Beetle (MPB) stewardship research issues. It also recommends a process for allocating funding, collaborating and communicating these issues.

This report, along with the *MPB Research Stewardship Needs Definition* report and the *Gap Analysis – Research Related Stewardship Issues for the Mountain Pine Beetle (MPB) Infestation* report, forms the major deliverables of the MPB Research Strategy project.

This strategy is a living document, i.e, it will undergo periodic review and update when new issues emerge or when knowledge gaps are filled. It focuses on stewardship issues related to the environment and ecosystems and therefore is expected to address many issues that may be of concern to First Nations. However, First Nations have not had an opportunity to provide input into the strategy. Since the strategy will be updated periodically, First Nations input will be considered and incorporated into the strategy as MPB-related planning and implementation activities continue.



2. Acknowledgements

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4. Introduction

The Mountain Pine Beetle (MPB) epidemic in British Columbia is the largest forest insect infestation in Canada's history. As of late 2004, the mortality estimates for pine on the timber harvesting landbase are just under 300 million m³. The epidemic now affects an area of forest larger than the size of Sweden. Many stewardship research issues related to the MPB epidemic have arisen.

The publication of *British Columbia's Mountain Pine Beetle Action Plan 2005-2010* in early 2005 set a course of action to mitigate the epidemic's impact on forest values, communities, and the provincial economy in the short term, and ensure sustainability in the long term.

The development of this strategy for MPB research responds to the Ministry of Forest's recognition of the need to bridge the gap between the existing knowledge and the knowledge required to resolve the MPB stewardship research issues.

The *MPB Research Stewardship Needs Definition* report documented the MPB stewardship research issues and MPB research projects. The analysis identified 112 stewardship research issues and 132 research projects. This report was validated by the clients and forest science discipline experts.

The needs analysis and existing forestry research knowledge were analyzed to determine the extent to which the stewardship research issues can be resolved, and what additional knowledge was required to fill the knowledge gaps. The knowledge gaps are documented in the *Gap Analysis - Research Related Stewardship Issues for the Mountain Pine Beetle (MPB) Infestation* report.



5. Purpose of the Strategy

The purpose of this strategy is to identify the research required to resolve MPB stewardship issues. The strategy could aid research organizations in establishing internal research priorities and could help coordinate province-wide projects.

Another primary role of the research strategy is to help funding agencies co-ordinate and shift priorities so that the 2005-2010 Action Plan objectives are realized.

The strategy focuses on stewardship issues. Socio-economic and policy issues are not addressed. Although wildfire management is recognized as an important stewardship responsibility, it is not addressed in this strategy. However, wildfire research issues will be covered in the Forests For Tomorrow research strategy (under development) and will be integrated into this strategy.



6. Strategy Framework - MPB Action Plan Objectives

The government of B.C. has developed the *British Columbia's Mountain Pine Beetle Action Plan 2005-2010*. This plan is intended to provide a high level framework to direct provincial ministries and to assist coordination between government, industry and stakeholders. The plan provided a framework under which this strategy was developed.

The *Action Plan* sets out seven objectives:

1. Encourage long-term economic sustainability for communities affected by the epidemic.
2. Maintain and protect public health, safety and infrastructure.
3. Recover the greatest value from dead timber before it burns or decays, while respecting other forest values.
4. Conserve the long-term forest values identified in land use plans.
5. Prevent or reduce damage to forests in areas that are susceptible but not yet experiencing epidemic infestations.
6. Restore the forest resources in areas affected by the epidemic.
7. Maintain a project management structure that ensures co-ordinated and effective planning and implementation of mitigation measures.

The action plan and additional information about the government's response to the epidemic are available at

http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/.



7. Research Structure and Priorities

7.1. Research Structure

We defined nine generic discipline groupings of research and, within each discipline, identified research needs.

