Mountain Pine Beetle and Watershed Hydrology: Workshop Summary

Todd Redding and Robin Pike

Increasing concern over the potential effects of the mountain pine beetle (MPB) infestation and associated salvage harvesting on water resources throughout the Interior of British Columbia has prompted a broad range of research at both the stand and watershed scales. This research is attempting to address uncertainty about the hydrologic effects of MPB, such as an increased potential for flooding; changes in water yield, peak flows, and low flows; slope and channel changes associated with increased runoff; as well as the effects of hydrologic change on aquatic habitat and drinking water.

A workshop titled "Mountain Pine Beetle and Watershed Hydrology Workshop: Preliminary Results of Research from BC, Alberta and Colorado" was held in Kelowna, BC, on July 10, 2007. This workshop gave researchers an opportunity to present results of ongoing projects relevant to understanding MPB effects on hydrology. The audience was primarily from the Southern Interior, where the MPB infestation has not yet peaked, and time remains for proactive planning to address this large-scale disturbance.

This article highlights a few key points raised in the 21 presentations, and outlines future information needs and results of the post-workshop evaluation. Below, we outline the presentation titles with reference to their respective two-page presentation summaries, which are available on the FORREX Web site.

Introductory Presentations

The Changing Landscape: Tracking the Footprint of the Mountain Pine Beetle.
Lorraine Maclauchlan, BC Ministry of Forests and Range (p. 7)

Secondary Structure in Lodgepole Pine Dominated Stands Attacked or Threatened by the Mountain Pine Beetle in the Kamloops Timber Supply Area.
Alan Vyse, Thompson Rivers University (p. 9)

MPB from a Flood and Public Safety Perspective.
Markus Schnorbus, BC Ministry of Environment (p. 11)

Stand-scale Studies

Impact of MPB Infestation and Salvage Harvesting on Seasonal Snowmelt and Runoff.
Sarah Boon, University of Lethbridge (pp. 13–14)

Comparison of Peak Snow Accumulation Between Green and Grey MPB Stands.
Pierre Beaudry, Pierre Beaudry and Associates (pp. 15–16)

Solar Radiation and Snow Ablation in Natural and Managed Pine Stands.
Pat Teti, BC Ministry of Forests and Range (pp. 17–18)

Snow Accumulation and Melt in Southern Interior Lodgepole Pine Forests.
Rita Winkler, BC Ministry of Forests and Range (pp. 19–20)

Stand Water Balance in Absence of Mountain Pine Beetle: Synthesis of Several Alberta Studies to Characterize "Reference" Water Use of Lodgepole Pine.
Uldis Silins, University of Alberta (pp. 21–22)

Preliminary Findings on Canopy and Bryophyte Forest Floor Interception Loss of Growing-season Rainfall at Mayson Lake.
Darryl Carlyle-Moses, Thompson Rivers University (pp. 23–24)

Influence of the Mountain Pine Beetle on the Site Water Balance of Lodgepole Pine Forests.
Dave Spittlehouse, BC Ministry of Forests and Range (pp. 25–26)

Assessment of the Impacts of Wildfire and MPB Infestation on In-stream Wood Recruitment and Transportation Processes in the BC Interior (Poster).
Adam Wei, University of British Columbia-Okanagan (pp. 53–54)

Estimating Springtime Solar Radiation in Pine Stands by Different Methods (Poster).
Pat Teti, BC Ministry of Forests and Range (pp. 55–57)

Watershed-scale Studies

Preliminary Assessment of Water Quantity and Water Quality Changes in Beetle-killed Catchments in North-central Colorado.
John Stednick, Colorado State University (pp. 27–28)

MPB, Riparian Retention, and the Loss of Summer Ground: An Overview of Projects from the Central Interior.
John Rex, BC Ministry of Forests and Range (pp. 29–30)

The Fishtrap Creek Study: The Effects of Extreme Disturbance on Streamflow, Sediment, Aquatic Ecology and Channel Processes.
Tim Giles, BC Ministry of Forests and Range (pp. 31–32)

