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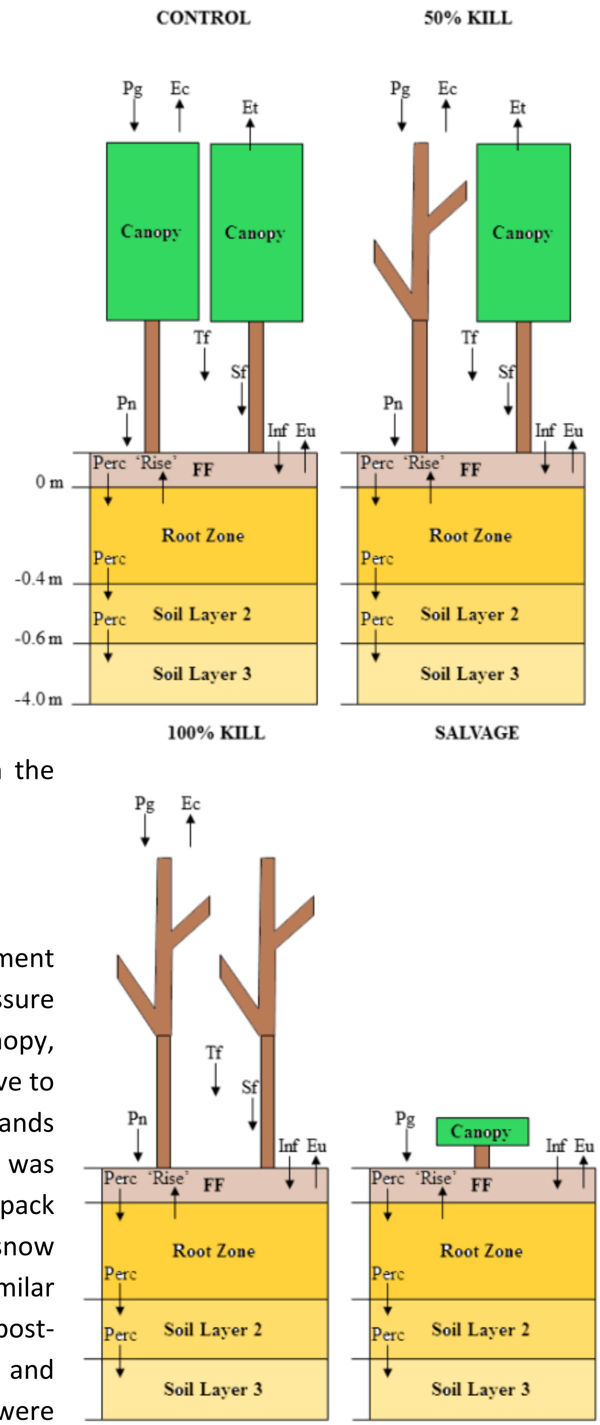
Impacts of Mountain Pine Beetle on Hydrology and Vegetative Redevelopment in Lodgepole Pine Forests of West-central Alberta, Phase II: Stand-level near Robb

