

Results of the Workshop to Develop Objectives for a Provincial Level Projection of the Current MPB Outbreak

*Supported by the
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1.0 Introduction and Process

On September 17, 2003 a workshop was held to develop specific objectives for a project to conduct a Provincial Level Projection of the Current MPB Outbreak. The workshop is one of the initial steps in the “Collaborative Landscape Analysis” process that is being used in this project (Fall *et al.* 2001. Transactions in GIS 5(1):67-86).

This document summarizes the results of the workshop. There are two additional documents, distributed with this summary, which provide context and important, detailed information. These are:

- Detailed Minutes of the Workshop.
- Mountain Pine Beetle Initiative Project Outline: Provincial Level Projection of the Current MPB Outbreak.

The presentations made at the workshop (PowerPoint format) are very large and, as a result, are available on the Ministry of Forests ftp site at:
<ftp://ftp.for.gov.bc.ca/hre/external/outgoing/meng/MPBWorkshop>

- 4YearsOfAttack.pps: A summary of the area affected by the last 4 years of the outbreak
- Collaborative Landscape Analysis Framework - Marvin Eng.ppt: A description of the framework and software Tool that will be used in the project
- Mountain Pine Beetle Strategy - Peter Hall.ppt: A description of the current, provincial Bark Beetle Strategy Technical Implementation Guidelines
- MPBSim-MPBSELES Modeling - Andrew Fall.ppt: Results of district level MPB modelling that has been conducted by project team members over the past 3 years.

The specific objectives of the workshop were to gather the group of proposed clients of the project along with practitioners with expertise in the topic and:

- Develop a common understanding of the context for the problem
- Discuss general objectives for the project.
- Discuss modelling and information issues.
- Develop specific questions to be answered and management scenarios and indicators that would answer those questions.
- Outline next steps for the project for the benefit of the client group.

Seventeen people attended the workshop including the members of the project team, domain experts and senior managers, or their delegates, from the provincial and federal governments. After spending the morning discussing the context for the problem the group proceeded to identify specific clients for the results of the project and outline:

1. The decision(s) those clients need to make that would benefit from having information that will be produced by the project;
2. The specific questions that need to be answered by the project in order assist with those decisions;
3. The indicators that need to be reported on by the model to answer those questions; and
4. The scenarios that need to be examined to gain confidence in and understanding of, the answers provided by the indicators
5. Finally, the group identified an appropriate domain expert to specify the conceptual models and evaluate the results

2.0 Clients and Their Needs

The clients are listed in Table 1. Note that clients are presented in Table 1 in the order in which they were discussed, rather than any implied order of importance. For each client Table 1 provides a summary of the decision or decisions that need to be made, at a provincial scale, as a result of the current Mountain Pine Beetle outbreak. In addition Table 1 outlines the questions that need to be answered to assist in that decision.

Table 1: Clients of the project, provincial scales decisions they need to make that will be affected by Mountain Pine Beetle outbreak and the questions that need to be answered to help with those decision.

Client	Decision	Questions
Federal government; National Forest Carbon Sinks Committee	Should forest management be included in the net carbon balance calculations for Canada?	<ul style="list-style-type: none"> • How do Mountain Pine Beetle affect the net provincial carbon balance? • What proportion of the pine will be killed in the first “commitment window” for the Kyoto protocol (2008 to 2012)?
Forest Investment Council	Where should the planning for forest health rehabilitation budget be allocated?	<ul style="list-style-type: none"> • How much is needed where? • How are allocation decisions made provincially? • Where is the damage, how much can be salvaged provincially
Ministry of Forests; Forest Practices Branch; Forest Health Program	Refinements to the bark beetle strategy.	<ul style="list-style-type: none"> • What is the rate of change of the outbreak characteristics. • What is the relative impact on the outbreak resulting from different management strategies • How would weather events of differing magnitude affect the outbreak.
Ministry of Sustainable Resource Management; Terrestrial Information Branch	Planning workload for Forest Cover/Inventory update	Where will the infestation spread to at various levels of intensity over the time frame of 3, 5 and 10 years?
Ministry of Water Land and Air Protection; Environmental Stewardship Division	How should habitat management change in response to the outbreak?	<ul style="list-style-type: none"> • What will the effect of the outbreak be on habitat quality for selected species and species groups as a result of: <ul style="list-style-type: none"> • The MPB outbreak itself? • Forest management designed to deal with the MPB outbreak?
Ministry of Sustainable Resource Management; Planning Division	Should land use / management zones be altered in the face of the MPB outbreak?	<ul style="list-style-type: none"> • What effect will the MPB outbreak have on the nature of management zones? • What effect will forest management under the Bark Beetle Regulation have on the nature of management zones?

