

Provincial Level Projection of the Current Mountain Pine Beetle Outbreak:

Appendix 5. Verification and Sensitivity of the Beetle Projection Sub-Model

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We developed the beetle projection model using data from 1999 to 2002 inclusive, reserving 2003 as a verification year. Out of curiosity, we also projected forward from 1999 to see how model errors might compound over time. Over the period from 1999 to 2003 the outbreak escalates somewhat faster than our model predicts (Figure 1). That is, we overpredict the growth of the outbreak in 2000 and 2001, and underpredict in 2002 and 2003. In 2003, we predict that 39 million m³ are killed by beetles (a 77% increase in cumulative volume killed), while the data shows 52 million m³ (a 100% increase in cumulative volume killed). Our concern about this discrepancy is moderated by our belief that (even after our modifications) the overview survey data still overestimates the volume killed by beetles.

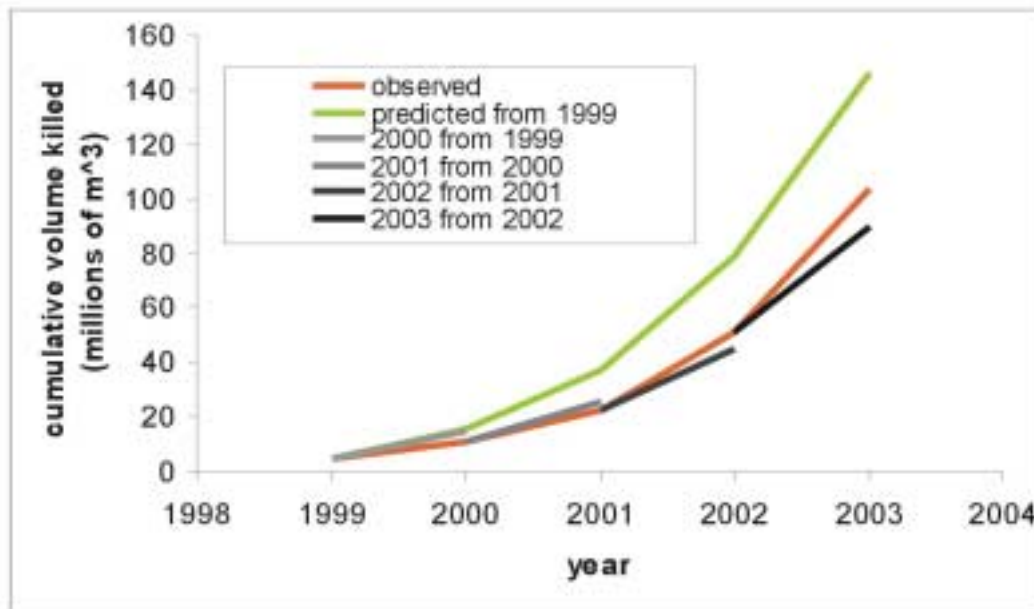


Figure 1. Province-wide performance of mountain pine beetle projection model. The model here is parameterized with data from 1999 to 2003.

The provincial-scale volume comparisons are interesting, but do not give us any real insight into how the model is behaving. For this, we turned to a more detailed comparison of observed and predicted outbreak dynamics in 2003. Aspatially, the two main differences between our model prediction and the data are: we underpredict the number of new low-severity infestations (Figure 2), and underpredict the number of infestations in progress that remain severe (Figure 3).

