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# Mountain Pine Beetle: Linking Recent and Current Projects to Identified Needs

## Version 3

# **Mountain Pine Beetle: Linking Recent and Current Projects to Identified Needs**

## **Version 3**

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Alan M. Wiensczyk and Jillian  
Merrick



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## ABSTRACT

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In the late fall of 2004, FORREX Forest Research Extension Partnership was approached by the Forest Science Board to gather information about research and extension activities currently addressing the needs of practitioners around the province to help determine if the Province's needs for research on mountain pine beetle (MPB) to combat the current infestation are being adequately addressed by the Forest Science Program and the Federal Government's Mountain Pine Beetle Initiative (MPBI). In October 2005, FORREX was asked to update the original File Report for the Mountain Pine Beetle Epidemic and the Future of Communities and Ecosystems: Research Synthesis and Strategy Workshop series. In February 2008, FORREX updated the report a second time in order to capture information on the many new mountain pine beetle projects that have been conducted over the past two years and in preparation for the conference "Mountain Pine Beetle: From Lessons Learned to Community-based Solutions". This report (Version 3) builds on the previous versions and includes information on new projects as well as new information on research and knowledge gaps identified through other processes and projects. Many groups are involved in answering questions related to the mountain pine beetle and funding sources are varied.

Using a coarse filter approach, funded projects directly related to mountain pine beetle and conducted within the last five years were classified according to a series of 23 topic areas which corresponded to priority information needs identified by forestry practitioners. A few projects older than five years and a few with an indirect relationship to mountain pine beetle were also included when they were found during the search process. A total of 399 related or closely related projects were found. Most of the projects (39%) received provincial funding from Forestry Innovation Investment and the Forest Investment Account (combined) while (36%) of the projects received funding from the federal Mountain Pine Beetle Initiative. There was at least one project in each topic area. Topic areas where projects have focussed include **product information/research** (95), **management, risk assessment and control strategies** (43), **hydrology** (30), and **detection methods** (22). Topic areas where work has been limited include **geomorphology** (2), **worker safety** (2), **access management** (4) and **climate change** (5). However, the report recognizes that the number of projects may not be a good indicator of information gaps. The B.C. Ministry of Forests and Range – Research Branch has published a Mountain Pine Beetle Stewardship Research Strategy in which they identified 38 high-priority, 19 moderate-priority, and 30 low-priority knowledge gaps related to mountain pine beetle and forest stewardship. How the recent and current projects included in this report address these gaps is discussed. Several recommendations for activities to determine gaps are made in the report.

A comprehensive review of the available literature on mountain pine beetle is also required to ensure that some of the current information needs have not already been addressed by previous studies. After this is complete, an analysis of what is known and what is unknown can be conducted to determine if there is a research need or an extension need. A mountain pine beetle extension plan, which is also needed to ensure that existing information is being efficiently and effectively communicated to those who need it, is currently being developed by FORREX.

### *Citation—*

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# 1 INTRODUCTION

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The Forest Science Board was asked by British Columbia's Deputy Minister of Forests in the fall of 2004, to determine whether the Province's needs for research on mountain pine beetle (MPB) to combat the current infestation are being adequately addressed by the Forest Science Program and the federal government's Mountain Pine Beetle Initiative (MPBI). The Forest Science Board approached FORREX to gather information about research and extension activities currently addressing the needs of practitioners around the province. In response to that request, FORREX produced the report: *Mountain Pine Beetle: Linking recent and current projects to identified needs* by Wiensczyk (2005).

In October 2005, FORREX was asked to update the original report for the "Mountain Pine Beetle Epidemic and the Future of Communities and Ecosystems: Research Synthesis and Strategy Workshop" series, an event co-sponsored by the University of British Columbia and the University of Northern British Columbia with funding from the Forest Investment Account–Forest Science Program. In February 2008, FORREX updated the report a second time in order to capture information on the many new mountain pine beetle projects that have been conducted over the past two years and in preparation for the "Mountain Pine Beetle: From Lessons Learned to Community-based Solutions" Conference scheduled for June 2008. This report (Version 3) builds on the previous versions and includes information on new projects as well as new information on research and knowledge gaps identified through other processes and projects.

There are many groups involved in answering questions related to the mountain pine beetle. Some have been funded under the provincial Forest Science Program or under the Natural Resources Canada–Canadian Forest Service Mountain Pine Beetle Initiative while others have found alternative funding sources. These groups include the B.C. Ministry of Forests and Range, the B.C. Ministry of Agriculture and Lands including the Integrated Land Management Bureau, the B.C. Ministry of the Environment, the McGregor Model Forest, the University of Northern British Columbia, the University of British Columbia, Simon Fraser University, and the University of Victoria as well as the Council of Forest Industries and many others. In order to determine if the province's research needs related to mountain pine beetle are being met, the projects being funded by alternate sources were also considered.

Funded projects were compared against natural resource managers' and practitioners' identified priority information needs with respect to mountain pine beetle. These needs, based on information gathered from a number of sources, have been summarized and classified into 23 topic areas that have been used throughout this report. Sources of information on priority needs include the Premier's Mountain Pine Beetle Symposium held in Quesnel in November 2003 and the "Mountain Pine Beetle Symposium: Challenges and Solutions" which took place in Kelowna in October 2003. Also included is the client technical needs assessment conducted by FORREX in 2004 (Morford *et al.* 2004) as well as discussions at the Mountain Pine Beetle workshop held in Prince George in 2005 and summarized by Thompson and Moshenko (2005). Information was also gathered from the B.C. Ministry of Forests and Range Mountain Pine Beetle Web site ([http://www.for.gov.bc.ca/hfp/mountain\\_pine\\_beetle/](http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/)), the federal government's Mountain Pine Beetle Initiative Web site ([http://mpb.cfs.nrcan.gc.ca/index\\_e.html](http://mpb.cfs.nrcan.gc.ca/index_e.html)), and the First Nations Forestry Council Web site (<http://www.fnforestrycouncil.ca/home.php>). Input on priority information needs was also gathered from discussions with members of the Mountain Pine

Beetle Task Force and from members of FORREX's Forest Resources Dynamics Working Group. Additional sources of information on priority research needs and gaps used in the updated version of the report include the Forest Science Board's *Mountain Pine Beetle Eligible Research Topics 2006/07* guidelines (Forest Science Board 2005), the Ministry of Forests and Range *Mountain Pine Beetle Stewardship Research Strategy* (B.C. Ministry of Forests and Range 2005) and its supporting documentation, *Strategies for Managing Mountain Pine Beetle: Efficacy and Economics – summary report* (Mitchell and Stjernberg 2005), and the report, *Projects to mitigate the impact of the mountain pine beetle infestation – an overview* (CrossRoads Strategies Group Inc. 2004).

This updated report summarizes the research and extension activities occurring in British Columbia to date and compares them with the client-identified priority information needs.

### **1.1 Project Objectives**

The project was designed to address the following objectives. As a result of this project:

- 1) Readers will have increased knowledge of which questions, based on the priority information needs identified by practitioners and researchers relating to the mountain pine beetle, are being or have been answered by projects funded through the FIA–Forest Science Program and Mountain Pine Beetle Initiative.
- 2) Readers will have increased knowledge of which questions relating to the mountain pine beetle are being or have been answered by projects funded through alternate sources.
- 3) Readers will have increased knowledge of the subject areas relating to mountain pine beetle where projects have focussed and the subject areas where projects have been limited.

### **1.2 Project Scope**

This project concentrated on current and recently completed MPB-related projects conducted within the past 5–7 years, although a few projects older than that were also included where adequate information on the project was available. A few non-MPB-related projects were also included where it was felt that the results were applicable to address current MPB issues. In addition, there are many other research and operational trials scattered throughout the province which could be used to provide baseline data to help determine the effects of the mountain pine beetle on a variety of factors. These will need to be thoroughly reviewed individually to determine applicability. A list of some potential research installations and other trials that could be applicable, based on data used in the development of the B.C. Ministry of Forests and Range's *Mountain Pine Beetle Stewardship Research Strategy*, is included in Appendix A.

The assessment did not involve collecting and reviewing all of the existing published literature on MPB. The amount of published material on MPB both in Canada and United States is quite extensive, and a comprehensive review of the material was beyond the scope of this project. However, in recognition of this need, a database of published literature on mountain pine beetle has been compiled and is now available through the Mountain Pine Beetle Information Portal ([www.forrex.org/mpb](http://www.forrex.org/mpb)). There are also several funded projects in the list that were designed specifically as literature reviews and syntheses. In addition, it is expected that the majority of the other projects also involved a review of the pertinent literature.

## 2 METHODS

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Information on past and current MPB projects was gathered from a variety of sources. Sources included: the Natural Resources Information Network (NRIN) (<http://www.forrex.org/nrin>); the Mountain Pine Beetle Initiative Web site ([http://mpb.cfs.nrcan.gc.ca/index\\_e.html](http://mpb.cfs.nrcan.gc.ca/index_e.html)); the Forest Investment Account–Forest Science Program Web site (<http://www.bcfsp.com/Login/login.asp>); the Forestry Innovation Investment Ltd. Web site (<http://www.bcfii.ca/>); the McGregor Model Forest Association bark beetle links Web site (<http://www.barkbeetlelinks.ca>); a Google™ search for mountain pine beetle; discussions with Provincial and Northern Interior regional government experts and the Mountain Pine Beetle Initiative research project co-ordinator; as well as correspondence with University of Northern British Columbia Masters students. Information on MPB projects was also obtained from the proceedings of the “Mountain Pine Beetle Symposium: Challenges and Solutions” conference held in Kelowna on October 30-31, 2003 (Shore *et al.* 2004), from presentations given at the “Mountain Pine Beetle Research Update: An Operational Perspective” workshop held in Prince George on January 25, 2005, from the December 2004 report by CrossRoads Strategies Group Inc. for Forestry Innovation Investment Ltd. entitled *Projects To Mitigate The Impact Of The Mountain Pine Beetle Infestation – An Overview*, from the B.C. Ministry of Forests and Range *Mountain Pine Beetle Stewardship Research Strategy* as well as its supporting documentation, and from the Canadian Forest Service *Mountain Pine Beetle Initiative – Interim report 2005*.

Using a coarse filter approach, projects were classified according to a series of topic areas (Table 1). The table also includes an explanation and examples of some specific subject areas that would fit under each topic area. The list of topic areas reflecting priority information needs identified by forestry practitioners was derived, in part, from the personal knowledge of the author and from ideas and input from FORREX’s Forest Resource Dynamics Working Group, members of which represent forest industry, provincial and federal governments, academia, NGOs, and the consulting community. Input was also received from members of the provincial Mountain Pine Beetle Task Force and through the review of the *Mountain Pine Beetle Initiative – Epidemic Risk Reduction and Value Capture R&D Strategy* (Natural Resources Canada 2004), the proceedings of the “Mountain Pine Beetle Symposium: Challenges and Solutions” (Shore *et al.* 2004), *Strategies For Managing Mountain Pine Beetle: Efficacy And Economics – Summary Report* (Mitchell and Stjernberg 2005), the B.C. Ministry of Forests And Range *Mountain Pine Beetle Stewardship Research Strategy* (B.C. Ministry of Forests and Range – Research Branch 2005) and supporting documentation and reports, the FIA–FSP *Guidelines for Mountain Pine Beetle Research: Eligible research topics 2006/07*, and a draft report by McGarrity and Hoberg (2005) entitled *The beetle challenge: An overview of the mountain pine beetle and its implications*. Some overlap between topic areas is possible.

The list of topics was further subdivided into three hierarchical classifications based on how the information would be used within the context of sustainable forest management. Projects that fall under the strategic level classification are those that concern broad-scale, long-term objectives or desired future conditions. Tactical-level projects involve the collection, tracking, analysis, and interpretation of data and information in support of strategic-level objectives and operational practices. Information from these projects, although usually site-specific, often requires further work before the results can be used to change operational-level practices, whereas projects classified under operational-level topics have direct site-specific applicability or can be applied immediately at the operational level. The reader should keep in mind that this is a very coarse classification and some topic areas may have associated projects or subject areas that fit better at a different level. However, rather than have the same topic area listed under multiple classifications, levels were assigned based on the majority of the given examples. The explanation and examples provided are not meant to be a

comprehensive list of all possible subjects that could fit within the particular topic area, but are intended to provide the reader with a general idea of the basis for the classification of the projects.