Evaluation of the Impacts of Large-scale Forest Disturbance on Hydrology in the BC Interior.
Adam Wei, University of British Columbia-Okanagan (pp. 33–34)

Effects of Pine Beetle Infestations and Treatments on Hydrology: Integrating Stand-level Data into Mesoscale Watershed Functions (Poster).
Younes Alila, University of British Columbia (pp. 57–58)

Hydrologic Model Applications

Modelling Hydrologic Effects of Landscape Disturbance - an Introduction.
David Hutchinson, Environment Canada (pp. 35–38)

Hydrologic Assessment of Potential Effects of Mountain Pine Beetle Infestations in Western Alberta.
Richard Rothwell, Watertight Solutions (pp. 39–40)

Predicting the Effects of Post-MPB Salvage Harvesting Using a Conceptual Streamflow Model (HBV-EC): Initial Evaluation Using a Paired Catchment Approach.
Dan Moore, University of British Columbia (pp. 41–42)

Delineating the Limits on Peak Flow and Water Yield Responses to Clearcut Salvage Logging in Large Watersheds.
Younes Alila, University of British Columbia (pp. 43–44)

Modeling Streamflow Following MPB Attack and Salvage Harvest in the Baker Creek Watershed Using the Distributed Hydrology-Soil-Vegetation Model (DHSVM).
Steve Chatwin, BC Forest Practices Board (pp. 43–44)

Risk Assessment Procedures

Modeling Hydrologic Hazards to Support Decisions in MPB Response.
Martin Carver, BC Ministry of Environment (pp. 47–50)

Rating the Peak-Flow Hazard by Identifying and Mapping Runoff Generation Processes.
Markus Weiler, University of British Columbia (pp. 47–50)

FREP Water Quality Effectiveness Evaluation: A Methodology to Determine Forestry and Range Effects on Water Quality.
Dave Maloney, BC Ministry of Forests and Range (pp. 51–52)

Key Findings from Workshop Presentations

- In British Columbia, over 9.2 million ha of various levels of red attack were mapped in 2006. The pressure is so extreme in many areas throughout the core of the outbreak that non-traditional hosts and younger age classes of pine are at risk.
- Contrary to popular thought, pine-leading stands in riparian zones and wetter ecosystems can have a large component of non-pine species (i.e., are not dominated by pine).
- Approximately 7.7 million ha (or 88%) of the MPB-affected area lies within the area drained by the Fraser River, raising the possibility that hydrologic impacts may be detected as far downstream as the Lower Mainland.
- Grey attack stands are intermediate between mature forest (low) and clearcuts (high) for both maximum snow accumulation and snowmelt rates; snow tends to persist longer in the forest than in openings.
- Hydrologic recovery of pine stands on the Fraser Plateau tends to be very low in the first 12 years after logging in terms of transmitted solar radiation and snow ablation rates. However, 35 years after logging, it is possible for radiation and ablation rates in recovering cutblocks to be close to those in old healthy forests if the site index is 16 or more.
- In Alberta, stand leaf area index (LAI) peaked early in the developmental sequence of lodgepole pine (roughly around the time of peak crown closure; ~25 years on productive sites). Rainfall interception–storage capacity of lodgepole pine canopies varied from 1 to 4 mm.
- In some areas, bryophyte storage capacity is sizable, ranging from 4 to 8 mm.
- A process-based stand water balance model showed that annual soil water drainage out of the root zone (water potentially available to become streamflow) was greatest in a clearcut and least in a green stand, with grey and red stands intermediate.
- The percentage of beetle-killed forest may not be the best metric of hydrologic disturbance. The variability in the response may be due to the forest coverage in the study catchment. Forest covers are often neither uniform nor completely cover the catchment.
- Field research and modelling indicate potential increases in peak flows and annual water yield, with magnitudes varying by location and year.
- A number of hydrologic models and risk assessment procedures are available that can be applied to MPB-affected watersheds. The appropriate selection and application of these tools depend on management objectives, data availability, and time/resources. Further testing and application of these tools is required.