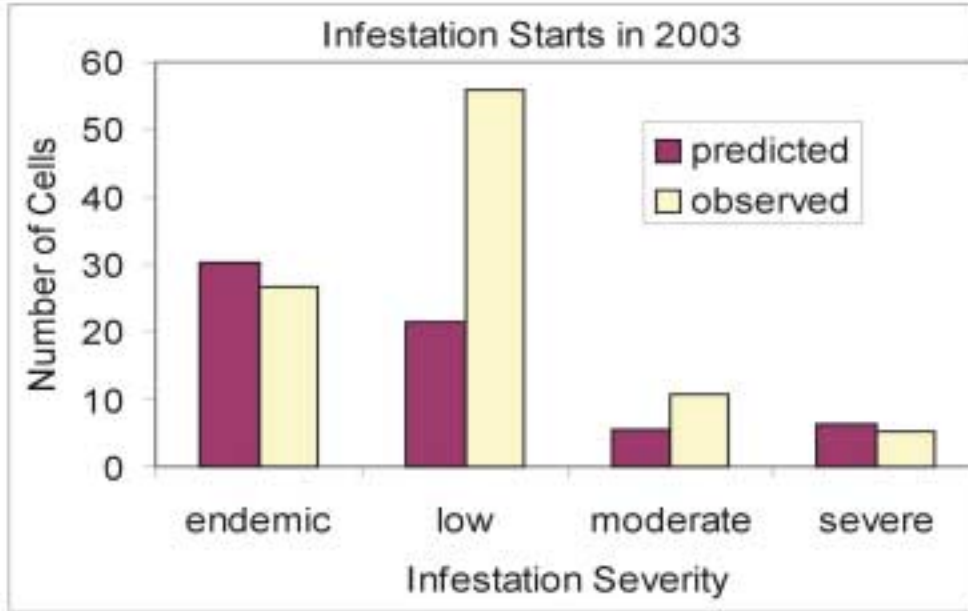


Figure 2. Comparison of behaviour of infestation start sub-model to observed infestations starts in 2003.

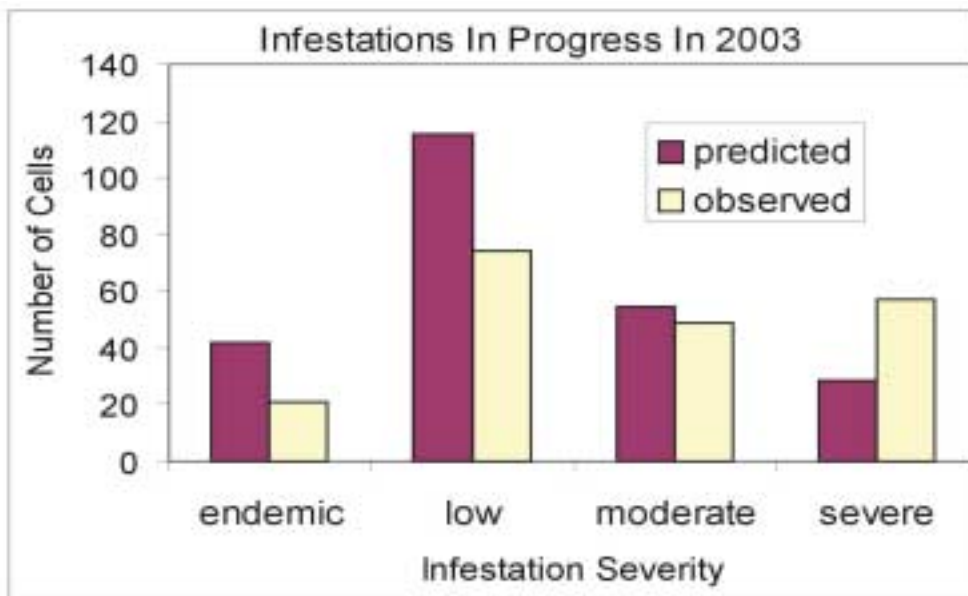


Figure 3. Comparison of behaviour of infestation progress sub-model to the observed progress of infestations in 2003.

A quick comparison of our projected map (Figure 4) to the observed distribution of beetles (Figure 5) shows that fail to predict the correct number of low infestation starts because we fail to predict the large area of the Chilcotin that became infested in 2003. First, we note that the land in this area is apparently 1-2% infested, putting it at the bottom end of the low severity class (Ebata and Westfall, personal communication). We also note that the rapid movement of beetles into this area is somewhat anomalous, given the progress of the infestation over the preceding four years. So our failure to predict this

Chilcotin outbreak underlines an inherent limitation of the beetle projection model as we have formulated it – we predict that the outbreak will continue to spread as it has since 1999. We do not include major stochastic events such as cold weather or strong winds, and we cannot unprecedented spread patterns.