**TABLE 1** *Topic areas for classification of mountain pine beetle projects*

<b>Topic area</b>	<b>Explanation and examples</b>
<b>Strategic-level Topics</b>	
Natural structural stand dynamics and ecosystem function	<ul style="list-style-type: none"> <li>• Includes successional patterns</li> <li>• MPB as a natural disturbance agent</li> </ul>
Biodiversity and wildlife	<ul style="list-style-type: none"> <li>• Impacts on general wildlife populations and habitat</li> <li>• Includes viability of ungulate winter range in MPB-killed stands</li> <li>• Biodiversity</li> <li>• Coarse old woody debris</li> <li>• Old growth management areas</li> <li>• Impact on non-timber forest products such as mushrooms (direct and indirect)</li> </ul>
Species at Risk	<ul style="list-style-type: none"> <li>• Specific projects dealing with species listed in <i>SARA</i></li> </ul>
Socio-economics	<ul style="list-style-type: none"> <li>• Impacts on forest-dependent communities</li> <li>• Recreation and tourism</li> <li>• Range values (removal of natural barriers, forage production, spread of invasive species, etc.)</li> <li>• Visual quality objectives</li> <li>• Public perceptions of epidemic</li> <li>• Secondary impacts of MPB infestation (e.g., hydrological changes, homes, bridges and culverts, safety issues around increased harvesting and hauling, drinking water quality)</li> </ul>
Timber supply	<ul style="list-style-type: none"> <li>• Decision-support systems</li> <li>• Growth and yield</li> <li>• Forest inventory</li> <li>• (Linkages with shelf life issues)</li> </ul>
Climate change	<ul style="list-style-type: none"> <li>• Role of climate change in affecting current and future outbreaks</li> <li>• Loss of carbon</li> <li>• Impact on reforestation decisions</li> </ul>
Access management	<ul style="list-style-type: none"> <li>• Increased numbers of roads due to salvage activities</li> <li>• Potential for duplication if access between licensees is not co-ordinated</li> </ul>
<b>Tactical-level Topics</b>	
MPB biology	<ul style="list-style-type: none"> <li>• Flight and dispersal characteristics</li> <li>• Pheromones</li> <li>• Host resistance (e.g., genetics)</li> <li>• Tree age and size impacts</li> <li>• Interaction between different species of beetles and MPB</li> </ul>
MPB and other pine species	<ul style="list-style-type: none"> <li>• Effects of MPB on other pine species, e.g., whitebark pine, western white pine</li> </ul>
Population dynamics	<ul style="list-style-type: none"> <li>• Modelling population spread</li> <li>• Modelling dispersal patterns</li> </ul>
Detection methods	<ul style="list-style-type: none"> <li>• Alternative remote sensing capabilities</li> </ul>

<b>Topic area</b>	<b>Explanation and examples</b>
Fuel loading and fire behaviour	<ul style="list-style-type: none"> <li>• Forest fire risk in fully and partially MPB-killed stands</li> <li>• Strategies to minimize future large-scale wildfire risk</li> <li>• Fire behaviour in stands should a wildfire occur</li> </ul>
Hydrology	<ul style="list-style-type: none"> <li>• Water table and operable ground (change between summer and winter ground)</li> <li>• Watershed assessments and models</li> <li>• Roads and crossings, harvesting</li> <li>• Water quantity (peak and low flows, timing of flows)</li> <li>• Water quality – sediment, temperature</li> <li>• Biological components – fish and fish habitat, aquatic invertebrates, nutrients</li> <li>• Hydrologic recovery</li> <li>• Riparian management, including windthrow dynamics and indicators for riparian function development</li> </ul>
<b>Operational-level Topics</b>	
Shelf life	<ul style="list-style-type: none"> <li>• Viability of standing dead MPB-killed trees</li> </ul>
Management, risk assessment and control strategies	<ul style="list-style-type: none"> <li>• ‘Beetle-proofing’ the future landscape</li> <li>• Chemical repellents</li> <li>• Risk assessment models, determination of stand susceptibility</li> <li>• Management strategies and plans (includes info on how to reduce potential for future MPB outbreaks)</li> </ul>
Geomorphology	<ul style="list-style-type: none"> <li>• Terrain stability on steep slopes of MPB-killed stands</li> <li>• Soil management (site disturbance)</li> <li>• Stream geomorphology (LWD, channel and bank stability)</li> </ul>
Regeneration	<ul style="list-style-type: none"> <li>• Amount and growth of regeneration (new and advanced)</li> <li>• Natural vs. artificial</li> <li>• Assessment procedures and survey methods</li> </ul>
Silvicultural options/restoration	<ul style="list-style-type: none"> <li>• Incremental treatment effects (e.g., fertilization, spacing)</li> <li>• Effects of no treatment – what happens if just left as is (linkage to natural stand dynamics)</li> </ul>
Salvage and ecosystem function	<ul style="list-style-type: none"> <li>• What to harvest/salvage as it relates to maintaining ecosystem function and biodiversity</li> <li>• Where to leave retention areas and wildlife tree patches</li> </ul>
Harvesting, hauling, and storage	<ul style="list-style-type: none"> <li>• Harvesting safely</li> <li>• Reducing breakage</li> <li>• Haul load weight issues</li> <li>• Prevention of excessive drying while in storage</li> </ul>
Product information/research	<ul style="list-style-type: none"> <li>• Fibre quality (suitability for current products)</li> <li>• Technology</li> <li>• Alternate uses</li> <li>• Blue stain</li> <li>• Marketing – managing real and perceived issues of product quality and pest transfer concerns</li> </ul>
Worker safety	<ul style="list-style-type: none"> <li>• Silviculture workers and WCB</li> </ul>
<b>General Extension Activities</b>	<ul style="list-style-type: none"> <li>• General (not specifically related to another topic area) workshops, displays, presentations on mountain pine beetle</li> </ul>

### 3 RESULTS

A total of 399 projects were found that either directly related to the mountain pine beetle or whose results were closely related or easily applicable to mountain pine beetle (Table 2). Multi-year projects were counted as one project (a notation in the table indicates that they are multi-year projects). In addition, some projects listed were still in the planning/proposal stages and a notation to that effect has been made in the table. Several projects, which could be used to provide baseline data to assist in the evaluation of mountain pine beetle impacts, were also found but were not included in the table. These projects are listed separately in Appendix A. The greatest number of projects was classified under **product information/research** (95), followed by **management, risk assessment and control strategies** (43), and **hydrology** (30) (Figure 1). These three topic areas accounted for 43% of the total number of projects. There was at least one project in each of the topic areas.

**TABLE 2** *Summary of mountain pine beetle projects by topic area*

<b>Strategic-level projects</b>			
<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
<b>NATURAL STRUCTURAL STAND DYNAMICS AND ECOSYSTEM FUNCTION</b>			
Analysis and synthesis of information on stand dynamics following mountain pine beetle outbreaks in British Columbia	Rene Alfaro	Canadian Forest Service (CFS)	MPBI
Historical frequency, intensity and extent of MPB disturbance in landscapes of British Columbia and Alberta	Rene Alfaro	CFS	MPBI
Effects of fire return rates on forest age distribution and on the susceptibility of lodgepole pine stands to attack by the mountain pine beetle	Hugh Barclay	CFS	MPBI
MPB stand dynamics in Kootenay and Waterton Lakes National Park	Brad Hawkes	CFS	MPBI
Possible future forests: Balancing biological and social risks in mountain pine beetle epidemics	Hamish Kimmins	UBC	MPBI
The influence of mountain pine beetle on stand dynamics in Rocky Mountain National Parks, Canada	Pamela Dykstra	Parks Canada	MPBI
Mountain pine beetle impacts on young age class pine leading stands in the SBS biogeoclimatic zone	Chris Hawkins	University of Northern British Columbia (UNBC)	FIA-FSP (2007/08)
Stand dynamics following mountain pine beetle outbreaks in central British Columbia	Rene Alfaro	CFS	FIA-FSP (2007/08)
Balancing disturbances in forest management	V.G. Nealis	CFS	FIA-FSP (2007/08)
Stand and forest dynamics following MPB: How spatial patterns of salvage harvesting affect Warren root collar weevil pressure in regenerating stands	Brian Aukema	CFS	FIA-FSP (2007/08)

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Stand to landscape level effects of the mountain pine beetle (MPB) outbreak in central British Columbia	Chris Hawkins	UNBC	FIA-FSP (2005/06)
Development and Analysis of a British Columbia Natural Disturbance Database (4th year of project)	Steve Taylor	CFS	FIA-FSP (2004/05)
Quantification of disturbance processes along a temperature and moisture gradient in Sub-Boreal spruce	Kathy Lewis	UNBC	FIA-FSP (2004/05)
Impacts of Mountain Pine Beetle Attack on Stand and Ecosystem Dynamics – multi-year project 2002-2004	Brad Hawkes	CFS	FII (2002-2004)
Impacts of mountain pine beetle attack on stand and ecosystem dynamics in southeastern British Columbia	Brad Hawkes	CFS	FII (2003)
Tolko Industries (Okanagan) mountain pine beetle impact analysis	Cam Brown	Forsite Consultants Ltd	FIA (2004/05)
Within Stand Properties of Natural Disturbance in Arrow TSA	Eliot McIntire Jane Miller	Consultants	Arrow IFPA (2000)
Strategic landscape level design – Testing the value of strategic harvest in mitigating MPB impact for protecting multiple values, including the mid term supply in the Vanderhoof Forest District	Craig DeLong	B.C. Ministry of Forests and Range (BC MFR)	Forests for Tomorrow
West Arm Demonstration Forest: Development and Coordination Proposal ( <i>complete – publication produced</i> ) – “Application of natural disturbance processes to a Landscape Plan: The Dry warm Interior Cedar–Hemlock subzone (ICHdw) near Kootenay Lake, BC”	Harry Quesnel and Heather Pinnell	West Arm Demonstration Forest	FRBC (2000)
Mountain Pine Beetle risk in the foothills of Alberta	Dave Andison	Foothills Model Forest	Foothills Model Forest (2002-2007)

## **BIODIVERSITY AND WILDLIFE**

Decision support tool for managing biodiversity and ecosystem resilience in mountain pine beetle-susceptible landscapes.	Ann Chan-McLeod	UBC	MPBI
Integrating silvicultural control of mountain pine beetle with wildlife and sustainable forest management objectives	Fred Bunnell	University of British Columbia (UBC)	MPBI
Potential Approaches to Integrating Silvicultural Control of Mountain Pine Beetle with Wildlife and Sustainable Management Objectives	Ann Chan-McLeod Fred Bunnell	UBC	MPBI
Potential Approaches to Integrating Silvicultural Control of Mountain Pine Beetle with Wildlife and Sustainable Management Objectives	Ann Chan-McLeod Fred Bunnell	UBC	MPBI
Predicting biodiversity maintenance after bark beetles and MPB management	Kathy Martin	UBC	FIA-FSP (2007/08)
Assessing the effectiveness of management strategies in creating and maintaining stand-level biodiversity on large-scale mountain pine beetle cutblocks in the Arrow Boundary Forest District	John Innes	UBC	FIA-FSP (2007/08)
Effects of Cumulative Disturbances on an Endangered Whitebark Pine – Cladina Lichen Ecosystem	Sybille Haeussler	UBC	FIA-FSP (2007/08)

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Developing Retention Strategies to Maintain Landscape-Level Wildlife Habitat and Biodiversity During the Salvage Harvesting of Mountain Pine Beetle Attack Areas in the Southern Interior Forest Region	Walt Klenner	BC MFR	FIA-FSP (2007/08)
Implications on Grizzly bears and Moose of Forest Management in Response to the 1970s Mountain Pine Beetle Infestations in the Flathead Drainage	Bruce McLellan	BC MFR	FIA-FSP (2007/08)
Developing Molecular Tools to Help Determine the Effect of Natural Disturbance on Pine Mushroom (NTFP) Distribution and Sustainability	Bill Chapman	BC MFR	FIA-FSP (2007/08)
Understanding the spatial and quality attributes of culturally important non-timber forest product species in mountain pine beetle affected areas of the Cariboo-Chilcotin	Wendy Cocksedge	Royal Roads University	FIA-FSP (2007/08)
Tsi Del Del Furbearer DNA Pilot Project 2002/2003 Summary Report	Larry Davis Phillip Theriault	Consultant (DWB) Riverside Forest Products	FIA (2003/04)
Tsi Del Del Furbearer Track Transect Project 2002/2003 Summary Report	Larry Davis Phillip Theriault	Consultant (DWB) Riverside Forest Products	FIA (2003/04)
Stand Level Habitat Use By Furbearer Species In The Anahim Lake Area Of British Columbia	Larry Davis	Consultant (DWB)	FIA (2002)
Stem mapping of MPB affected pine mushroom patches	Bill Chapman	BC MFR	Forests for Tomorrow
Verification of the map of predicted pine mushroom producing areas in the West Chilcotin	Bill Chapman	BC MFR	Forests for Tomorrow
Nest tree dynamics in the ICH (complete – publication in <i>Journal of Wildlife Management</i> )	Christoph Steeger Christine Hitchcock	Consultant Canadian Wildlife Service	FRBC (1998)
<b>SPECIES AT RISK</b>			
Implications of salvage scale: Mountain pine beetle and integrity of woodland caribou winter ranges	Scott McNay	McGregor Model Forest Association	FIA-FSP (2007/08)
Mountain pine beetle as an agent of enhanced hair lichen biomass, with implications for the winter ecology of mountain caribou	Andre Arsenault	BC MFR	FIA-FSP (2007/08)
Effects of a mountain pine beetle epidemic on Northern Caribou habitat use, migration and population status	Deborah Cichowski	Bulkley Valley Centre for Natural Resources Research and Management (Bulkley Valley Centre)	FIA-FSP (2007/08)
Response of woodland caribou to partial retention logging of winter ranges attacked by mountain pine beetle	Dale Seip	BC MFR	FIA-FSP (2007/08)

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Silvicultural systems to maintain northern caribou habitat in lodgepole pine forests in central B.C.	Michaela Waterhouse	BC MFR	FIA-FSP (2007/08)
Enhancing the resiliency of the Tweedsmuir-Entiako caribou to the current Mountain Pine Beetle outbreak	Don Morgan	Bulkley Valley Centre	FIA-FSP (2007/08)
Effects of a mountain pine beetle epidemic on forest floor vegetation dynamics and regeneration in the Itcha-Ilgachuz caribou winter range in the Quesnel TSA	Deborah Cichowski	Bulkley Valley Centre	FIA-FSP (2006/07)
The Response Of Caribou Terrestrial Forage Lichens To Forest Harvesting And Mountain Pine Beetles In The East Ootsa And Entiako Areas Annual Report - 2003/04 - Year 3	Patrick Williston Deb Cichowski Jennifer Lecuyer	Consultants  West Fraser Mills	FIA – 2003/04
Caribou Terrestrial Forage Study - Cariboo Region	John Youds	B.C. Ministry of Environment (BC MOE)	Forest for Tomorrow
Silvicultural Systems Research in the Cariboo Forest Region (Silvicultural Systems to Maintain Northern Caribou Habitat in Lodgepole Pine Forests in the MSxv and SBPSxc Subzones) (multi-year project) (1997 to present)	Michaela Waterhouse	BC MFR	Various