		<ul style="list-style-type: none"> Given extent of outbreak what are the implications for not employing additional harvesting in zones with high old growth requirements that would be compromised by roading and harvesting of impacted stands?
Ministry of Forests; Forest Analysis Branch	<ul style="list-style-type: none"> What are the cumulative impacts of AAC uplifts. Economics of forest industry resource reallocation. Development of regional strategies in the face of the outbreak. 	<ul style="list-style-type: none"> What is at risk provincially: <ul style="list-style-type: none"> To the “end” of the outbreak? After 5 years? What is the effect of cutting pine preferentially? What are the implications of the possible regeneration delay on NSR. What is the most likely outcome given the various factor involved but most importantly the probability of different weather events.

3.0 Indicators

The “indicators” that will be produced by the model can be thought of as the “raw information” that will assist in answering the questions presented in Table 1. Although some progress was made at the workshop in specifying the indicators required for each question, further refinement of the exact nature of the “indicator file” required by each client will be necessary. This will be done in conjunction with discussions with domain experts about the specific conceptual models required. In general each indicator will have 4 characteristics: a measured value (e.g. pine affected), unit of measurement (e.g. volume in cubic meters); a reporting strata (e.g. each Beetle Management Unit); and a time period (e.g. the 5 years from 2004 to 2009).

3.1 Measured Values

There were five measured values identified as being of interest to the client group:

1. Green tree harvest.
2. Salvage harvest.
3. Non-recovered losses.
4. Forest at risk to attack – further modified by categories of risk to be estimated in a fashion similar to the Shore/Safranyik susceptibility and risk methodology.
5. Forest affected by Mountain Pine Beetle – further modified by “intensity” of effect; i.e. the percentage of the pine trees killed and the percentage of all trees killed.

3.2 Units of Measurement

For each of the measured values one or more of the following units of measurement will be used in reporting:

- Volume of wood affected (in cubic meters) will be reported as the standing volume of pine that is affected and the percentage of total pine and the percentage of the total volume (in the strata).
- Area affected (in hectares) will be reported as the total area affected.

Note that measured values involving rates, such as the rate of change in the amount of area affected and the speed of progression of any observed front will be derived from the area or volume affected and the appropriate time period.

3.3 Reporting Strata

Reporting Strata are the spatial units that will be used to summarize each measured value for each time period. The complete list of reporting strata that will be used will be determined in consultation with domain experts for each client. At a minimum the following reporting strata were identified at the workshop:

- Beetle Management Units
- Timber harvesting landbase and non-contributing landbase
- Selected Wildlife Species Ranges (Caribou, Grizzly Bear)
- Ungulate Winter Ranges
- Biogeoclimatic subzone/variant
- Visual Quality zones
- Timber types suitable for natural regeneration and those requiring silvicultural intervention
- Age class distribution of the forest.

Note that reporting strata can be nested in any way that is required. For example measured values can be reported for the age class distribution of the forest within each biogeoclimatic subzone. Note also that two other reporting strata are implicit in the discussions during the workshop:

- Reporting at the level of the spatial “grain” of the model (16 hectare cells) is equivalent to creating maps. When the maps are summarized over extended time periods (e.g. the temporal extent of the model) they provide a spatial depiction of the effect of the outbreak.
- Reporting at the level of the spatial extent of the model is effectively a provincial summary

3.4 Time Periods

The client group identified five different time periods that were of interest in the context of the current outbreak:

1. Annual (a.k.a. the temporal grain of the model)
2. 1999 to present (“historical”)
3. 2004 to 2009 (next 5 years)
4. 2008 to 2012 (first Kyoto reporting commitment period)
5. 1999 to approximately 2019 (maximum expected length of the current outbreak; a.k.a. the temporal extent of the model. This end date will be a matter of discussion amongst domain experts.)