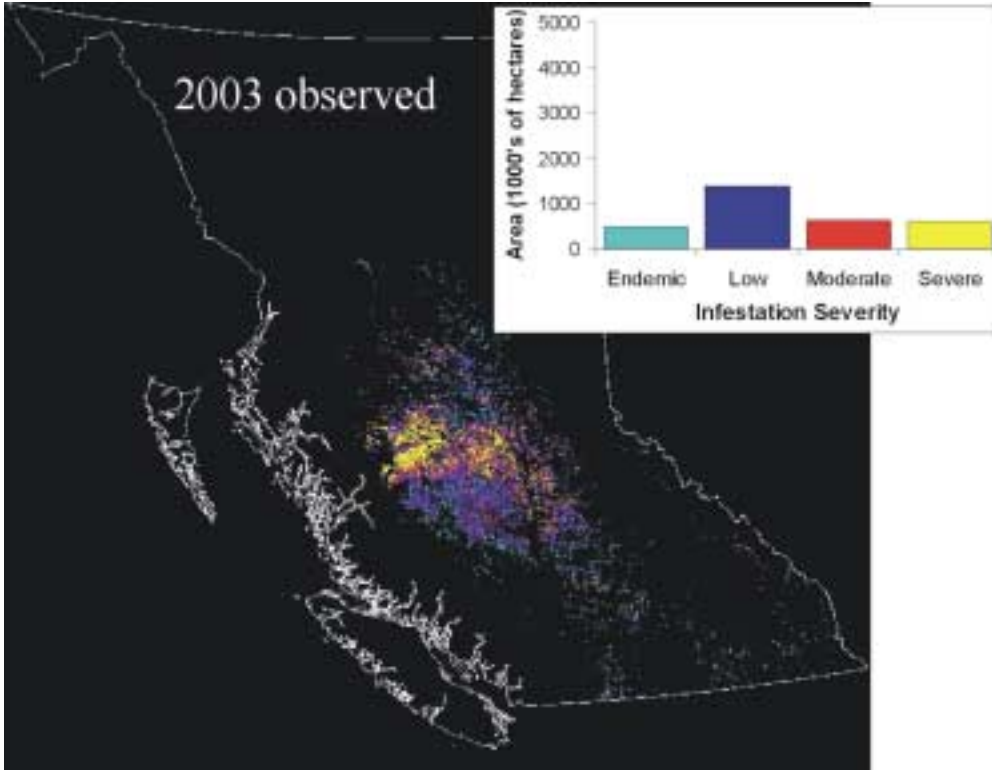


Figure 4. Observed overview of mountain pine beetle infestations in 2003.

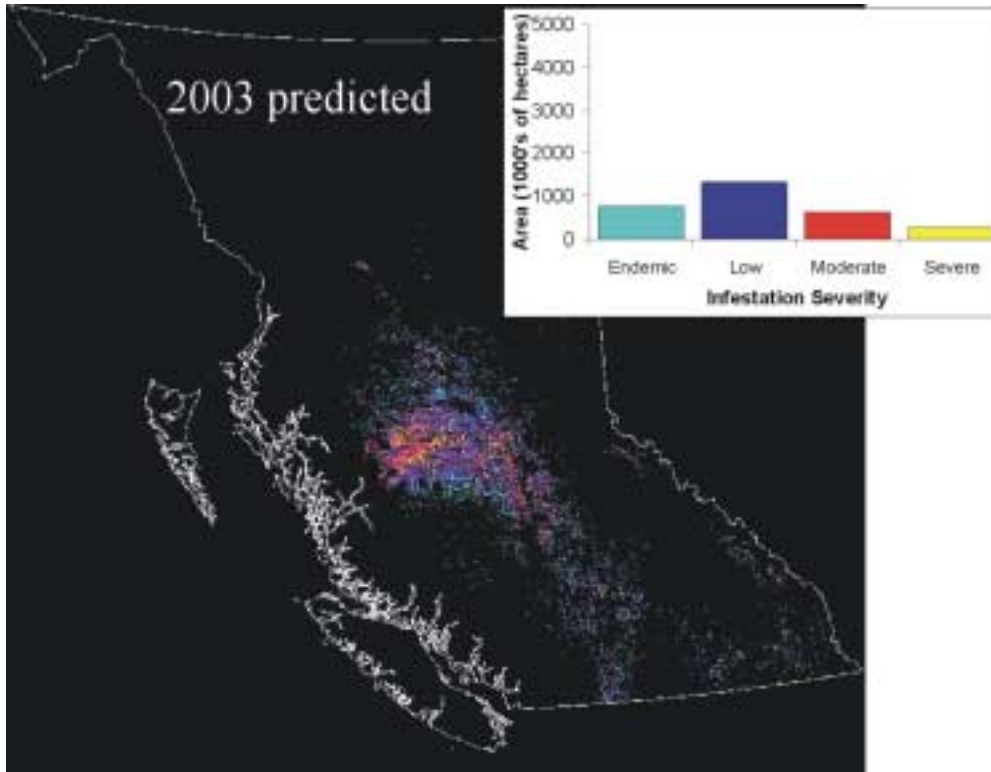


Figure 5. Predicted overview of mountain pine beetle infestations across in 2003.