## **SOCIO-ECONOMICS**

Public perceptions of mountain pine beetle management alternatives	Michael Meitner	UBC	MPBI
Assessing the economic impacts of mountain pine beetle infestations and other natural disturbance in British Columbia: A regional, multi-regional and provincial analysis	Bill White	CFS	MPBI
Socio-economic dimensions of community vulnerability to mountain pine beetle	John Parkins	CFS	MPBI
Assessing the economic impacts of mountain pine beetle infestations and other natural disturbance in forest dependent regions of BC: Region-specific economic impact modeling within the emergency bark beetle management area	Bill White	CFS	MPBI
A Synthesis of Mountain Pine Beetle and Other Natural Disturbance Impacts on Community Stability - March 2003 (output from above)	Mike Patriquin	Consultant McGregor Model Forest	MPBI
The Economic Impact of Natural Disturbances - A Review and Synthesis of Policy Responses	Thomas Maness	UBC	MPBI
Indicators of community sustainability for the Morice and Lakes IFPA region		Morice and Lakes IFPA	IFPA (2004)
Omineca Beetle Action Coalition	Chair – Len Fox Manager - Elizabeth Andersen		Other
Cariboo-Chilcotin Beetle Action Coalition	Chair – Donna Barnett Manager – Keith Dufresne		Other
Southern Interior Beetle Action Coalition	Chair – David Laird Managers – Mickey Werstuik, Reiner Augustin		Other

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
First Nations Mountain Pine Beetle Initiative	Dan George		Other
Communities and Natural Resources in Transition: Linking social science, decision makers and practitioners for a sustainable future – Conference <a href="http://www.forrex.org/publications/filereports/fr04-04.pdf">http://www.forrex.org/publications/filereports/fr04-04.pdf</a>	Shawn Morford	FORREX	Various (2003)
Managing for Tomorrow – Conference, May 2004 <a href="http://web.unbc.ca/politicalscience/managingfortomorrow.html">http://web.unbc.ca/politicalscience/managingfortomorrow.html</a>	Gary Wilson	UNBC	Various (2004)

### **TIMBER SUPPLY**

Provincial scale mapping of post beetle forest structure and composition	Trisalyn Nelson	University of Victoria (UVic)	MPBI
Modeling the impacts of mountain pine beetle and potential management responses on forest values in Alberta's eastern slopes region	Stan Boutin	University of Alberta	MPBI
Stand management growth and yield field experiments in the B.C. interior	Robert Brockley	BC MFR	FIA-FSP (2006/07)
Improving juvenile tree growth prediction for complex mountain pine beetle damaged stands	David Coates	Bulkley Valley Centre	FIA-FSP (2005/06)
Improving predictions of juvenile tree growth in complex mixtures for sustainable forest management (indirect application to MPB)	Suzanne Simard	UBC	FIA-FSP (2004/05)
Calibrating PrognosisBC in the Sub-Boreal Spruce and the Sub-Boreal Pine-Spruce Biogeoclimatic zones (indirect application to MPB)	Abdel-Azim Zumrawi	BC MFR/ UBC	FIA-FSP (2004/05)
Strategic Harvest and Investment Planning (SHIP) (2003)	Jennifer LeCuyer	West Fraser Mills	FIA 2003/04
Prince George TSA Silviculture Strategy (Type 1) – Update March 2003	Barry Mills Bruce Bradley Rob Schutz	Consultant (IFS)	FIA 2003/04
Mountain Pine Beetle Management - Decision Support System (DSS) Tools Analysis	Jim Burbee	Tweedsmuir Forest Ltd.	FIA 2003/04
Timber Supply Analysis Report: Nicola-Similkameen Innovative Forestry Society Base Case and Innovative Timber Supply Analyses	Stewart Aird	Nicola-Similkameen Innovative Forestry Society	NS IFPA (2000)
Fertilization on Non-Mountain Pine Beetle Stands on the Prince George TSA Analysis	Bill Kuzmuk	Timberline Forest Inventory Consultants	Forests for Tomorrow
Simulating Natural Disturbance Dynamics and Evaluating Management Scenarios with the Robson Valley Landscape Model Year 1 Report	Marvin Eng Andrew Fall Glenn Sutherland	BC MFR	FRBC (2001)
AAC modeling and silvicultural strategies to address mountain pine beetle – Induced timber supply falldown in central British Columbia (graduate student thesis)	John Pousette Chris Hawkins	UNBC	Unknown (2005)

### **CLIMATE CHANGE**

Impacts of climate change on range expansion of the MPB – Internal	Allan Carroll	CFS	MPBI
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<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Impacts of climate change on range expansion of the MPB – Utah State	J.A. Powell		MPBI
Incorporating present and future climatic suitability into decision support tools to predict geographic spread and risk for the mountain pine beetle	Terry Shore	CFS	MPBI
Bark beetle response to climate change: A landscape-level risk model for British Columbia	Brian Aukema	UNBC	FIA-FSP (2007/08)
Climate Change Project	David Price	CFS	Foothills Model Forest (2004)

### **ACCESS MANAGEMENT**

Vanderhoof Forest District Access Management Plan	Traci Leys-Schirok	Integrated Land Management Bureau (ILMB)	FIA – Crown Land Use Planning Enhancement Program (CLUPE)
Prince George Forest District Consolidated Roads	Angela Smith-Rockwell	ILMB	BC MAL (2006)
Vanderhoof Forest District Consolidated Roads	Angela Smith-Rockwell	ILMB	BC MAL (2007)
Fort St James Forest District Consolidated Roads	Angela Smith-Rockwell	ILMB	BC MAL (2007)

## **Tactical-level Projects**

### **MOUNTAIN PINE BEETLE BIOLOGY**

Forecasting MPB overwintering mortality in a variable environment	Barry J. Cooke	CFS	MPBI
Terpenoid Defense in Pines as a Factor Affecting the Eastern Spread of the Mountain Pine Beetle	Dezene Huber	UNBC	MPBI
MPB outbreak development: The endemic-incipient transition	Allan Carroll	CFS	MPBI
The potential of <i>Ips mexicanus</i> to limit endemic MPB populations	Staffan Lindgren	UNBC	MPBI
Interactions between <i>Pseudips mexicanus</i> and mountain pine beetles in stressed lodgepole pine (UNBC grad student thesis)	Greg Smith Staffan Lindgren Allan Carroll	UNBC CFS	MPBI
Microbial impacts on larvae of mountain pine beetle	Richard Winder		MPBI
Environmental effects on dispersal and reproduction in MPB	Mary Reid	University of Calgary	MPBI
Geographic variation in the effect of tree size on MPB productivity in B.C. (grad student thesis)	Tim Cudmore Staffan Lindgren	UNBC	MPBI (partial)
Studying mountain pine beetle dispersal patterns through analysis of genetic markers: investigation of population structure and examining current dispersal assumptions	Brent Murray	UNBC	FIA-FSP (2007/08)
Beetle Families of British Columbia	Geoffrey Scudder	UBC	FIA-FSP (2004/05) (2005/06)
Success rate of MPB attack in young stands	Chris Hawkins	UNBC	FIA-FSP (2005/06)

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Mountain Pine Beetle ( <i>Dendroctonus ponderosae</i> ) Analysis	Ken Simonar Saphida Migabo Marvin Eng	BC MFR	FRBC (2000)
The mountain pine beetle epidemic: Strategies for improvement of pine host defense and reduction of fitness of beetle-associated fungi	Joerg Bohlman Colete Breuil	UBC	NSERC (2003/04)
Modelling Mountain Pine Beetle Phenological Response to Temperature	Jesse Logan James A. Powell	USDA Forest Service Utah State University	USDA, Nat. Science Foundation (2003)
Mountain Pine Beetle: A menace to pine forests – 1987	Unknown	BC MFR	Unknown (1987)
MPB behavior and physiology (grad student thesis)	Marnie Graf Staffan Lindgren	UNBC	Unknown (2005)
<b>MOUNTAIN PINE BEETLE AND OTHER PINE SPECIES</b>			
Risk of colonization of jack pine by the mountain pine beetle and its phytopathogenic ophiostomatoid fungi	David Langor	CFS	MPBI
Characterization of the jack pine forests of Western Canada for susceptibility to infestation by the mountain pine beetle	Terry Shore	CFS	MPBI
Assessing the threat of mountain pine beetle outbreaks to whitebark pine in British Columbia	Elizabeth Campbell	BC MFR	FIA-FSP (2007/08)
Sustainable management of the ponderosa pine parkland ecosystems in the Thompson River watershed after the mountain pine beetle epidemic	Alan Vyse	Thompson Rivers University (TRU)	FIA-FSP (2007/08)
Distribution and severity of white pine blister rust and mountain pine beetle on whitebark pine in British Columbia. <i>Canadian Journal of Forest Research</i> publication (2000)	Elizabeth Campbell Joseph Antos	UVic	NSERC (1998)
Impact of Blister Rust, Mountain Pine Beetle, and Fire Suppression on Whitebark Pine Ecology. <i>Canadian Journal of Forest Research</i> publication (2000)	Elizabeth Campbell Joseph Antos	UVic	NSERC (1998)
Impact of Blister Rust, Mountain Pine Beetle, and Fire Suppression on Whitebark Pine Ecology – MSc Thesis	Elizabeth Campbell	UVic	FRBC (1998)
<b>BEETLE POPULATION DYNAMICS</b>			
Spatial and temporal patterns of mortality due to mountain pine beetle: Outbreak progression through novel habitat	Brian Aukema	CFS	MPBI
Data Visualization Techniques for MPB Dispersal Scenarios	Sheelagh Carpendale	University of Calgary	MPBI
The mountain pine beetle in novel habitats: Quantifying the potential for boreal invasion	Allan Carroll	CFS	MPBI
Provincial level projection of the current mountain pine beetle outbreak	Marvin Eng	BC MFR	MPBI
Modelling infestation and mortality rates for lodgepole pine trees attacked by the MPB	Fangliang He	CFS	MPBI
Using Reconstructed Histories of Mountain Pine Beetle, Fire and Climate to Predict the Risk of Future Outbreaks	Kathy J. Lewis	UNBC	MPBI
MPB Dispersal through Managed and Unmanaged Forest Landscapes	Mary Reid	University of Calgary	MPBI

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Incorporating mountain pine beetle impacts on stand dynamics in stand and landscape level models: Evaluation and problem analysis	Steve Taylor	CFS	MPBI
Provincial level projection of the current MPB outbreak	Marvin Eng	BC MFR	MPBI
Modeling of MPB transport and dispersion using atmospheric models	Peter Jackson	UNBC	MPBI
Mountain pine beetle population studies for prioritization of stand management during outbreak	Staffan Lindgren	UNBC	MPBI
Modeling spatio-temporal patterns of MPB infestation	Mark Lewis	University of Alberta	MPBI
A landscape-level, spatial investigation of the response of MPB populations to treatment	Barry Boots	Wilfred Laurier University	MPBI
Mountain Pine Beetle Outbreaks in Western Canada: Coupled Influences of Climate Variability and Stand Development	Dan Moore	UBC	CCIAP
Mountain Pine Beetle ( <i>Dendroctonus ponderosa</i> ) Event Parameters for the Robson Valley Forest District	Ken Simonar Saphida Migabo Marvin Eng	Consultants BC MFR	FRBC (2000)
GIS Modelling – Spread of mountain pine beetle over time	Steve Norton	UBC – Dept of Geography	Unknown (1999)

## **DETECTION**

Monitoring to reduce the future risk of mountain pine beetle attack: Aerial and satellite image processing methods	Nicholas Coops	UBC	MPBI
Monitoring to reduce the future risk of mountain pine beetle attack: Project management and monitoring implementation	Mike Wulder	CFS	MPBI
Novel aerial photography as an aid to sampling secondary structure in pine stands.	Pat Teti	BC MFR	MPBI
Synthesis and assessment of remote sensing techniques for detection of green, red, and grey stages of MPB attack	Mike Wulder	CFS	MPBI
Workshop to aid in the development of research priorities for remote sensing of MPB attack	Mike Wulder	CFS	MPBI
Literature review - Remote sensing of insect infestations	Olaf Niemann	UVic	MPBI
Spatial and temporal patterns of MPB infestation and susceptibility in newly infested stands within the South Peace region (TFL48) of North-Eastern BC	Nicholas Coops	UBC	MPBI
Red attack stage mapping with remotely sensed data	Mike Wulder	CFS	MPBI, NSERC, CFS
Utilization of satellite-based Hyperspectral remote sensing data for identification of Mountain Pine Beetle infestations	Rajeev Sharma Bill Bourgeois Peter Murtha	UBC	FIA-FSP (2002/03)
Statistical verification of red attack stage mountain pine beetle detection with high resolution satellite imagery	Darin Brooks	Canfor	FII (2003)
Mountain Pine Beetle detection and monitoring: Remote sensing evaluations	Arthur Roberts	Simon Fraser University (SFU)	FII (2003)
Utilization of Satellite-based Hyperspectral Remote Sensing Data for Identification of Mountain Pine Beetle Infestations	Bill Bourgeois	Lignum	FII (2003)
Mountain Pine Beetle Detection and Monitoring Year Two: Remote Sensing Detection Procedures	Jennifer Lecuyer	West Fraser Mills	FIA (2004/05)