The nine discipline groupings are:

- **Hydrology, Geomorphology, & Fisheries** – research in fish-forestry interactions, watershed processes, and aquatic ecology.
- **Soils** – research to improve knowledge of soil and its role in forest ecosystem function, productivity, and effective management.
- **Wildlife, Ecology, Range, Biodiversity** – ecological research activities related to landscape biodiversity (including old growth and rangelands) and wildlife habitat.
- **Silviculture, Growth & Yield** – research to provide the tools and information to make sound resource management decisions in the practice of controlling forest establishment, composition, and growth.
- **Strategic Analysis, Planning, Decision Support** – research to create and implement tools and information to facilitate landscape level planning.
- **Climate** – research to link land resources to the global climate, and also aid assessment of the effects of future climate changes on forest ecosystems.
- **Entomology** – research on the effects of insects on trees and forests, in particular focusing on the operational problems in managing affected stands and evaluating treatment options.
- **Genetics** – research in tree breeding and genetic improvement, gene conservation, and seed transfer and climate change.
- **Shelf Life** – research into the length of time after death that a tree will have a productive use (e.g. sawlogs, OSB, pulp, bio-fuels, habitat).



7.2. Research Priorities

The discipline experts ranked the knowledge gaps in each of the disciplines as high, moderate or low based on importance and urgency. The moderate and low ranked research gaps are consolidated and summarized in the appendix.

Table 1 shows the number of knowledge gaps for each discipline area by priority ranking.

• **Table 1** Number of detailed knowledge gaps by discipline area.

Research Discipline Area	Priority Ranking		
	High	Moderate	Low
Hydrology, Geomorphology, and Fisheries	11	1	6
Soils	0	3	10
Wildlife, Ecology, Range & Biodiversity	4	0	0
Silviculture, Growth & Yield	12	1	3
Strategic analysis, Planning, Decision Support	4	4	2
Climate	0	5	3
Entomology	6	5	4
Genetics	0	0	2
Shelf Life	1	0	0

Table 2 contains a consolidated summary of the high priority knowledge gaps.

• **Table 2** Consolidated summary of high priority knowledge gaps

Knowledge Gaps	MPB Action Plan Objective
Hydrology, Geomorphology, and Fisheries	
1. Impacts of MPB infestation and salvage harvesting on the hydrological cycle (snow accumulation/melt, rainfall, evapo-transpiration, groundwater regime, water yield, and peak flows) at the watershed and landscape scale.	4,6



Knowledge Gaps	MPB Action Plan Objective
2. Impacts of MPB infestation and salvage harvesting on riparian and stream channel physical processes (water quality, large woody debris dynamics, shade, air and water temperatures, understory vegetation, sediment production and delivery, channel stability/destabilization, and water chemistry).	4,6
3. Impacts of MPB infestation and salvage harvesting on riparian and stream channel biological conditions and processes (alteration to fish spawning and rearing habitat, fish species composition and spatial distributions, and aquatic communities).	4,6
4. Modelling of potential impacts and generation of risk analysis for the hydrological, geophysical, and aquatic resources of MPB infested areas at the watershed and landscape scales.	4,6
5. Development of indicators for riparian function, water quality, and aquatic ecosystem health to monitor the effects of beetles and salvage operations.	4,6
Wildlife, Ecology, Range & Biodiversity	
6. Impacts of alternative patterns of salvage harvest and no harvest at the landscape and stand scales on critical habitat for plants and animals.	4
7. Impacts of alternative patterns of salvage harvest and no harvest at the landscape and stand scales on ecological functioning.	4
Silviculture, Growth & Yield	
8. *Recruitment, development and health of natural and planted regeneration across a wide range of post-attack stand types and conditions (i.e., mixed species - salvaged; mixed species - unsalvaged; pine dominant - salvaged; pine dominant - unsalvaged) in different BEC zones.	6
9. *Growth, development, and health of residual stands (overstory and understory) across a wide range of post-attack stand types and conditions (i.e., mixed species - salvaged; mixed species - unsalvaged; pine dominant - unsalvaged) in different BEC zones.	6
10. *Silvicultural treatments and regimes, such as fertilization of non-lodgepole pine stands and treatment of repressed lodgepole pine stands, to accelerate operability and enhance mid-term timber supply	1, 6

* Knowledge gap is being partially addressed by existing projects. Funding should continue for these projects.