By management unit, the projection model predicts lower amounts of kill than the data shows in heavily infested districts such as Quesnel, Lakes, Prince George, and Williams Lake (Figure 6). This is not a surprise, nor do we find it particularly concerning. Of more interest are the areas with fewer beetles where we significantly over-predict kill. These areas include Robson Valley, Merritt, Okanagan, Morice, and Mackenzie. In Robson Valley and Mackenzie, it may be that the overview survey under-reports the actual amount of beetle activity, so our predictions are not as wrong as they appear. In Morice and the more southern management units, beetles have been simmering away for a long period, and the dynamics in these areas might be different than in the parts of province where the beetle outbreak is a more recent phenomenon. We thank the participants in our March workshop for these insights and others. We will focus in the coming year on more thoroughly investigating the possibilities.

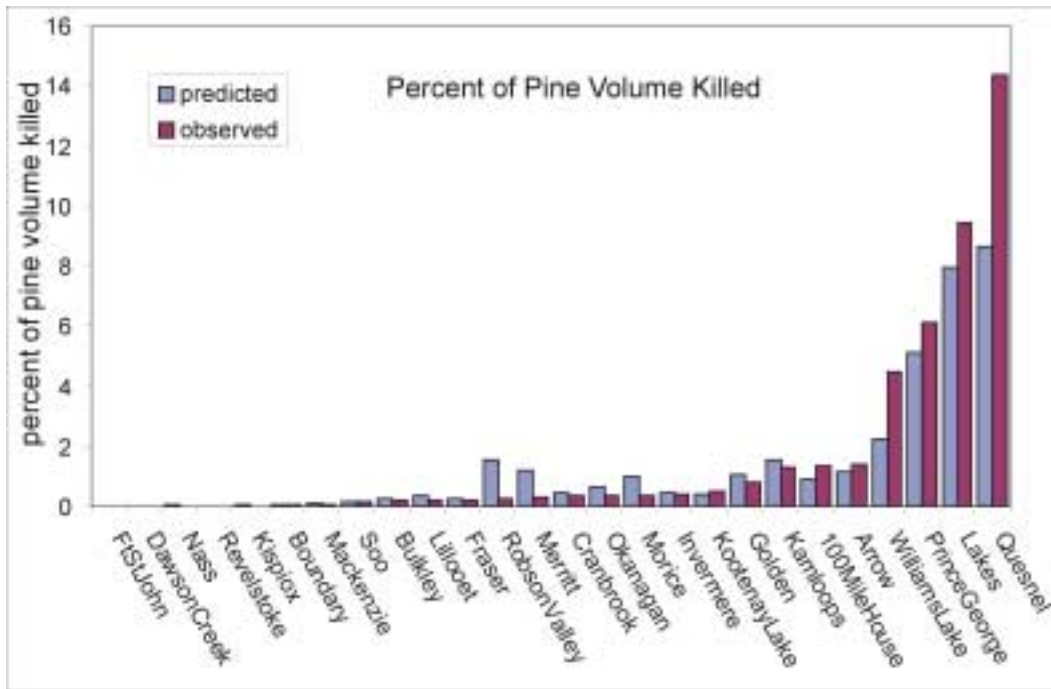


Figure 6. Performance of the mountain pine beetle projection model by management unit.

We have several major areas of uncertainty in our beetle model, including: Over what scale does the presence of current infestations affect the probability of new infestations arising? How far away must a new infestation be from other infestations before we reasonably assume that the infestation has arisen independently?; And once an infestation has subsided, what happens? Under what conditions, if any, might it restart?

We do not know the answers to these questions, but we can investigate the consequences of alternative assumptions. In brief, we found that changing our assumption about the scale at which infestations might be considered emergent has almost not effect on the annual amount of pine killed (Figure 7) nor the cumulative amount of pine killed (Figure 8). This is because the outbreak has by now progressed so far that most pine forest in the province is by now quite close to infested areas. If we started in 1999, when beetles were less thoroughly distributed, our assumption about the scale of influence would make more difference.

In contrast, the model is quite sensitive to our assumption about whether or not infestations are allowed to “re-start” in cells where they have completely subsided, given sufficient local beetle pressure and some remaining host.

Feedback at a recent workshop on the modeling approach described here indicated that we should devote significant effort to this question of stopping conditions, so we will focus on this in the coming months.