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Mountain Pine Beetle Detection and Monitoring: Phase II Enhancement, Interpretation and Evaluation of Airborne Imagery	J. Northrup A. Roberts S. Wolf Yinbin Li Richard Reich Jennifer Lecuyer	SFU  BC MFR West Fraser Mills	FIA (2003/04)
Remote Sensing Summary Landsat 7 An Assessment of Error of Omission/Commission and Accuracy	Jeff Alexander Keith Jones Darren Taylor Pam Jorgenson Ron Meister Angela Clarke	Lignum Consultant (DWB)  Consultant (Inland)	FIA (2003/04)
Brief Summary of Mountain Pine Beetle Project	Peter Murtha Dave Conly	UBC Lignum	Lignum IFPA (2000)
Mountain Pine Beetle Green Attack Detection	Terry Smith Jim Burbee Ritchie Morrison	Morice-Lakes IFPA	Morice Lakes IFPA (2002)
Evaluating satellite imagery for estimating Mountain Pine Beetle-caused lodgepole pine mortality.	Barbara J. Bentz D. Enderson	USDA Forest Service	USDA (2004)
Red attack detection with SPOT-5 satellite imagery	Terry Smith Robert Albricht	Consultants	Unknown (2004)
Mountain Pine Beetle detection using remote sensing – MSc Thesis (complete)	Jaime Heath, Peter Murtha, John McLean, Leo Rankin	UBC – Alex Fraser Research Forest	Unknown (1998)
Remote sensing for detection of mountain pine beetle green attack – MSc Thesis (complete)	Val Fletcher Robin Brown Leo Rankin Jaime Heath	UBC	Unknown (2000)
Remote sensing and variegated magenta theory for mountain pine beetle detection – MSc Thesis (complete)	Dan Stebbens	UBC	Unknown (2001)
Red Attack Detection with SPOT-5 Satellite Imagery	Terry Smith Robert Albricht	Consultants	Unknown (2004)

## **HYDROLOGY**

The Bowron River Watershed: A landscape level assessment of the post beetle change in stream riparian function	David Maloney	MFR	MPBI
Effects of mountain pine beetle infestations and treatments on water yield and peak flow regimes in the central interior of BC	Younes Alila	UBC	MPBI
Impact of MPB infestation and salvage harvesting on seasonal snow melt and runoff	Sarah Boon	UNBC	MPBI
Water quantity and quality related to rates of mountain pine beetle infestation and salvage logging: a regional comparison.	Sandra Brown	UBC	MPBI
Quantifying the water resource impacts of mountain pine beetle and associated salvage operations across a range of watershed scales	Tony Cheong	MFR	MPBI
Effects of overstory mortality on snow accumulation and ablation – Phase 2	Pat Teti	MFR	MPBI

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
The mountain pine beetle infestation and small stream ecology: Riparian zones, water quality and fish habitat implications	John Rex	MFR	MPBI
Effects of overstory mortality on snow accumulation and ablation	Pat Teti	MFR	MPBI
Hydrological effects of MPB infestation and salvage harvesting operations	John Rex	MFR	MPBI
Review and synthesis of potential hydrological impacts of mountain pine beetle infestation and related harvesting activities in British Columbia.	John Gibson	UVic	MPBI
Predicting stream temperature responses to BC MPB epidemic: Test of predictive model developed by Mellina <i>et al.</i> (2002)	Eric Mellina	UBC	MPBI
Peak flow and water yield responses to mountain pine beetle infested and salvage logged watersheds	Younes Alila	UBC	FIA-FSP (2007/08)
Stand Level Harvesting in Mountain Pine Beetle Affected Stands and Impact on Riparian-based Cultural Resource Management Zones	Chris Ortner	Skeetchestn Indian Band	FIA-FSP (2007/08)
Measurement and Modelling of Mountain Pine Beetle Impacts on the Annual Forest Water Balance	Darryl Carlyle-Moses	TRU	FIA-FSP (2007/08)
Using GIS and Time Series Analysis to Evaluate Impacts of Large-Scale Salvage Logging on Hydrology in the BC Interior	Adam Wei	UBC	FIA-FSP (2006/07)
Determining the impact of MPB-killed forest and elevated harvesting on snow accumulation and the projected impacts on melt and peak flow	Sarah Boon	UNBC	FIA-FSP (2005/06)
Benthic macroinvertebrate sustainability indicator development for SFMP and LRMP applications.	Ian Sharpe	BC MOE	FIA-FSP (2005/06)
BC forest hydrology and geomorphology compendium	Robin Pike	FORREX	FIA-FSP (2004/05)
Long-term evaluation of impacts of wildfire and mountain pine beetle infestation on large woody debris recruitment and transportation processes	Adam Wei	Okanagan University College	FIA- FSP (2004/05)
Forest Management in Interior British Columbia: Moving Beyond Equivalent Cut Area (ECA)	Younes Alila	UBC	FIA-FSP (2004/05)
Stream channels, large woody debris and biogeoclimatic zones in managed watersheds	S.A. Bird	Fluvial Systems Research	FIA-FSP (2003/04)
Hydrological Stability Assessment of the Saunders Creek and No Name Creek (Gerimi Area) Watersheds	Allan Johnsrude	Weldwood – Quesnel	FIA 2004/05
Community Watershed Adaptive Management Trials	Hugh Hamilton	Summit Environmental Consultants	Forests for Tomorrow
Surface and Groundwater Hydrology Assessments in the Naramata Watersheds		Penticton Forest District	FRBC (1996)
Disturbed Hydrology Soil Vegetation model – Sensitivity runs with respect to roads (initial planning stages)	Rita Winkler	BC MFR	BC MFR
Watershed Models – Re-running Disturbed Hydrology Soil Vegetation model in area affected by Mountain Pine Beetle	Dave Maloney	BC MFR	BC MFR
Vanderhoof Watershed Assessment	Dave Maloney	BC MFR	BC MFR

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Wet soil management using ditching techniques within the mountain pine beetle infestation	Stephane Dube	BC MFR	McGregor Model Forest
Ground based harvesting on sensitive sites (indirect relationship to MPB and changes in water table)		FERIC	FERIC (2005)
Extending the hauling season with CTI (indirect relationship to MPB and changes in water table)	Al Bradley	FERIC	FERIC (2005)

### **FUEL LOADING AND FIRE BEHAVIOUR**

Interaction of fire and mountain pine beetle via forest age structure	Hugh Barclay	CFS	MPBI
Wildfire risk assessment and prediction for mountain pine beetle killed lodgepole pine stands	Judi Beck	BC MFR	MPBI
Time of burning and stand susceptibility to the MPB in Canada's Southern Rocky Mountains	Michael Feller	UBC/Parks Canada	MPBI
Video documentary on the contribution of control-burns in achieving forest health and ecology objectives	Dave Harrison	CFS	MPBI
Retardant drop mixtures and their affect on Mountain Pine Beetle Fires	Wally McCullogh BC MFR Rep.	FERIC BC MFR	FERIC (2005)
Fire in Mountain Pine Beetle Stands	Dave Marek	BC MFR	BC MFR (2005)
Mount Robson Ecosystem Management Planning and Mountain Pine Beetle	Gail Ross Bruce Blackwell	WLAP Consultant	Unknown (2004)

## **Operational-level Projects**

### **SHELF LIFE**

Predicting decay and degrade rates in standing and fallen trees killed by the Mountain Pine Beetle	Kathy Lewis	UNBC	MPBI
Wood decay and degradation in standing lodgepole pine killed by mountain pine beetle: Phase II	Kathy Lewis	UNBC	MPBI
Tree Characteristics Related to the Shelf Life of MPB-Killed Lodgepole Pine Stands in North Central British Columbia	Jim Thrower	J.S. Thrower and Associates	MPBI
Wood decay and degradation in standing lodgepole pine killed by mountain pine beetle: Phase II – trees killed over 6 years ago.	Kathy Lewis	UNBC	MPBI
Proposal to develop a sample design & sample plan for the determination of timber quality deterioration through time on forestlands impacted by the Mountain Pine Beetle	Jim Thrower	CFS	MPBI
Development of a portable rapid assessment tool to quantify wood and fibre quality deterioration in standing lodgepole pine trees and decked logs	Thanh Trung	Paprican	MPBI
Decay fungi and associated rates of decay in standing trees killed by mountain pine beetle	Collette Breuil	UBC	MPBI
Mountain Pine Beetle Red Attack Shelf Life Discriminations	Arthur Roberts	SFU	FIA-FSP (2007/08)
Mountain Pine Beetle Workshop (March 31st, 2004 - Quesnel, BC): Developing a Requirements Definition for "Shelf Life" Studies & Developing Interim Guidelines for Harvest Planning in the Quesnel TSA	Phil Winkle	Consultant (Inland)	FIA (2004/05)

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
<b>MANAGEMENT, RISK ASSESSMENT, AND CONTROL STRATEGIES</b>			
Temporal composition and structure of post-beetle lodgepole pine stands: Regeneration, growth, economics, and harvest implications	Chris Hawkins	UNBC	MPBI
Decision support framework for assessing alternative mountain pine beetle management strategies on sustainable forest management indicators	Ann Chan-McLeod	UBC	MPBI
Monitoring to reduce the future risk of mountain pine beetle attack: Project management and monitoring implementation	Mike Wulder	CFS	MPBI
Projection of the efficacy of MPB management at the landscape scale	Terry Shore	CFS	MPBI
A synthesis of the economic efficiency of beetle-proofing management options	Bill White	CFS	MPBI
Plan for establishment of long-term monitoring plots in mountain pine beetle killed stands	Craig DeLong	BC MFR	MPBI
Review and synthesis of historical adaptive management strategies to control mountain pine beetle ( <i>Dendroctonus ponderosae</i> ): Efficacy and economics	Ernst Stjernberg	FERIC	MPBI
Spatial-temporal analysis of MPB infestations to characterize pattern, risk, and spread at the landscape level	Barry Boots Trisalyn Nelson	Wilfred Laurier University	MPBI
Retrospective spatial analysis and implications of mountain pine beetle in mixed-species stands	Lorraine Maclauchlan	BC MFR	MPBI
Refinement of the Shore/Safranyik mountain pine beetle risk assessment method by incorporation of host susceptibility characteristics	Rene Alfaro	CFS	MPBI
Exploring opportunities for Mitigating the ecological impacts of current and future MPB outbreaks through improved planning: A focus on Northeastern BC	John Nelson	UBC	MPBI
Using reconstructed outbreak histories of mountain pine beetle, fire and climate to predict the risk of future outbreaks.	Kathy Lewis	UNBC	MPBI
Monitoring to assess the efficacy of mitigation activities and reduce the future risk of mountain pine beetle attack	Mike Wulder	CFS	MPBI
Expansion of “beetle-proofing” research, and operational evaluation for feedback and adaptive management (multi-year project)	Roger Whitehead	CFS	MPBI, FRDA, FRBC, CFS
Monitoring to reduce the future risk of mountain pine beetle attack: Aerial and satellite image processing methods.	Nicholas Coops	UBC	MPBI
Mountain pine beetle impacts and risk projections in young lodgepole pine stands	Lorraine Maclauchlan	BC MFR	FIA-FSP (2007/08)
Identification of young pine stands at high risk to mountain pine beetle through an integration of GIS analysis and field evaluation techniques	Lorraine Maclauchlan	BC MFR	FIA-FSP (2007/08)
Evaluation of the impact of N fertilization on mountain pine beetle success in mature lodgepole pine stands at the leading edge of an infestation	John McLean	UBC	FIA-FSP (2007/08)
A Strategic Analysis Framework for Managing Forests under the Mountain Pine Beetle Outbreak	Don Morgan	BC MFR	FIA-FSP (2007/08)
A Framework for Documenting the Effects of the Mountain Pine Beetle Outbreak in Sub-Boreal Forests of Northern B.C.	Craig DeLong	BC MFR	FIA-FSP (2007/08)

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Determining susceptibility of young pine plantations to the mountain pine beetle, <i>Dendroctonus ponderosae</i> , and manipulating future stands to mitigate losses	Lorraine Maclauchlan	BC MFR	FIA-FSP (2005/06)
Tools for the Successful Establishment of Long-term Monitoring of Mountain Pine Beetle Effects – April 2004	Craig DeLong Brad Hawkes	BC MFR CFS McGregor Model Forest	FIA-FSP (2005-06)
Test of A Simplified Non-Host Volatile Blend as a Supplement to Verbenone in Protecting Lodgepole Pines from Attack by the Mountain Pine Beetle (multi-year project)	John Borden	SFU	FIA (2003/04)
Chemical ecology and management of forest insects	John Borden	SFU	FII (2004)
Integrating insects and diseases into ecosystem management planning	Bill Bourgeois	Lignum	FII (2003)
Incorporating The Impacts Of Insects And Diseases Into Ecosystem Management Planning	Dave Conly Joan Westfall	Lignum	Lignum IFPA (2001)
Lignum 2001 Operational Strategy For Mountain Pine Beetle And Douglas Fir Bark Beetle Within The Williams Lake Forest District	Dave Conly Shawn Meisner	Lignum	Lignum IFPA (2001)
IFPA Mountain Pine Beetle Management Plan	Dave Conly Joan Westfall	Lignum Consultant	Lignum IFPA (2001)
Report On Implementation Of The Lignum 2000 Operational Strategy For Mountain Pine Bark Beetle And Fir Bark Beetle Within The Williams Lake Forest District	Dave Conly Shawn Meisner	Lignum	Lignum IFPA (2000)
Lignum Innovative Forestry Practices Agreement Forest Health Program	Dave Conly	Lignum	Lignum IFPA (2001)
Report on the Implementation of the Lignum 2000 Operational Strategy for Mountain Pine Beetle and Fir Bark Beetle within the Williams Lake Forest District	Dave Conly Shawn Meisner	Lignum	Lignum IFPA (2000)
2001 Bark Beetle Strategy	Dave Conly	Lignum	Lignum IFPA (2001)
Lignum Innovative Forestry Practices Agreement (IFPA) Forest Health Program	Dave Conly	Lignum	Lignum IFPA (2001)
Operational Case Studies and Extension Activities (complete) – Extension note on beetle proofing	Deb DeLong	BC MFR	FRBC (1999)
Commercial Thinning of Mature Lodgepole Pine to Reduce Susceptibility to Mountain Pine Beetle (complete) FRDA report	Janet Mitchell	FERIC	FRDA (1994)
A Biological Evaluation of the Prototype Standing Tree Debarking System (STDS) Used for Direct Control of Mountain Pine Beetle in Lodgepole Pine (complete) FRDA report	H.S. Whitney L. Safranyik D.C. Moulson	CFS	FRDA (1995)
Verbenone reduces Mountain Pine Beetle attack in Lodgepole pine	R.A. Progar	USDA Forest Service	USDA (2003)
CFS Mountain Pine Beetle-proofing trial – SX 94401C (ongoing through 2000)		CFS	Unknown (2000)
Mountain Pine Beetle risk and management	Annette Waechter (German Intern)	UBC – AFRF	Unknown (1998)
Regulation of spruce bark beetles by woodpeckers – A literature review ( <i>Forest Ecology and Management</i> )	P. Fayt M.M. Machmer C. Steeger	University of Joensuu, Finland Consultants	Unknown (2005)