By Amy Goodbrand & Petra Albrechtova

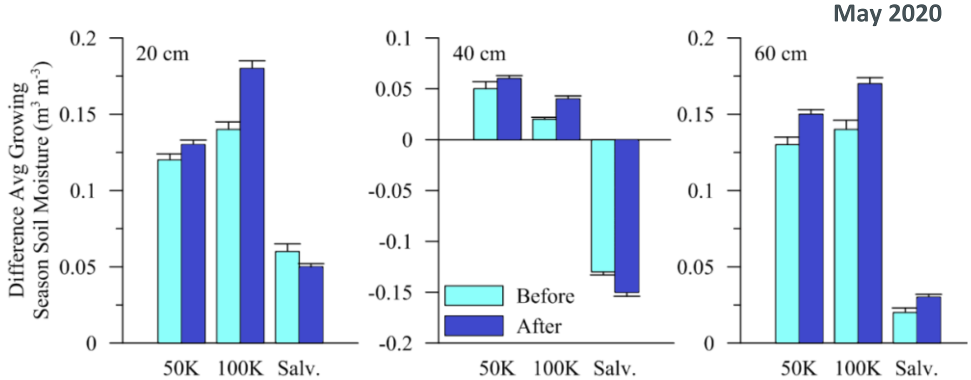


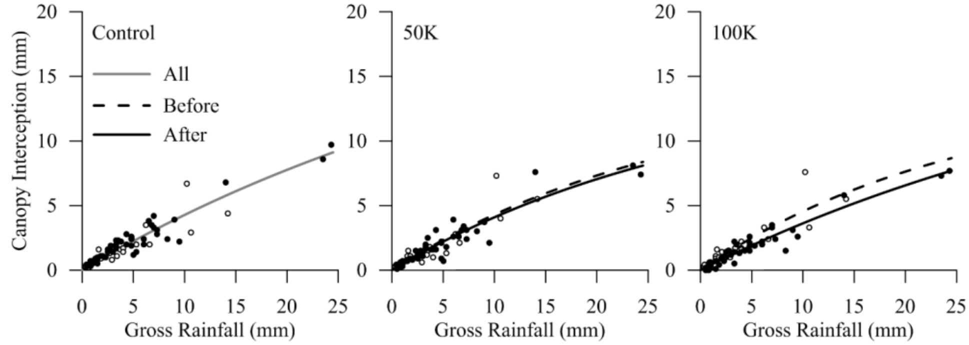
The rapid rate of mountain pine beetle (MPB) infestation prompted the need to understand the effect of these forest cover changes on water resources. The forest cover loss can alter hydrologic processes that generate runoff, and thus, potentially change the amount of water delivered to a stream. The opening of canopy after MPB infestation is gradual; pine needles are typically lost within 3-5 years, and trees may begin to fall 5 years after stand death (Mitchell and Preisler, 1998). Thus, the MPB attacked stands typically have no immediate soil disturbance which is different from timber harvest or wildfire and make the ability to predict MPB effects on water resources more difficult (Adams et al., 2011).

The objective of this part of the project is to provide an understanding of hydrologic responses to simulated MPB attacks of different severity (50% kill, 100% kill, and salvage) in mature lodgepole pine forests near Robb, AB. The stand--level micro--climate and hydrology (rainfall interception, transpiration, soil moisture, and groundwater) data was used to understand impacts to stand--level forest water balances through the phases of MPB attack (green to grey).

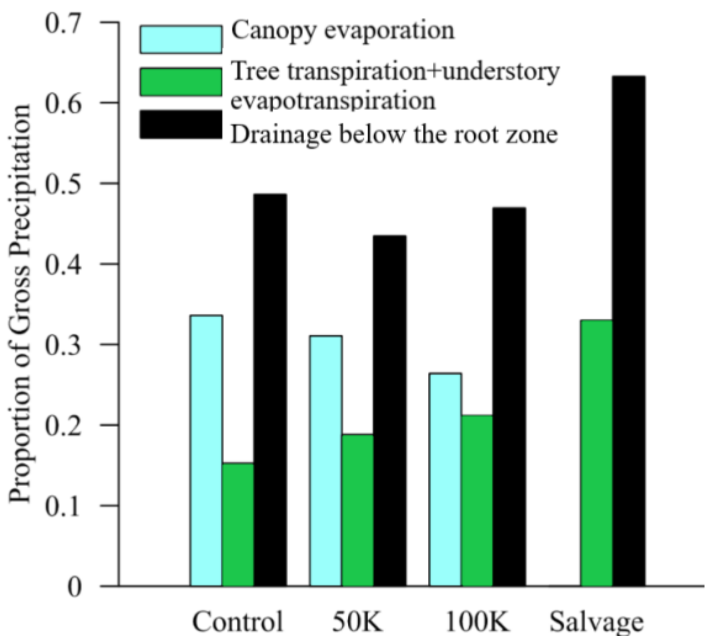
Results

Hydrometeorological data collected in the stands before and after treatment application showed little change in air temperature or vapour pressure deficit but there was an increase in wind speed at the top of the canopy, increased light transmission to the forest floor and net radiation. Relative to the pre-treatment period, canopies within the 50K and 100K stands intercepted 6% and 20% less rainfall, respectively. Peak snow depth was highest in the harvest and lowest in the control for all years. The snowpack disappeared earliest in the control, followed by the 100K stand, while snow remained the longest in the harvest stand. Soil temperature was similar between periods, except in salvage harvest. Soil moisture increased post-treatment in the 100K stand at all measured soil moisture depths and decreased in clearcut in root zone area. These soil moisture changes were more evident than those observed in the 50K stand, which suggests increased soil moisture with increased grey-attack intensity.





Winter interception declined with an increase of grey-attack intensity and varied depending on the year in the 50K stand (9 – 11%) and 100K stand (7 – 9%). Rainfall interception accounted for 35% to 40% of growing season precipitation in the control stand. Despite higher grey-attack intensity, rainfall interception was similar between the 100K (26 – 36%) and 50K stands (23 – 35%). Water loss through evaporation accounted for 40 to 48% of annual precipitation in the control. Total evaporation was similar between the 50K (35 – 42%) and 100K (38 – 44%) stands. Despite no transpiration from mature trees, the decline in evapotranspiration was compensated by increased interception loss, soil evaporation and understory plant transpiration compared to the 50K stand.



Grey-attack stands showed increased soil moisture and drainage below the root zone. Average annual drainage below the root zone was lower in the control stand (56%). Similar total evaporation from the MPB stands resulted in similar drainage below the root zone between the 50K (61%) and 100K (59%) stands. For comparison, the regenerating harvest stand, 6 years post-harvest, had similar drainage to the 50K and 100K stands (62%). This was likely due to increased soil moisture from reduced canopy interception, increased soil evaporation, and increased plant transpiration of regenerating trees compared to a clearcut stand. Our results suggest that forest management strategies that include salvage harvesting as a rehabilitation strategy for MPB attack would only initially have a greater hydrological impact than a grey-attack stand.

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