Knowledge Gaps	MPB Action Plan Objective
Strategic analysis, Planning, Decision Support	
11. The effect of MPB management activities on the leading edge of the outbreak, and the rate of progress of the leading edge.	5
12. Effect of forest management activities on the nature and extent of the current outbreak.	5
13. Allocation of the post-attack live volume to harvesting schedules.	1
14. Retention and salvage harvesting design at scales ranging from individual cutblocks through landscape units to entire management units (TSAs)	3
Entomology	
15. Understanding mechanisms and percentages of populations dispersing locally versus long distance.	5
16. Influence of micro-climate factors from various stand types and ages on MPBs emergence.	5
17. Success rate of MPB attack in young stands.	5
18. Effects of MPB in jack pine stands; insect physiology; brood success; fungi colonization; natural enemies etc.	5
19. Impact of global warming on MPB survival, virulence and distribution.	5
20. Detection of green-attacked stands before they become red-attacked.	5
Shelf Life	
21. The shelf-life of MPB-killed trees for the various forest products.	3



8. MPB Stewardship Research Issues Governance

8.1. Structure

The project team recommends the formation of a MPB - Research Issues Steering Committee comprised of management representatives from all MPB research funding agencies (e.g., Ministry of Forests and Range, Forest Investment Account, and MPB Initiative), which may have different funding objectives and strategies. B.C. government representation should include, at a minimum, members from the Research Branch and the Forests for Tomorrow program. Additional representation may be needed as the project management structure referenced in objective 7 of the MPB Action Plan is developed.

The mission of the steering committee would be to coordinate, promote and ensure collaboration in research to resolve MPB stewardship research issues, and to promote the extension of the research.

8.2. Functions

8.2.1. Reviewing the strategy

The steering committee would review the strategy annually to ensure that it adequately reflects current issues and priorities.

8.2.2. Collaboration

We recommend that steering committee members encourage collaborative multi-disciplinary research because many MPB issues are multi-disciplinary in nature. The Steering Committee should develop



partnerships with other MPB research agencies to promote collaboration and to help direct MPB research to the highest priority areas.

8.2.3. Coordination

The execution of projects across funding sources will be better coordinated by having representatives from all MPB funding agencies on the steering committee.

8.2.4. Extension

We recommend the implementation of a MPB Research Issues web page to provide a communication link between researchers and practitioners. The web page should contain an inventory of MPB stewardship research issues and corresponding research results. The web page will provide funding agencies, researchers, clients of MPB mitigation initiatives, and others with a forum to discuss and draw conclusions for decision making, bridging knowledge gaps, and identifying future research needs.

8.3. Benefits

The benefits of the steering committee will be:

Consistent Priorities amongst all funding agencies for allocating research funding.

Expertise in all relevant forest research disciplines. The partners will bring additional expertise in MPB research.

Experience in co-ordinating research. The steering committee and proposed partners currently co-ordinate many MPB research projects.



9. Appendix

• Table 3 Consolidated Summary of Moderate Priority Knowledge Gaps

Knowledge Gaps

Hydrology, Geomorphology, and Fisheries

- Impact of mass wasting processes and delivery of sediment and debris to stream channels on amount and frequency of alterations to fish spawning and rearing habitats.

Soils

- Assessment of extent and severity of soil disturbance due to salvage harvesting, particularly on wet or moist soils, and evaluate different harvesting methods and timing to ameliorate disturbance.
- Impact of accelerated access road construction on erosion, sedimentation, and landslides.