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Testing repellent volatiles in mountain pine beetle infected trees (complete)	Dezene Hubert John Borden	SFU	Unknown (1999)
Sequential baiting for the mountain pine beetle	Alex Gustaffson John Borden	SFU	Unknown (2000)
Extension of the Forest Ecosystem Simulation Model FORECAST: Incorporating Mountain Pine Beetle, Fire, Climate Change, and Wildlife	Hamish Kimmins	UBC	Unknown (2004)
<b>GEOMORPHOLOGY</b>			
Mountain Pine Beetle Impacts on Channel Morphology and Woody Debris in Forested Landscapes	Marwan Hassan	UBC	MPBI
Monitoring soil disturbance on harvested areas within the mountain pine beetle infestation	Stephane Dubé	BC MFR	FIA-FSP (2005/06)
<b>REGENERATION</b>			
Modeling natural regeneration following MPB attacks in the Southern and Central Interior of British Columbia	Valerie LeMay	UBC	MPBI
Forest health and mortality of advance regeneration 4, 8 and 12 years post mountain pine beetle outbreak.	Kathy Lewis	UNBC	MPBI
Test and refine a new approach to stocking assessment in stands resulting from MPB salvage partial cutting	Pat Martin	BC MFR	MPBI
Review and synthesis of regeneration methods in beetle-killed stands following mountain pine beetle ( <i>Dendroctonus ponderosae</i> ) attack	Ernst Stjernberg	FERIC	MPBI
Assessment of post-beetle impacts on natural regeneration of lodgepole pine	Keith Egger	UNBC	MPBI
Lodgepole pine stand dynamics as a result of mountain pine beetle attack in central British Columbia (Grad student thesis)	Patience Rakochy Chris Hawkins	UNBC	MPBI, NSERC, Other
Evaluation of regeneration delay, release of advance regeneration, future growth rates, and stand dynamics after a 40-50 year old MPB attack in sub-boreal forests around Takla Lake	David Coates	Bulkley Valley Centre	FIA-FSP (2007/08)
Development of residual trees and regeneration following MPB attack in thinned lodgepole pine stands	Rob Brockley	BC MFR	FIA-FSP (2007/08)
Modeling Natural Regeneration in Mountain Pine Beetle Impacted Stands	Peter Marshall	UBC	FIA-FSP (2007/08)
Predicting development and productivity of southern interior mixed species stands following mountain pine beetle attack	Suzanne Simard	UBC	FIA-FSP (2007/08)
Estimating Natural Regeneration and Yield in Pine-Dominated Stands Following Mountain Pine Beetle Attack Using SORTIE-ND and PrognosisBC in a Hybrid Modelling Approach	Valerie LeMay	UBC	FIA-FSP (2007/08)
Growth and release of understory trees in partially-cut pine stands	Rasmus Astrup	Bulkley Valley Centre	FIA-FSP (2007/08)
Moving towards a desirable future: Developing and evaluating alternative MPB salvage strategies in the Prince George Forest District	Bruce Bradley	Canfor	FIA-FSP (2006/07)
Regeneration and stand structure in stands in the East Ootsa and Entiako areas after infestation by mountain pine beetles	Deb Cichowski	Bulkley Valley Centre	FIA-FSP (2005/06)

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Regeneration and stand structure following mountain pine beetle infestation in the sub-boreal spruce zone	David Coates	Bulkley Valley Centre	FIA-FSP (2005/06)
Predicting advanced regeneration density in lodgepole pine stands in the Northern Interior of British Columbia	Phil Burton	CFS	FIA-FSP (2005/06)
Implementing a PrognosisBC Regeneration submodel for the complex stands of Southeastern and Central British Columbia	Abdel-Azim Zumrawi	UBC/MoF	FIA-FSP (2004/05)
Partially cut: Occupied or not? What are my options? A proposed survey approach	Pat Martin Bryce Bancroft Ken Zielke	BC MFR Consultant	FIA (2003/04)
Evaluating the Success of Natural Regeneration in Partially Cut Douglas-fir Stands in Southern BC: A Retrospective Investigation (complete) TR report 18 – Nelson Forest Region	K. Saceniaks C.F. Thompson	BC MFR	Unknown (1999)

### **SILVICULTURAL OPTIONS/RESTORATION**

Determining year of death and nature of stand recovery using a time series analysis of remotely sensed data: Project Management	Nicholas Coops	UBC	MPBI
Framework to support impact analyses of renewal strategies of forestlands affected by mountain pine beetle.	Emina Krcmar	UBC	MPBI
Factors affecting the ecological legacy of un-salvaged post-beetle stands	Ann Chan-McLeod	UBC	MPBI
Growth and Yield implications of alternate silvicultural strategies in Mountain Pine Beetle damaged stands	David Coates	Bulkley Valley Centre	FIA-FSP (2004/05)
Modelling the impact of stand management regimes on the wood characteristics of lodgepole pine (indirect relationship to MPB)	Jim Goudie	BC MFR	FIA-FSP (2004/05)
Strategic Regional Restoration Plans – Cariboo, Northern Interior, and Southern Interior		Enar Esde Inc.	Forests for Tomorrow
Opax Mountain Silvicultural Systems Project: Effect of Insects on Health of Trees and Stands (multi-year project – 1997 to present)	Lorraine MacLauchlan	BC MFR	FRBC, MoF internal

### **SALVAGE AND ECOSYSTEM FUNCTION**

An interactive tool for evaluating the impacts of spatially explicit mountain pine beetle salvage alternatives on multiple forest resource values.	Brad Seely	UBC	MPBI
Decision support for managing wildlife habitat in mountain pine beetle impacted ecosystems.	Trisalyn Nelson	UVic	MPBI
Assessing ecological effects of MPB salvage operations	Fred Bunnell	UBC	MPBI
Harvesting beetle-killed lodgepole pine while protecting advanced regeneration and non-pine species	Ernst Stjernberg	FERIC	FIA-FSP (2007/08)
The effects of salvage logging on the net ecosystem productivity of MPB-attacked lodgepole pine forests of the northern-BC interior	Andrew Black	UBC	FIA-FSP (2007/08)
Rating options for post attack cutting on affected stands	Bruce Larson	UBC	FIA-FSP (2006/07)

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Moving towards a desirable future: developing and evaluating alternative MPB salvage strategies in the Prince George Forest District	Bruce Bradley	Canfor	FIA-FSP (2006/07)
Can wildlife tree patches conserve sensitive species in MPB impacted landscapes?	Craig DeLong	BC MFR	FIA-FSP (2007/08)
Retention measures to address ecological values in Mountain Pine Beetle affected forests in BC	Marnie Martin	BC MOE	Forests for Tomorrow
Retention mapping options and alternatives	Mike Landers	Forsite Forest Management Specialists	Forests for Tomorrow
Retention mapping for non-timber objectives: Vanderhoof and Quesnel management units		Timberline	Forests for Tomorrow
Strategies for Maintaining or Recruiting Habitat in Areas Affected by Mountain Pine Beetle and other Catastrophic Events	E. Todd Manning	Manning, Cooper and Associates	Forests for Tomorrow
The ecological role of beetle killed trees: A review of salvage impacts	John Stadt	WLAP	Unknown (2001)

### **HARVESTING, HAULING, AND STORAGE**

Extending the logging season in Mountain Pine Beetle damaged stands by using ground wood to surface in-block roads	C. Kevin Lyons	UBC	FIA-FSP (2007/08)
Developing new techniques, systems and equipment for harvesting post mountain pine beetle stands	Tony Sauder	FERIC	FIA-FSP (2007/08)
Evaluating the potential to store beetle-killed logs under an insulated snowpack to mitigate volume and value losses after mountain pine beetle attack	Roger Whitehead	CFS	FIA-FSP (2006/07)
Transportation of Mountain Pine Beetle logs	Rob Jokai	FERIC	FERIC (2005)
Strategies for managing wood residues	Patrick Forester	FERIC	FERIC (2005)
Storage strategies for Mountain Pine Beetle (dealing with yard and bush decked)	Jack McDonald	FERIC	FERIC (2005)
Cut to length vs. Tree Length at Tolko	Bjorn Anderson	FERIC	FERIC (2005)
Tembec in-woods chipping (quality of dry chips as well as green)		FERIC	FERIC (2005)
Shortlog vs. Long log in mountain pine beetle stands (presented at MPB research update workshop – Jan 2005)	Duke Armleder	Tembec	Unknown (2005)
Issues with Mountain Pine Beetle log storage (presented at MPB research update workshop – Jan 2005)	Gord Gunson	West Fraser (Smithers)	Unknown (2005)

### **PRODUCT INFORMATION/RESEARCH**

Quantifying the Effect of Extractives from Mountain Pine Beetle Attacked Lodgepole Pine for Pulp and Papermaking	Paul Bicho	Paprican	MPBI
True shape and defects data from MPB affected stems	Jan Brdicko	Forintek Canada	MPBI
Minimizing the impact of MPB veneer on plywood glue dryout and delamination	Chunping Dai	Forintek	MPBI
Assessing the influence of time-since-death: Pilot scale kraft and thermomechanical pulping of beetle killed lodgepole pine	Barbara Dalpke	Paprican	MPBI

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Evaluation and review of potential impacts of mountain pine beetle (MPB) infestation to composite board production and related manufacturing activities in British Columbia	Ian D. Hartley	UNBC	MPBI
Overcoming the brightness ceiling for mechanical pulps prepared from blue-stained lodgepole pine chips	Thomas Hu	Paprican	MPBI
Pilot mechanical pulping assessment of dry blue-stained and grey-stage wood chips from beetle killed lodgepole pine	Thomas Hu	Paprican	MPBI
Development of protocols for quality assessment for structural lumber from mountain pine beetle attacked timber	Conroy Lum	Forintek	MPBI
Quantifying lumber value recovery from beetle-killed trees	Lazlo Orbay	Forintek	MPBI
Kraft Pulp and Paper Mill Utilization Options for Grey-Stage Wood	Gail Sherson	Paprican	MPBI
Operational Extractives Management from Mountain Pine Beetle Attacked Lodgepole Pine for Pulp and Papermaking	Gail Sherson	Paprican	MPBI
Heat disinfection of decay fungi found in post-MPB wood	Adnan Uzunovic	Forintek	MPBI
Bioconversion of beetle-killed lodgepole pine to bioethanol	Jack Saddler	UBC	MPBI
Development of high performance and durable engineered wood products using PF impregnated post-mountain pine beetle veneer	Brad Wang	Forintek	MPBI
Feasibility of composing green mountain pine beetle veneers	Chunping Dai	Forintek	MPBI
Near infrared detection of decay in post – mountain pine beetle lumber	Rod Stirling	Forintek	MPBI
Feasibility of using X-ray scanning to characterize mountain pine beetle check severity for optimizing log sorting and lumber manufacturing processes	Jan Brdicko	Forintek	MPBI
Determining the relationship between wood and fibre quality of mountain pine beetle killed wood and the paper quality of mechanical paper	Barbara Dalpke	Paprican	MPBI
Investigating means to increase tall oil soap recovery and reduce extractives in kraft mills pulping mountain pine beetle killed wood	Gail Sherson	Paprican	MPBI
Phytosanitary risks associated with MPB-killed trees	Eric Allen	CFS	MPBI
Fitness and pathogenicity of the fungi associated with the MPB and other secondary beetles in green attack	Colette Breuil	UBC	MPBI
Alternative wood products from stained MPB lumber	Frank Lam	UBC	MPBI
A synthesis of the literature on the blue stain impacts on major forest products	Kathy Woo	Paprican	MPBI
Maximizing value recovery from MPB attacked pine for veneer products	Chunping Dai	Forintek	MPBI
Implications of properties of post-MPB wood	Tony Byrne	Forintek	MPBI
Optimizing drying of post-MPB wood	Luiz Oliveira	Forintek	MPBI
Improving value recovery of OSB from post-MPB wood	Martin Feng	Forintek	MPBI
Addressing marketplace durability issues with beetle-killed lodgepole pine	Adnan Uzunovic	Forintek	MPBI
A blue stain and split detection system for optimizing log and cant breakdown	Laszlo Orbay	Forintek	MPBI
Optimization of gluing, lay-up and pressing for MPB plywood	Chunping Dai	Forintek	MPBI
Optimizing drying and MSR lumber grade recovery of post-MPB wood	Conroy Lum	Forintek	MPBI

