Forest dynamics are usually influenced by more than a single disturbance regime. In the lodgepole pine (\textit{Pinus contorta} var. \textit{latifolia} (Hopkins)) forests of western Canada, forest fire and mountain pine beetle (\textit{Dendroctonus ponderosae} Hopkins) (MPB) are the commonly observed disturbance regimes (e.g., Safranyik et al. 1975). An estimate of the percentage of lodgepole pine forest area susceptible to the MPB, which is largely dependent on the dynamics of the pine forest age distribution, is required for beetle management. In this presentation, we demonstrate that (1) the dynamics of the forest age distribution is related to fire disturbances, and various shapes of the forest age distribution could be expected under large and irregular fire disturbances; (2) the temporal dynamics of the percentage of area susceptible to the MPB attack could significantly influence the estimate of the percentage of area susceptible to MPB attack.

\textbf{Introduction}

Some literature suggests a stable forest age distribution over time following a negative exponential probability distribution (e.g., VanWagner 1978); however, empirical forest inventory data do not always support this theoretical prediction. An improved understanding of the dynamics of forest age distribution is required for more successful decision-making in practical forest management.

\textbf{Objectives}

To demonstrate that the dynamics of the forest age distribution is related to fire disturbances;

To present one of its management applications on estimating the dynamics of the percentage of the lodgepole pine forest area susceptible to the beetle attack under different fire regimes.

\textbf{SEM-LAND model}

The SEM-LAND model is a raster-based long-term spatial fire regime model. It has 1-ha spatial resolution and yearly time step, and has a 2-stage fire process: ignition and spread, driven by the relationships summarized in the Canadian Forest Fire Weather Index system and the Canadian Forest Fire Behavior Prediction system.

\textbf{Abstract}

Forest dynamics are usually influenced by more than a single disturbance regime. In the lodgepole pine (\textit{Pinus contorta} var. \textit{latifolia} (Hopkins)) forests of western Canada, forest fire and mountain pine beetle (\textit{Dendroctonus ponderosae} Hopkins) (MPB) are the commonly observed disturbance regimes (e.g., Safranyik et al. 1975). An estimate of the percentage of lodgepole pine forest area susceptible to the MPB, which is largely dependent on the dynamics of the pine forest age distribution, is required for beetle management. In this presentation, we demonstrate that (1) the dynamics of the forest age distribution is related to fire disturbances, and various shapes of the forest age distribution could be expected under large and irregular fire disturbances; (2) the temporal dynamics of the percentage of area susceptible to the MPB attack could significantly influence the estimate of the percentage of area susceptible to MPB attack.

\textbf{Simulation results}

\textbf{A management application}

The average percentage of the lodgepole pine area susceptible to beetle attack would be dramatically changed if the susceptibility of the old pine stands were similar to younger stands. This suggests the importance of understanding more precisely the tree age range that is susceptible to the beetle attack;

An increase in fire suppression expenditures could reduce area burned; allowing forests to grow older, and potentially increasing timber supply. However, increased continuity of forest fuels on the landscape would be favourable for large fires to develop. This could lead to an increase in fire impacts on future timber supply and area susceptible to mountain pine beetle;

From a forest resource management perspective, the expected mean forest age that maximizes timber supply could be used to set a maximum area-burned target for fire managers (Li et al. 2004). However, maximizing timber supply by increasing fire suppression effectiveness has potentially other consequences, e.g., increasing the area susceptible to MPB, unless pine dominated stands are targeted for harvest over other tree species and mean forest age is low enough to minimize MPB susceptibility.

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