QuickNotes

Science summaries from fRI Research

Introducing: Modelling long-term dynamics of MPB in Alberta under climate change

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Increased mortality of trees arising from climate change is occurring worldwide. The capacity of forests to respond to future change has yet to be discovered, especially when involving direct and indirect climate-driven stressors. Forests in western Canada are being subjected to the direct climate effects of high temperatures and drought and to the indirect climate effects of the climate-driven spread of mountain pine beetle (MPB). To complicate matters, the recent spread of MPB across Alberta has shifted from lodgepole pine hosts to the genetically distinct lodgepole x jack pine hybrid, and pure jack pine stands in the boreal forest. This spread through the hybrid and jack pine stands has been intermittent in recent years, distinct from the sustained spread seen earlier in lodgepole pine hosts. Research suggests that survivors of MPB attacks may be genetically different from those who succumb based on having superior defences. This implies the beetles themselves are an agent of selection on tree genetics. The question then arises as to the long-term dynamics of MPB in Alberta's hybrid and jack pine forests, especially in the context of stresses driven by the changing climate.

Objectives

1. Develop and apply models to estimate changes in long-term susceptibility and resilience of forest stands to MPB in the presence of intermittent MPB outbreaks and climate change.

Federal-Provincial MPB Research Partnership

Mountain Pine Beetle remains a severe threat to Alberta's pine forests despite the province making positive progress in controlling its spread within the province and reducing the risk to the rest of Canada.

Natural Resources Canada and Alberta Agriculture and Forestry have provided funding to a suite of projects with the goals of limiting the spread of Mountain Pine Beetle and mitigating damages where it has already invaded.

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2. Develop and apply models to determine the impact of intermittent MPB outbreaks and climate change on persistence of low-level endemic beetle populations.

Expected Outcomes

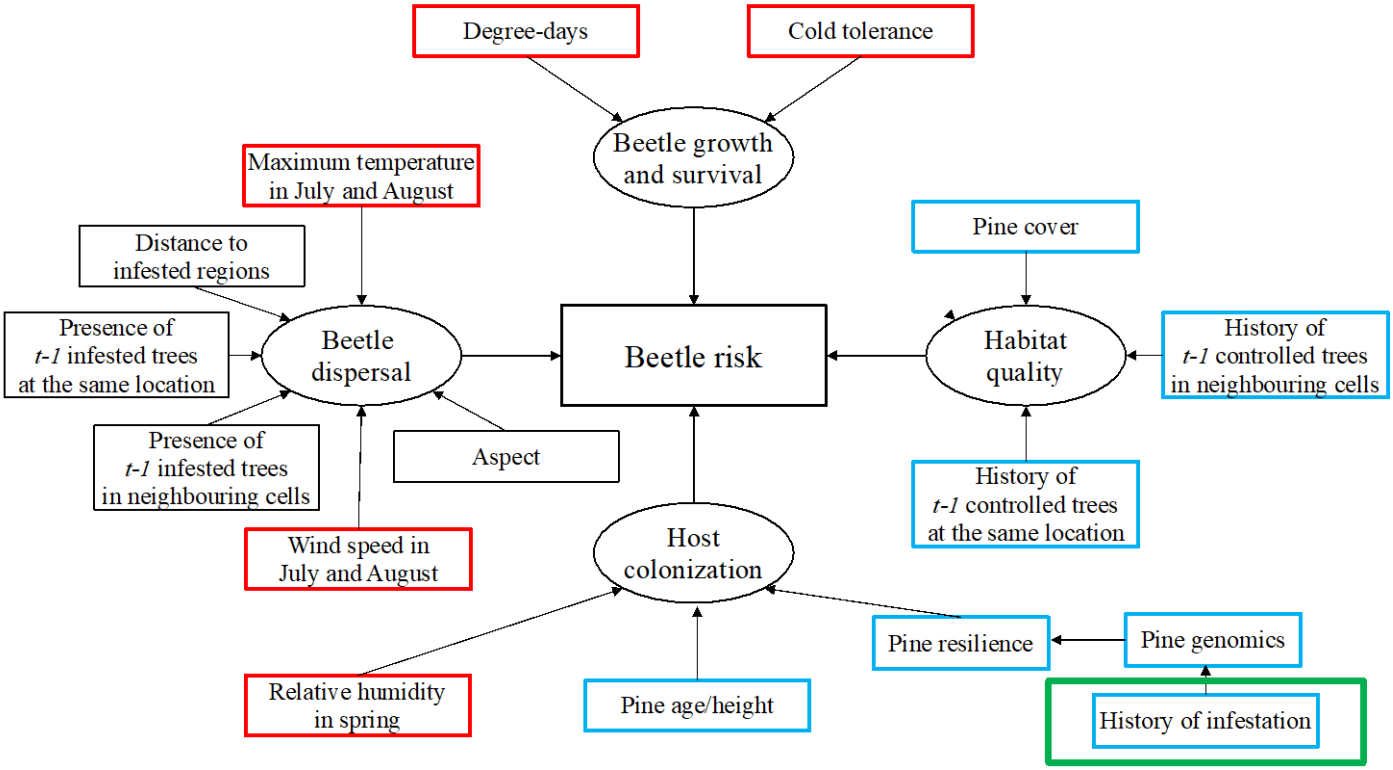
We will develop stand productivity models (dynamical systems) and machine learning models to estimate long-term susceptibility and resilience as well as the impacts of intermittent outbreaks on low-level endemic populations. These models will be parameterized to an extensive Alberta dataset. Models will be made available as R code and, where possible, will be integrated into the SpaDES platform for developing and running integrated simulation models for MPB. We will give workshops for end-users.

Implications for Land Management

Modelling results will provide a valuable tool for discussion with stakeholders and rights holders. Model predictions will be incorporated in the presentation of alternative scenarios to determine risk and social preferences for different management options of forests, and to determine the long-term impact of MPB on forest ecosystems in Alberta.

Expected Social, Economic, and Ecological Value

MPB expansion into Alberta has cost the province over $568M in management expenses alone. Our research will provide a means to predict and evaluate the long-term impact of MPB on forest ecosystems in Alberta.



Typical mountain pine beetle risk model based on a literature review. The square boxes represent the independent covariates and dependent variables; the circles represent the latent variables or categories. Typical risk models only use a subset of these depending on the question asked and the data available. Red boxes can be directly impacted by climate change. Blue boxes can be directly impacted by management. The green box shows that history of infestation itself can affect pine genomics, which then has an impact on beetle risk. Few risk models to date have included this range factors.