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Chemical, mechanical, and durability properties of mountain pine beetle infested timber	John Kadla	UBC	MPBI
Synthesis of impacts of increased use of chips with elevated pitch levels, dry chips (standing dead) and chips with blue stain on pulping	Paul Watson	Paprican	MPBI
Assessment of the economic (pulp and pulp quality) effects of increased lodgepole pine in SPF chip mixtures	Wadood Hamad	Paprican	MPBI
Evaluation of chipping options for beetle-killed lodgepole pine wood to maintain wood and fibre quality	Paul Bicho	Paprican	MPBI
A wood and fibre quality deterioration model for mountain pine beetle infested trees by biogeoclimatic subzone	Paul Watson	Paprican	MPBI
Fungi degrade wood quality in green, red and gray lodgepole pine attacked by Mountain Pine Beetle	Colette Breuil	UBC	FIA-FSP (2003/04)
Characterizing the properties of beetle-killed wood	Tony Byrne	Forintek	FIA-FSP (2003/04)
MPB for Wood Charcoal	Chunping Dai	Forintek	FII (2008)
MPB Specialty Treated Landscape Products	Brian Hawrysh	BC Wood Specialties Group	FII (2008)
Mixing MPB pine with BC Coast species for structural LVL products	Brad Jianhe Wang	Forintek	FII (2008)
Coating of Hot Oil-treated Siding Using MPB Impacted Lodgepole pine	Jieying Wang	Forintek	FII (2008)
Increasing value recovery for MPB attacked pine for specialty plywood products	Brad Wang	Forintek	FII (2008)
Manufacturing and testing of glulams made from MPB laminating stock treated with Copper-cobiocide	M. Robert Knudson	Forintek	FII (2008)
Enhanced Termite Resistance for Borate Treated Post MPB Lumber	P.I. Morris	Forintek	FII (2008)
Development of Hardened Flooring from Post MPB Boards	Brian Hawrysh	BC Wood Specialties Group	FII (2008)
MPB wood plastics and MPB wood cement	Frank Lam	UBC	FII (2008)
Thick laminated MPB woodplates	Frank Lam	UBC	FII (2008)
Thick strand based MPB wood composites	Frank Lam	UBC	FII (2008)
Finishing of mountain pine beetle affected lodgepole pine wood	Phillip Evans	UBC	FII (2008)
Recovery of Hemicellulose from MPB wood chips and Bio-conversion to Valuable Products	Sheldon Duff	UBC	FII (2008)
High Temperature Pre-heating of MPB logs for Optimized Processing into Strand based composites	Frank Lam	UBC	FII (2008)
Log Yard Inventory Management for the MPB Resource	Derek Goudie	Forintek	FII (2008)
Whole log chipping of MPB killed wood for the pulp and paper industry	Paul Bicho	Paprican	FII (2008)
Developing Bio-refining Technologies for the Production of Forest-based Bio-ethanol	Warren Mabee	UBC	FII (2008)
In-refiner Bleaching of Mechanical Pulps from MPB-infested bluestained Lodgepole pine chips	Thomas Hu	Paprican	FII (2008)

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Stud Mill Lumber Grade and Value Yields from Green Spruce-Pine-Fir and Grey-Stage Dry Mountain Pine Beetle Attacked Logs	Frank Lam	UBC	FII (2007)
Comparing the Flatwise Modulus of Elasticity (Eflat) of Green Lodgepole Pine Lumber & Grey-Stage Dry MPB Lumber	Dan Alexander	Forestry Innovation Investment Ltd	FII (2007)
Detection Methods of Internal Checks and Rots in Mountain Pine Beetle Lumber	Frank Lam	UBC	FII (2007)
Specialty plywood products: A way to increase value recovery from mountain pine beetle (MPB)-attacked lodgepole pine	Brad Wang	Forintek	FII (2007)
Development of MPB wood plastic and wood cement products	Frank Lam	UBC	FII (2007)
Development of Thick MPB Strand Based Wood Composites	Frank Lam	UBC	FII (2007)
Development of Thick Laminated MPB Wood Plates	Frank Lam	UBC	FII (2007)
Finishing of Mountain Pine Beetle Affected Lodgepole Wood	Philip D. Evans	UBC	FII (2007)
Initial evaluation of thermal-oil treatment for post-MPB lodgepole pine	Jieying Wang	Forintek	FII (2007)
Hydrolysis & fermentation of wood waste and MPB wood to produce ethanol	Steve Helle	UBC	FII (2007)
Conversion of MPB sawmills residuals to flakes for OSB	Frank Lam	UBC	FII (2007)
Online detection and characterization of MPB wood furnish to optimize OSB mill processing efficiency	Kevin Groves	Forintek	FII (2007)
Community Kiln Drying of Mountain Pine Beetle Infested Lumber for Value-added Products	Wei Li	BCIT	FII (2007)
Bondability of beetle-killed lodgepole pine for the manufacture of wood composite products	Martin Feng	Forintek	FII (2007)
Improved processing efficiency of post mountain pine beetle wood, part II	John Taylor	Forintek	FII (2007)
Accuracy of check modeling and its effect on lumber value recovery	Lazlo Orbay	Forintek	FII (2007)
Improving productivity, recovery and quality of veneer products with a new pressing method	Chunping Dai	Forintek	FII (2007)
Specialty Treated Landscape Product Development: Prototype Production and Evaluation	P.I. Morris	Forintek	FII (2007)
Through-treating post-MPB lumber: Demonstration of treatability	Shane McFarling	Forintek	FII (2007)
Log quality of Mountain Pine Beetle (MPB) infested wood in relation to lumber manufacture – Year 2 lumber and fibre properties	Igor Zaturecky	Canfor	FII (2006)
Stress-Wave Technology for Defect Detection and Classification of Mountain Pine Beetle Infested Logs and Lumber	Igor Zaturecky	Canfor	FII (2006)
Economic shelf life and valuation of beetle killed trees from BC's mountain pine beetle epidemic	J.S. Thrower	J.S. Thrower & Associates Ltd	FII (2006)
Quality of mountain pine beetle infested fibre: Implications on the production of pulp and paper products	Gurminder Minhas	Canfor	FII (2006)
Innovation methods for moisture conditioning MPB logs for OSB production	Kenneth Lau	UBC	FII (2006)

<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Development of Properties Indicators and database for Mountain Pine Beetle (MPB) infested wood in relation to time-since-tree-death	Igor Zaturecky	Canfor	FII (2006)
Through-treating post MPB-lumber: Technical feasibility and process development	P.I. Morris	Forintek	FII (2006)
Literature review On Properties and Market Opportunities of Wood-Plastic and Wood-Cement Composites	Aries Feng-Cheng Chang	UBC	FII (2006)
Development of MPB Wood-Cement and Wood-Plastic Composite Products	Bob Holm	UBC	FII (2006)
Laminated Decking and Flooring Products from MPB Infested Wood	Igor Zaturecky	Canfor	FII (2006)
Development of MPB Thick Laminated Wood Plate Products	Yue Chen	UBC	FII (2006)
Bleaching and Finishing of Mountain Pine Beetle Affected Lodgepole Wood	Philip D. Evans	UBC	FII (2006)
Improved processing efficiency of post-MPB wood, Part 1A: Mill survey	John Taylor	Forintek	FII (2006)
Improved processing efficiency of post-MPB wood, Part 1B: Benchmark cutting tests	John Taylor	Forintek	FII (2006)
A statistical method of determining check depth in MPB affected logs	Lazlo Orbay	Forintek	FII (2006)
China Rail Tie Market Analysis		Fiducia Management Consultants	FII (2006)
A Conceptual Comparison of Using Bioenergy Options for BC's Mountain Pine Beetle Infested Wood	Amit Kumar	University of Alberta	BIOCAP Canada
Feedstock Availability and Power Costs Associated with Using BC's Beetle-Infested Pine	Amit Kumar	University of Alberta	BIOCAP Canada
British Columbia's Beetle Infested Pine: Biomass Feedstocks for Producing Power	Amit Kumar	University of Alberta	BIOCAP Canada
New product based on infested pine timber (Grad student thesis)	Sorin Pasca Ian Hartley Ronald Thring	UNBC	Other (2005)

## **WORKER SAFETY**

An Assessment of Tree Condition and Worker Safety Concerns in Mountain Pine Beetle-killed and Fire-damaged Lodgepole Pine Stands in Central Interior British Columbia	E. Todd Manning	Manning, Cooper and Associates	BC MFR
Worker safety in unlogged mountain pine beetle stands. (presented at MPB research update workshop – Jan 2005)	Patience Rakochy	UNBC	Unknown (2005)

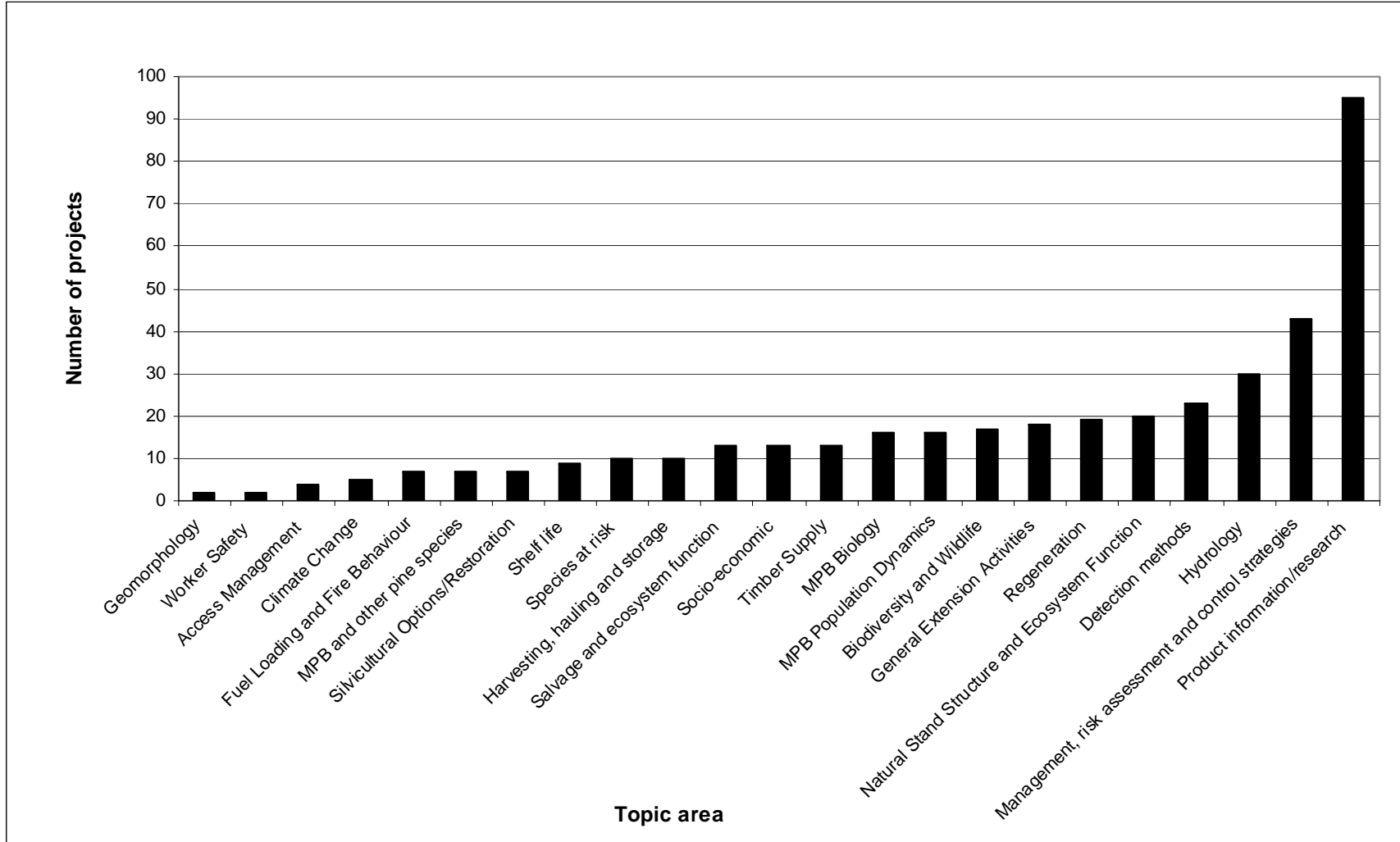
## **General Extension Activities**

“Mountain Pine Beetle Symposium: Challenges and Solutions”	Bill Wilson	CFS	MPBI
Natural Resources Canada Mountain Pine Beetle Initiative Research & Development Information Session	Bill Wilson	CFS	MPBI
MPBI project on the SFM exhibition in Exploration Place	Bob Campbell	Exploration Place – Prince George	MPBI
Southern Interior MPB workshop	Dr. Bennett	Unknown	MPBI
Northern Interior 2005 workshop	Max Blouw	UNBC	MPBI