Silviculture, Growth and Yield

- Reducing the risk of future MPB outbreaks using silviculture techniques such as harvesting patterns, species selection, and stand management.

Strategic Analysis, Planning, Decision Support

- Extent of pine at risk of attack, considering climate change, mixed species, young stands, etc.
- Heterogeneity of mortality in pure and mixed stands.
- Allocation of salvaging operations to harvesting schedules.
- Data (mortality, regeneration, etc.) needed for calibration of stand and landscape level models to assess silvicultural activities to mitigate future AAC impacts.
- Prediction methods to determine forest values (i.e., shelf life, including beyond commercial products) of stands.

Climate

- Influence of increased salvage and use of wood on the carbon balance.
- Species-specific climate response surfaces and growth models that explicitly include climate.
- Inter- and intra-specific seed source testing to find seed that is compatible with the future climate.

Entomology

- Climate data to help predict MPB dispersal.
- Continue support for projects that examine the startup and establishment mechanisms of the outbreak.



Knowledge Gaps

- Numeric decision-support systems to decide when to switch from single-tree treatments/small patch techniques.
- Investigate other outbreak collapses with unknown causes to determine if other factors are at work that may cause the collapse.
- Continued support into reliable prediction models for different conditions that influence infestations.

• **Table 4 Consolidated Summary of Low Priority Knowledge Gaps**

Knowledge Gaps

Hydrology, Geomorphology, and Fisheries

- Effects of rising water tables and increased runoff on landslide frequency (deep-seated failures, gully processes, failures associated with roads).
- Effect of increased mass wasting on stream channel morphology and riparian areas through changes in sediment production and delivery from hillslopes and large woody debris dynamics.
- Consequences for channel destabilization through changes in erosion and deposition processes.
- Changes in windthrow dynamics in stands killed by MPB with respect to riparian-aquatic ecosystem interactions.
- Effects on riparian and aquatic ecosystem function from shifts in riparian plant species, including effects related to dead standing trees.
- Consequences on aquatic biota from warming of pooled surface water in floodplains resulting from elevated water tables.

Soils

- Levels of morel production in MPB-killed stands.
- Confirm that morel production on stands where prescribed fire is used is consistent with current state of knowledge.
- Assess whether MPB survey photos can be used for soil disturbance assessments.
- Effect of higher burn intensity in MPB stands on soil productivity.
- Assess whether there will be regeneration and site productivity problems on toe slopes that have become waterlogged due to higher water tables and increased runoff.
- Assess whether water-logged soils can be identified using surface drainage patterns and water table elevation.
- Levels of pine mushrooms in beetle-proofed stands.
- Effect of CWD on soil productivity, soil development, ground microclimate, and erosion in logged and unsalvaged areas.

**Knowledge Gaps****Silviculture, Growth and Yield**

- Impact of site preparation for promoting regeneration.
- Susceptibility of residual stands to windthrow.
- Potential for using fast-growing broadleaf and coniferous hybrids to enhance mid-term timber supply.

Strategic Analysis, Planning, Decision Support

- The proportion of annual area and volume of timber affected by the MPB outbreak that is on the timber harvesting landbase.
- Timber supply impacts of MPB in young stands.

Climate

- Conversions from biomass to carbon stock and flow modelling to assess losses of carbon.
- Impact of continued warming on reforestation in dry subzones and dry sites with different species.

Entomology

- Survival rates and repercussions of MPB after processing of timber (e.g. in hog fuel).
- Continued support into research on comparing and evaluating methods of detecting MPB-attacked stands.
- Alternatives to MSMA that are more environmentally friendly.
- Methods of treating high-value trees to prevent or avoid attack.

Genetics

- Identification of MPB-resistant genotypes and subsequent modification of orchards to breed trees with higher levels of resistance.
- Development of markers and models that may be able to predict reductions in genetic diversity in MPB-attacked stands.