Information Needs

Both the audience and presenters made a range of suggestions about information needs and future research activities, including:

- an improved ability to estimate streamflow changes at large watershed scales;
- an improved ability to identify and select the appropriate hydrologic models for various questions and circumstances;
- a greater knowledge of the roles and benefits of retaining non-pine and understorey vegetation; and
- a need for a follow-up workshop(s) in 2–3 years as research projects are completed.

Workshop Evaluation

A post-workshop evaluation survey completed by 47% of participants showed that over 90% of respondents stated that the workshop increased their knowledge of hydrological effects of MPB infestation and salvage harvesting, and increased their knowledge of current research. The workshop was rated as good to excellent by 90% of respondents; many indicated that the knowledge gained from the presentations will be directly applied in their resource management activities.

Continued on page 24

Continued from page 23

References for Further Information

The workshop handbook with two-page summaries from each presenter is available at *http://www.forrex.org/program/water/mpb_hydrology.asp*

Acknowledgements

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Update

New Publications

Adams, P.W. 2007. **Policy and management for headwater streams in the Pacific Northwest: Synthesis and reflection.** Forest Science 53(2):104–118.

De Groot, J.D., S.G. Hinch, and J.S. Richardson. 2007. **Effects of logging second-growth forests on headwater populations of coastal cutthroat trout: A 6-year, multi-stream, before-and-after field experiment.** Transactions of the American Fisheries Society 136:211–226.

Guthrie, R.H. and S.G. Evans. 2007. **Work, persistence, and formative events: The geomorphic impact of landslides.** Geomorphology 88(2007):266–275

Hudson, R. and G. Horel. 2007. **An operational method of assessing hydrologic recovery for Vancouver Island and south coastal BC.** B.C. Ministry of Forests and Range, Research Section, Coast Forest Region, Nanaimo, B.C. Technical Report TR-032/2007. 16 p.

MacDonald, L.H. and D. Coe. 2007. **Influence of headwater streams on downstream reaches in forested areas.** Forest Science 53(2):148–168.

May, C.L. 2007. **Sediment and wood routing in steep headwater streams: An overview of geomorphic processes and their topographic signatures.** Forest Science 53(2):119–130.

Owens, P., W. Blake, and E. Petticrew. 2006. **Changes in sediment sources following wildfire in mountainous terrain: A paired–catchment approach, British Columbia, Canada.** Water, Air, and Soil Pollution: Focus (2006) 6:637–645.

Perrin, C.J. 2006. **Application of multivariate techniques to examine quality of streams in the Okanagan region.** Report prepared by Limnotek Research and Development Inc. for B.C. Environment. 39 p.

Petticrew, E., P. Owens, and T. Giles. 2006. **Wildfire effects on the quantity and composition of suspended and gravel-stored sediments.** Water, Air, and Soil Pollution: Focus (2006) 6:647–656.

Richardson, J.S. and R.J. Danehy. 2007. **A synthesis of the ecology of headwater streams and their riparian zones in temperate forests.** Forest Science 53(2):131–147.

Upcoming Publications

Compendium of Forest Hydrology and Geomorphology in British Columbia

The compendium has been designed to synthesize over 30 years of British Columbia forest hydrology/geomorphology research and experience into a consolidated and readily accessible document. The overall goal of the project is to help protect water in British Columbia by (1) providing an applied synthesis of forested watershed processes, and (2) demonstrating how land-use affects these processes in different regions of our province. It promotes an integrated understanding of forest hydrology and geomorphology issues. The focus is on principles and techniques, drawing on BC case studies to illustrate and move discussions from fundamentals to application.

The compendium will be published in the Land Management Handbook series as a joint publishing venture between the B.C. Ministry of Forests and Range and FORREX. *By March 2008, chapters listed below will be completed in preparation for compilation and printing in 2008. In the interim, as chapters are completed, they will be made available for download on the following Web site: http://forrex.org/program/water/compendium.asp*

WORKING TABLE OF CONTENTS
(Last update: Oct.1, 2007) Chapters in blue are immediately available for download.

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