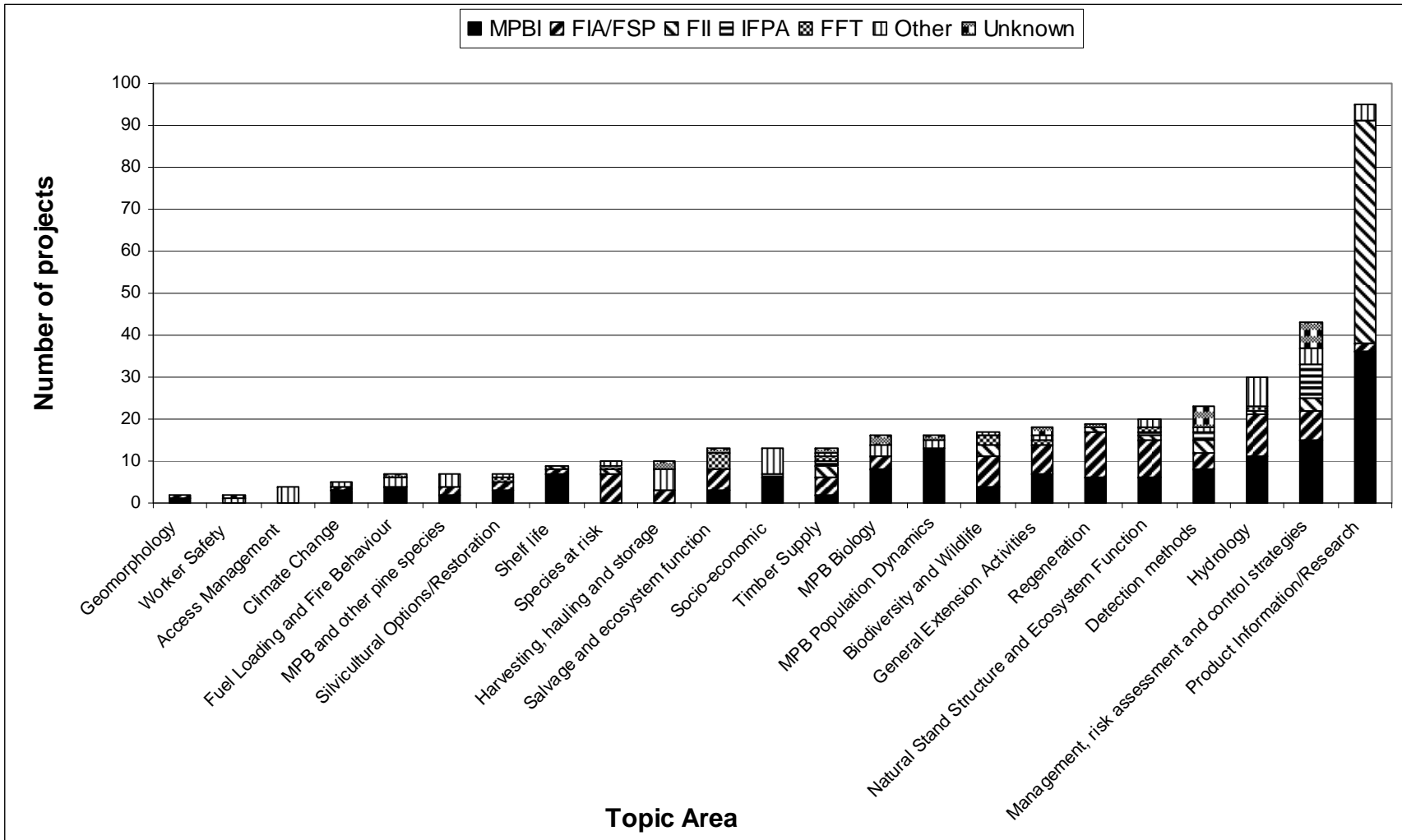
<b>Project Title</b>	<b>Researcher</b>	<b>Agency</b>	<b>Funding Source</b>
Southern Interior 2005 workshop	John Karakatsoulis	TRU	MPBI
Workshop to aid in the development of research priorities for remote sensing of MPB attack			MPBI
UBC MPB funding for graduate student posters	Cindy Prescott	UBC	FIA-FSP (2005/06)
UNBC MPB funding for graduate student posters	Tamsin Miley	UNBC	FIA-FSP (2005/06)
MPB Extension Plan	Al Wiensczyk	FORREX	FIA-FSP (2005/06)
MPB Special Issue of the <i>BC Journal of Ecosystems and Management</i>	Al Wiensczyk	FORREX	FIA-FSP (2005/06)
Operational MPB Research Update Workshops	Albie Thompson Darcy Moshenko	FORREX/ FERIC	FIA-FSP (2005/06)
MPB annotated bibliographic database (NRIN)	Al Wiensczyk	FORREX	FIA-FSP (2005/06)
“MPB Research Synthesis and Strategy Forum”	George Hoberg Max Blouw	UBC UNBC	FIA-FSP NRC
“Ecosystem restoration and managing natural disturbance” Workshop	Mike Landers Kathie Swift	Forsite, FORREX, BC MOE	Forests for Tomorrow
“MPB Seminar Series: The Mountain Pine Beetle Encounter”	Andy Godden	FPIInnovations	Unknown
“MPB: Where do the Kootenays go from here?” Workshop	Art Stock Kandy Schroder	Selkirk Management Services	Unknown
Hydrologic Implications of Mountain Pine Beetle: Learning from Experience <a href="http://www.sfmnetwork.ca/html/prevworkshop_e.html">http://www.sfmnetwork.ca/html/prevworkshop_e.html</a>	John Diiwu Axel Anderson	Alberta Sustainable Resource Development (ASRD)	ASRD Sustainable Forest Management Network, Foothills Model Forest

The largest proportion of the projects (39%) was funded provincially by Forestry Innovation Investment (FII) and the Forest Investment Account (FIA). Projects funded by the federal Mountain Pine Beetle Initiative accounted for (36%) of the funded projects. Projects designated as ‘other’ for the funding source include projects funded by Forest Renewal BC (FRBC), the National Science and Engineering Research Council (NSERC), the Forest Resource Development Agreements (FRDA I and II), industry, British Columbia Provincial Government, and the United States Department of Agriculture Forest Service (USDA), and account for 12% of the funded projects. The funding source was classified as ‘Unknown’ for 6% of the projects as it was not possible to confirm where the funding for the project came from. Several projects also received funding from a variety of sources. These were classified by the main funding source. The number of projects by topic area and funding source is shown in Figure 2.

**FIGURE 1** Number of mountain pine beetle projects by topic area.



**FIGURE 2** Number of mountain pine beetle projects by topic area and funding source.



## 4 DISCUSSION AND CONCLUSIONS

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This project concentrated on current and recently completed MPB-related projects conducted within the last 5–10 years. This project was not intended to be a detailed literature review of published information on the mountain pine beetle. The amount of literature on mountain pine beetle in Canada and the United States is quite extensive and was beyond the scope of this project. However, FORREX has completed another project, an annotated bibliographic database of published mountain pine beetle-related literature. This database has been incorporated into the Natural Resources Information Network (NRIN) (<http://www.forrex.org/nrin>) and is available through the Mountain Pine Beetle Information Network (<http://www.forrex.org/mpb>)

During the preparation of the original version of this report, the B.C. Ministry of Forests and Range, Research Branch was in the midst of conducting a needs definition and gap analysis. This process resulted in the development of a mountain pine beetle stewardship research strategy which was published in July 2005 (de Montigny *et al.* 2005), and an implementation framework published in 2007. During this exercise, 112 stewardship research issues were identified (de Montigny *et al.* 2007). After comparison with existing research projects, the strategy identified 38 high-priority, 19 medium-priority, and 30 low-priority knowledge gaps based on importance and urgency. The high-priority knowledge gaps were further consolidated down into 21 research discipline areas covering:

1. hydrology, geomorphology, and fisheries;
2. wildlife, ecology, range, and biodiversity;
3. silviculture, growth, and yield;
4. strategic analysis, planning, and decision support;
5. entomology; and
6. shelf life.

Other research discipline areas containing medium- and low-priority gaps but no identified high-priority gaps included:

7. soils;
8. climate; and
9. genetics.

Although no high-priority knowledge gaps were identified under the research discipline area of climate, there was a high-priority knowledge gap to determine the impact of global warming on MPB survival, virulence, and distribution which was included under the entomology research discipline area. Areas not addressed by this strategy include socio-economics and policy, forest products, and wildfire management issues. A large number of these high-priority knowledge gaps have been included in the Forest Science Board *Mountain Pine Beetle Eligible Research Topics 2006/07* guidelines for funding under the Forest Investment Account–Forest Science Program.

Another publication which identified knowledge gaps pertaining to mountain pine beetle is the report written by Mitchell and Stjernberg (2005). Their project, however, focussed only on beetle-proofing and beetle-control and mitigation strategies for managing mountain pine beetle. They identified eight knowledge gaps as well as a communication/technology transfer gap in this area.

Three of the eight gaps corresponded with high-priority gaps identified in the research strategy document, while three others corresponded to moderate- or low-priority gaps. Two unique knowledge gaps were 1) determining administrative costs and economic barriers to management strategies, and 2) understanding the mechanisms and key factors involved in biological control of mountain pine beetle (Mitchell and Stjernberg 2005).

A presentation hosted on the First Nations Forestry Council Web site presents nine issues raised by First Nations with respect to the mountain pine beetle (First Nations Forestry Council 2006). They reported that by 2011, 99 bands (almost 60,000 people) will experience impacts to their traditional economics and lifestyles as a result of the mountain pine beetle. Four of the issues raised correspond to high-priority gaps identified in the research strategy document. These include concerns about the impact of the mountain pine beetle and salvage logging on ecosystems and potential damage to local flora and fauna including traditional foods and medicines, as well as the impact on hydrology patterns which could affect water quality for fish habitat and human consumption. The impact of the mountain pine beetle on salmon was a major issue raised by First Nations due to the critical importance of this resource (from both sustenance and cultural perspectives) to First Nations. The remaining five issues that were raised focussed on socio-economic concerns as well as several issues unique to First Nations. Socio-economic concerns included the loss of economic opportunities (timber products, eco-tourism and non-timber industries) as well as the impact on existing timber businesses due to the increased supply of lumber on the market.

Another of the major concerns raised by First Nations was the impact of the mountain pine beetle on community safety with respect to increased risk of wildfire as well as potential flooding and landslides. Other issues included the disruption or loss of trails, camps, and ceremonial sites as well as the loss of “land value” which could negatively affect treaty negotiations. Also described was the physiological impact to the “Stewards of the land” from the devastation of the forest lands as a result of the mountain pine beetle and salvage harvesting.

A total of 399 projects relating to mountain pine beetle were found in this assessment, an increase of 67% from the same assessment completed in 2005. While the top research areas have shifted over the last five years, there are several topic areas that, in general, have been consistently identified as the main focus for mountain pine beetle-related research initiatives.

It should be recognized, however, that the number of mountain pine beetle-related projects under a specific topic area may not necessarily be a good indicator of whether the subject area is being adequately addressed or not. There may be specific subject areas within a particular topic area where more detailed research is required. Also, because this analysis did not involve a thorough review of all mountain pine beetle literature, it is possible that there are existing research papers dealing with some of the topics which are identified as research gaps based only on the analysis of the current and recent projects. There may also be projects that were missed in the search as they were not directly related to mountain pine beetle but whose results could be applied to address some of the identified gaps. For example, growth and yield models developed to model growth in uneven-aged or thinned stands may have applicability in “beetle-proofed” stands in which only the pine component was removed.

Some indirectly related projects were included when they were found during the search process. Other projects whose results could serve as baseline data to help determine the impacts of mountain pine beetle on various values were also found and some are included in Appendix A.

This list is not complete as there are no doubt other research projects and trials which could provide baseline data. The B.C. Ministry of Forests and Range (MFR) has completed the development of a research and operational trial database which could be used to address this need. The data is stored in the Land Resource Data Warehouse (LRDW) (<http://lrdw.ca/>) and can be accessed by government and industry staff using ArcGIS, iMapBC, and Forest Mapview. For more information on the database, visit: <http://www.for.gov.bc.ca/hre/pspdata/>

The largest number (95) of projects was classified under **product information/research**. This represents a more than three-fold increase compared to the number of such projects identified in the previous version of this report issued in 2005. This category includes the use of (and the technology to use) mountain pine beetle-killed timber in existing products, the effects of blue stain, and the development of alternate uses for this wood. Funding sources for these projects were varied, but 75% of the additional 69 projects from 2005 to 2008 were funded under Forestry Innovation Investment Ltd. Approximately 73 projects in this category are complete, the majority of which have publications or reports associated with them.

There has also been quite an extensive amount of research done (40 projects) on **management, risk assessment, and control strategies**. This topic area includes projects on “beetle-proofing” landscapes, the use of chemical repellents, and risk assessment models as well as MPB management strategies and plans. In contrast to product information/research, the management, risk assessment and control strategies topic area experienced moderate growth (16%) in the number of projects from 2005 to 2008. Approximately 32 of the 40 projects are complete. Some of the projects listed in this topic area in Table 2 corresponded to several of the high-, moderate-, and low-priority gaps identified in the MFR research strategy, most notably in the strategic analysis, planning, and decision support research discipline area. It is difficult to determine whether or not more research is required in this area as management and control strategies can vary extensively depending on the level and stage of infestation as well as the biogeoclimatic zone and resultant tree species composition of the infested forest.

The third topic area with a significant number of research projects (30) is **Hydrology**. Twenty-one of these projects are complete. Since 2005, 13 new projects have emerged, a growth that seems to address the significant knowledge gaps in this area identified in the B.C. Ministry of Forests and Range’s *Mountain Pine Beetle Stewardship Research Strategy* (2005) and issues raised by First Nations. The hydrology topic area is quite extensive, covering a wide range of subjects relating to water quality and quantity. Subject areas that do not appear to be covered by projects include hydrologic recovery and riparian management.

A significant amount of funding has also been directed toward projects related to **MPB detection methods**. Of the 23 projects identified in the report, only two remain incomplete. Several studies have looked at different remote sensing techniques, including satellite and spectral imaging, to determine the extent of the mountain pine beetle infestation.

The next six topic areas had between 15 and 20 projects each. These were in the area of **regeneration, natural structural stand dynamics and ecosystem function, general extension activities, biodiversity and wildlife, MPB population dynamics, and MPB biology**.