Several of these time periods were of interest only to specific clients. Note that where the results of the model are provided in tabular format (summarized over specific reporting strata) it is simplest and most flexible to present the results on an annual basis for the temporal extent of the model run. The user of the results can then summarize them for any time period of interest. However, when maps are required it is simplest to have the model produce the spatial summaries over the time period of interest

3.5 Derived Indicators

The model will represent beetle population growth and spread, effects of the beetle on the forest and the effects of forest management. The model directly influences the measured values outlined in section 3.1 that is, their values are a result of feedback mechanisms that will be built into the model. For example, the area salvaged will vary in proportion to the area affected by beetles.

Many indicators other than those listed in section 3.1 are conceivably of interest to different clients. For example, caribou biologists may be interested in the effect of the outbreak on caribou habitat. We consider this kind of indicator to be a “derived” one. That is, it requires information that is not necessary to the model (in this example area of old forest patches) and it has no effect on the “operation” of the model (in this example caribou are affected by the beetle outbreak but have no impact on the outbreak). It is neither efficient nor desirable to have the model report on a “caribou habitat” indicator. It is better to have the model provide information that can be used by specific domain experts to create their own derived indicators. This has two advantages: it reduces the need for time consuming interactions between the core modelling team and all of the domain experts and, more importantly it allows domain experts the ability to modify their own interpretative models without requiring time consuming runs of the core model.

Where required variables will be added to the state space of the model if those variables cannot be derived from the variables that are required by the beetle or forest management models.

4.0 Scenarios

The model will provide projections of possible future outcomes. The model will not “predict” the future because of 3 types of uncertainty that are inherent in the process:

- Uncertainty in the data – e.g. forest cover maps are known to be not completely accurate
- Uncertainty in our understanding – e.g. we do not know exactly how forest managers will respond to the outbreak under all circumstances, nor do we know exactly how effective that response will be in dealing with the outbreak.
- Inherent uncertainty – e.g. it is not possible to predict which way the wind will blow during the beetle flight periods

Scenarios are used to project a range of outcomes and to provide a “most likely” outcome. Scenarios are developed by modifying the parameters of the model within the range specified by the scenario concept. The workshop identified a variety of scenarios that will require exact specification by the core modeling team and (as required) appropriate domain experts. The scenarios are of two basic types

4.1 Sensitivity Analysis Scenarios

- Forest inventory uncertainty: modify trees species, age and volume within ranges based on the inventory audit
- Weather/Climate uncertainty: modify spread and growth of the beetle population based on potential variability in flight period weather and weather affecting over-winter survival
- Population growth uncertainty: modify the growth parameters in the beetle model to reflect uncertainty in the rate of long distance spread and the ability of the population to grow as the susceptibility of the host decreases. This scenario may include various “hard” stopping rules for the outbreak.
- Management uncertainty: modify the parameters specifying the ability of forest managers to detect beetles and modify their populations with forest management

4.2 Forest Management Scenarios

Forest management scenarios represent a range of “reaction” to the outbreak. Reasonable comparison will require that all possibilities be examined:

- No harvest
- Harvest under the “*status quo*”; i.e. no beetle management
- Harvest with the anticipated beetle management per the bark beetle strategy. This includes harvesting with a preference for stands at risk of attack.
- Harvesting with varying amounts of AAC uplift
- Examine the effect of increasing or decreasing the harvest in particular land use zone on the impact of beetle outbreak (relaxing or intensifying forest policy requirements).

For each scenario the appropriate parameters of the model will be adjusted over the entire plausible range. The scenarios will be run in a Monte Carlo fashion, with numerous runs at each parameter level, and the results will be presented as means (and variance as appropriate). Combinations of scenarios, particularly weather/climate scenarios and forest management scenarios will be developed as indicated by the results of the “individual’ scenarios.

Many indicators will be suitable for presentation as time series graphs and tables but we expect the most significant indicators will be those presented as maps.

5.0 Next Steps

This workshop was one of the initial steps in the Collaborative Landscape Analysis process. The members of the project team now have a significant amount of work to do, some of which involves collaboration with domain experts identified at the workshop. The following steps will take us to the end of this fiscal year, at which point we will have completed one iteration of the Collaborative Landscape Analysis process:

- October and November:
 - Engage domain experts as required in conceptual model development and development of indicator files
 - compilation and formatting of data
- December: Model implementation and testing
- January: Engage domain experts in model verification; model modifications as required
- January and February: run scenarios
- March: report back to stakeholder group