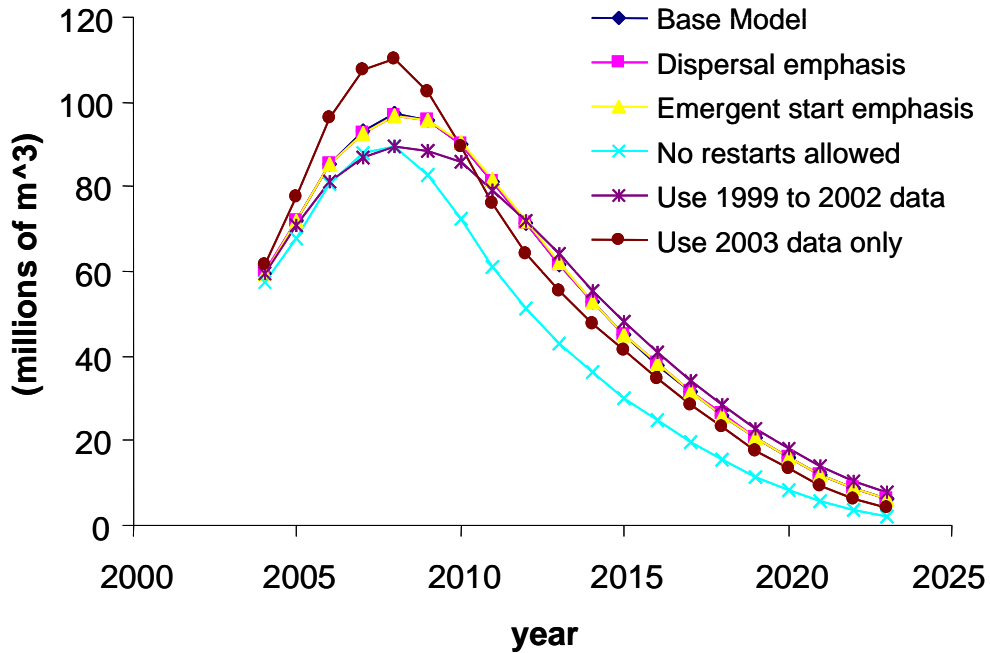


Figure 7. Sensitivity of projections of annual kill of pine on the THLB to various beetle model parameters (No Management Scenario).

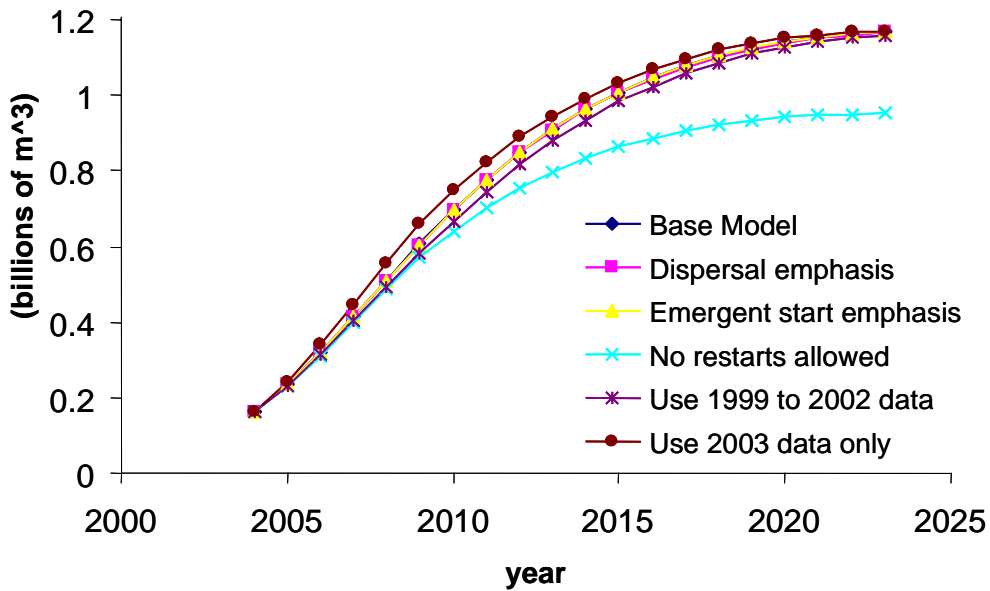


Figure 8. Sensitivity of projections of cumulative kill of pine on the THLB to various beetle model parameters (No Management Scenario).