The **regeneration** topic area, which has grown significantly (90%) since 2005, contains 19 projects, 11 of which are complete. Several of these projects attempt to predict release and advance regeneration, which will help forest managers prioritize stands for silvicultural treatments. Other projects aim to relate natural regeneration to existing stand structure, corresponding to high-priority knowledge gaps under the silviculture, growth and yield discipline area in the MFR strategy document.

The subject of successional patterns following mountain pine beetle infestation and mountain pine beetle as a natural disturbance agent are covered in the topic of **natural structural stand dynamics and ecosystem function**. An additional five projects, all of which are currently active, have been identified in the 2008 edition of this report, representing a 33% increase. This topic area was not identified as a knowledge gap in the MFR research strategy, but was identified as such in the Mitchell and Stjernberg (2005) paper.

The **biodiversity and wildlife** topic area now includes 17 projects, which cover a range of subjects from specific species in the forest ecosystem to biodiversity on a more general level. The number of projects in the biodiversity and wildlife topic area has grown significantly since 2005 (113%). Ten of the 17 projects are now complete. It should also be noted that the 10 projects in the species at risk category could also be classified under biodiversity and wildlife, bringing the total number of projects up to 27.

There are 18 **general extension** projects dealing with the communication of information on the mountain pine beetle. Mitchell and Stjernberg (2005) noted the need for improved dissemination of existing knowledge on mountain pine beetle as well as assistance in the application of this information in an operational context. The majority of projects in this topic area involve the communication of mountain pine beetle information to the natural resource management community. The seminar series conducted by FPIInnovations provided new operational guidelines for timber manufacturers. Together, these projects address Mitchell and Stjernberg's concern. The "MPB Research Synthesis and Strategy Forum" involved the development of a mountain pine beetle extension plan which can be used to guide and co-ordinate the delivery of the additional extension activities that are required due to the extremely wide breadth of the topic areas impacted by mountain pine beetle. Two other extension projects, a mountain pine beetle workshop in March 2008 and a major MPB conference, scheduled for June 2008 in Prince George, are currently in the process of being organized by FORREX and its partners.

The **population dynamics** topic area includes two main subjects, modelling population spread and modelling dispersal patterns, both of which are addressed by the projects identified in this report. Sixteen projects were identified in 2008, compared to 11 in 2005, representing a 45% increase; ten of these projects are now complete.

The **MPB biology** topic area includes projects on mountain pine beetle flight and dispersal characteristics, pheromones, host resistance, and interactions of MPB with other beetle species. While all of these areas are covered, the coverage is limited to two or three projects per subject. Three of the 16 projects are currently active or newly initiated.

The next six topic areas had between nine and 13 projects each. These were in the areas of **timber supply** (13), **socio-economics** (13), **salvage and ecosystem function** (13), **harvesting, hauling and storage** (10), **species at risk** (10), and **shelf life** (9).

Of the 13 projects related to **timber supply**, all are complete except one. Although this is not explicitly listed in the MFR strategy as a high-priority knowledge gap, there are some identified knowledge gaps that have timber supply concerns built into them. The strategy also lists moderate- and low-priority timber supply knowledge gaps.

In the **socio-economics** topic area, the newly formed community action committees constitute all four of the new projects. Of the remaining projects, two of these were conferences, both attended by the lead author, at which information on a variety of topics was presented and discussed. Reports are available for both on the Internet (the URL for each is included in Table 2). The remaining seven projects have all been completed, and were all funded by the MPBI with the exception of one which was funded by the Innovative Forest Practices Agreement program. This topic area is very broad and complex, and additional research is likely required. This topic area was not covered by the MFR research strategy but was raised by First Nations as one of the key issues.

The **salvage and ecosystem function** topic area has grown significantly, from two projects in 2005 to 13 projects in 2008, 10 of which are complete. The majority of projects address the effects of salvage harvesting on ecological, silvicultural, and non-timber values, relating to high-priority knowledge gaps identified in the MFR research strategy as well as those raised in the First Nations presentation.

Since 2005, two new projects have been added to the **harvesting, hauling, and storage** topic area, bringing the total to 10, all but one of which are complete. This topic area was not covered by the MFR research strategy, although determining the administrative costs and economic barriers to management, of which this would be a component, was listed as a knowledge gap in the Mitchell and Stjernberg (2005) report.

The number of projects in the **species at risk** topic area has also grown significantly, from two projects in 2005 to 10 projects in 2008, six of which are newly initiated. All projects in the category study caribou populations. It should be noted that one project studying grizzly bear habitat was included in the biodiversity and wildlife topic area, but could also be included here.

**Shelf life** of mountain pine beetle-killed wood for various forest products was identified in the MFR strategy as a high-priority knowledge gap area. There are currently nine projects investigating various facets of this topic area, six of which are complete.

The remaining six topic areas (excluding access management) each had seven projects or fewer. These topic areas include **silvicultural options/restoration** (7), **MPB and other pine species** (7), **fuel loading and fire behaviour** (7), **climate change** (5), **geomorphology** (2), and **worker safety** (2).

The **silvicultural options/restoration** topic area has one ongoing project and the remaining six are now complete. The MFR research strategy lists several high-priority knowledge gaps as well as some moderate- and low-priority gaps in two research discipline areas. This area was also identified as a knowledge gap in the Mitchell and Stjernberg report. Some of the projects may partially address the identified needs, but more research is required.

Of the seven projects studying **mountain pine beetle and other species**, two are ongoing and two are newly initiated. The majority of projects deal with whitebark pine while three of the newer projects deal with jack pine and ponderosa pine. Concern has been expressed about the potential of the mountain pine beetle to expand into the jack pine forests of the Boreal Forest Region. This was identified as a high-priority information need in the MFR strategy.

There have been no new additions to the six completed projects in the **fuel loading and fire behaviour** topic area since 2005. Fire and fire management was not included in the MFR strategy although the Mitchell and Stjernberg (2005) report acknowledged the need for further research on understanding “natural disturbance agents and processes (fire and beetle) and what’s required to manage natural disturbance regimes.” This need also may be addressed through projects under the topic area of natural stand structure and ecosystem function which was discussed earlier in this report. This topic area is a key issue for First Nations communities (First Nations Forestry Council 2006).

There are also no new projects identified in the **climate change** topic area. The MFR strategy identifies three moderate- and two low-priority knowledge gaps relating to climate change, none of which appear to be covered by the listed current and recent MPB projects in Table 2 (although the climate change project by the Foothills Model Forest may address some of these gaps). More detailed information on this project is needed. However, the MFR strategy lists one high-priority knowledge gap on the survival, virulence, and range expansion of the mountain pine beetle due to changes in climate under the entomology research discipline area. This need is being addressed by the current suite of projects, though further studies may be required.

Four new projects were added to the **access management** topic area. Three of these projects were GIS mapping exercises designed to assist in access management planning while the fourth dealt directly with access management in one of the forest districts heavily impacted by the mountain pine beetle.

Previously, there was only one identified project in both the **worker safety** and **geomorphology** topic areas, but the addition of a provincially funded project to each topic brings their totals up to two.

As mentioned previously, this analysis did not involve a detailed review of the available literature on mountain pine beetle. Much has been published on this topic in the United States and in Canada and it is recommended that a comprehensive review of the available literature be conducted to ensure that some of the current information needs have not already been addressed by previous studies. It is also recommended that a detailed needs assessment with client groups be conducted, covering those areas not addressed by the B.C. Ministry of Forests and Range *Mountain Pine Beetle Stewardship Research Strategy* or by the Mitchell and Stjernberg report, to help define the specific questions relating to mountain pine beetle for which answers are required. After these two activities are complete, a more thorough analysis of what is known and what is unknown can be conducted to determine where there is a need for further research to answer some of the specific questions and where some of the questions can be addressed through improved extension of currently available information.

#### 4.1 Other Initiatives

The Province has developed *British Columbia's Mountain Pine Beetle Action Plan 2005-2010* ([http://www.for.gov.bc.ca/hfp/mountain\\_pine\\_beetle/actionplan/2005/](http://www.for.gov.bc.ca/hfp/mountain_pine_beetle/actionplan/2005/)) which describes the short- and long-term steps to be taken to help mitigate the impacts of the mountain pine beetle infestation on forest values, communities, and the provincial economy. This high-level framework document, through the seven objectives and associated actions described in it, will help direct provincial ministries and assist in the co-ordination of efforts between governments, industries, and stakeholders.

The Province also formed a committee at the request of the Chief Forester to gather information on the management of species composition in cutblocks in beetle-impacted Timber Supply Areas. The committee was asked to answer the following questions:

1. Are harvested areas being reforested to desirable species composition?
2. Are species management practices and outcomes adequately monitored and controlled?
3. What actions are recommended to improve management of species composition?

The committee's results have been published in a report by Martin *et al.* (2005) entitled *Management of species composition in cutblocks in beetle-impacted TSAs* (available at <http://www.for.gov.bc.ca/hfp/fft/committees/sdag/reports/SpeciesManagement-All-Final-print.pdf>).

As well, FORREX has completed an annotated bibliographic database of published literature related directly or indirectly to mountain pine beetle. This database has been incorporated into the Natural Resources Information Network, under the title Mountain Pine Beetle Information Network (<http://www.forrex.org/mpb>) and is available to the public. Major updates to this information network are expected by mid to late March, 2008. A mountain pine beetle extension plan has also been developed by FORREX to guide extension efforts in this area.

Other groups involved in the efforts to address issues around the current mountain pine beetle infestation include the Mountain Pine Beetle Task Force, the Mountain Pine Beetle Stewardship Group, the Cariboo-Chilcotin Beetle Action Coalition, the Omineca Beetle Action Coalition, the Southern Interior Beetle Action Coalition, and the First Nations Mountain Pine Beetle Initiative.

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## APPENDIX A

### Examples of research and operational trials that could be used to provide baseline data for measuring effects of mountain pine beetle

Source: B.C. Ministry of Forests and Range *Mountain Pine Beetle Stewardship Research Strategy* background documentation and reports.

#### HYDROLOGICAL/GEOMORPHOLOGIC/SOILS

Project Title	Lead Researcher	Organization
Upper Penticton Creek Watershed Project – Water quantity and quality responses to rate of harvest. Water balances and hydrologic modelling (Reference for MPB effects)	Rita Winkler	BC Ministry of Forests and Range (BC MFR)
Mayson Lake Snow Studies. Influence of forest canopies on snow accumulation and melt. Studies of post-harvest hydrologic recovery (Reference for MPB effects)	Rita Winkler	BC MFR
Channel morphology, large woody debris in biogeoclimatic zones (Reference sites for MPB studies)	Dan Hogan	BC MFR
Work in partial cuts that are similar to pine beetle salvage in mixed stands	Various	Various
Soil conditions and tree growth in BC's forests	Chuck Bulmer	BC MFR
Long Term Soil Productivity Study	Graeme Hope Shannon Berch	BC MFR

#### PRODUCT INFORMATION/RESEARCH

Project Title	Lead Researcher	Organization
Modelling the impact of stand management regimes on the wood characteristics of lodgepole pine	Jim Goudie	BC MFR

#### BIODIVERSITY AND WILDLIFE

Project Title	Lead Researcher	Organization
Caribou herd research	Harold Armleder Dale Seip Bruce McLellan	BC MFR
Caribou/mule deer silviculture systems	Harold Armleder Dale Seip Bruce McLellan	BC MFR
Grizzly bear project	Dale Seip Bruce McLellan	BC MFR
Understorey species response to restoration (relates to range values)	Reg Newman	BC MFR
Variable retention and wind damage studies	Dave Coates	BC MFR
Effects of intensive fertilization on timber and non-timber resources	Rob Brockley	BC MFR

## TIMBER SUPPLY

<b>Project Title</b>	<b>Lead Researcher</b>	<b>Organization</b>
Stand management growth and yield field experiments in the B.C. interior	Rob Brockley	BC MFR
Treatment options for repressed pine in West Chilcotin Caribou habitat (EP 1221)	Teresa Newsome	BC MFR
Growth prediction of canopy trees in complex structured mixed-species stands	Dave Coates	BC MFR
Release of spruce and subalpine fir after partial cutting	Dave Coates	BC MFR
St. Mary's residual basal area study in a mixed conifer stand	Michaela Waterhouse	BC MFR
Partial cutting systems research in Armillaria root rot infected stands (EP 1186)	Michaela Waterhouse	BC MFR
Uniform shelterwood system for even-aged Douglas-fir and lodgepole pine stands in the SBSdw in the Cariboo Forest Region (EP1104.01)	Michaela Waterhouse	BC MFR

## REGENERATION

<b>Project Title</b>	<b>Lead Researcher</b>	<b>Organization</b>
Ongoing efforts to parameterize SORTIE for SBS zone	Dave Coates	BC MFR
Partial cutting systems research in Armillaria root rot infected stands (EP 1186)	Michaela Waterhouse	BC MFR
Uniform shelterwood system for even-aged Douglas-fir and Lodgepole pine stands in the SBSdw in the Cariboo Forest Region (EP 1104.01)	Michaela Waterhouse	BC MFR
Seeding and planting of spruce under varying densities of overstory pine	Dave Coates	BC MFR

## CLIMATE CHANGE

<b>Project Title</b>	<b>Lead Researcher</b>	<b>Organization</b>
BC's Forest Carbon Balance	Dave Spittlehouse	BC MFR
Spatial climate data and assessment of climate change impacts on forest ecosystems – FSP project	Dave Spittlehouse	BC MFR

## BEEBLE BIOLOGY

<b>Project Title</b>	<b>Lead Researcher</b>	<b>Organization</b>
Preliminary surveys of 25- to 30-year-old stands in the former Cariboo region have shown that of the 50 stands surveyed damage ranged from 0 to 65% – MFR background info	Lorraine Maclauchlan	BC MFR