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Can We Share the Forest With Mountain Pine Beetles?

By Dr. Mary Reid

Mountain pine beetles are very small beetles but they kill big trees. This lifestyle puts them in conflict with people who would like to use the same resource. However, they're a native species with a long evolutionary history of inhabiting pines in western North America, with some intriguing natural history.

Among the dozens of species of bark beetles (Scolytidae) in North America, mountain pine beetles, *Dendroctonus ponderosae*, are one of the few that breeds almost exclusively in live trees. Live trees are challenging prey, since they have active defences that they mobilize in response to an attack by bark beetles. To overcome this defence, mountain pine beetles have two main tactics.

First, they have a symbiotic blue-stain fungus that is carried within a special structure near the beetle's mouthparts. Once inoculated into the tree's inner bark, the fungi spread and disrupt the tree's vascular system. The other main tactic is to mass-attack the tree, overwhelming the tree's ability to respond effectively to each attack. This mass-attack is coordinated by pheromones that are released by beetles that have successfully penetrated the tree's bark and that are attractive to other beetles. If the attack is successful, female mountain pine beetles bore long straight tunnels through the inner bark up the tree, laying eggs along the side. The eggs hatch within the summer and develop as far as larvae or pupae by the time winter arrives. This also can girdle the tree, further ensuring its death. Beetles complete development the following summer, and then disperse in search of suitable live trees to attack.

Mountain pine beetles reach large populations only periodically. Overwintering mortality is thought to be one of the main controls of mountain pine beetle populations, with younger larvae being most susceptible to cold temperatures. Woodpeckers and insect predators also take advantage of the abundance of beetles. Another contributor to natural bark beetle mortality is likely the cost of finding a vulnerable host tree. However, when mountain pine beetle populations are large, there are enough beetles available to overwhelm almost any tree so they may no longer be limited by this cost. At this stage, populations can increase rapidly and kill most of the larger trees within large areas. This has been happening in eastern and central BC in recent years. Eventually, however, large live trees become scarce, and beetle success at finding them likely becomes low as well.

In Alberta, mountain pine beetles have been historically rare, despite the abundance of Lodgepole pine and the frequent outbreaks just across the border in BC. Currently, several hundred trees have been killed in Banff, and there have been a few trees killed in Jasper and the Willmore Wilderness Park. The historical lack of success of mountain pine beetle in Alberta is attributable to the colder climate that can both kill overwintering larvae directly and slow their development such that beetle populations grow slowly and asynchronously. Without the critical mass of synchronously emerging beetles, the beetles' success at overcoming tree defences is low. Currently in Alberta, beetles have emerged and attacked trees quite late in the summer, likely contributing to the complete overwinter mortality of beetles in trees monitored in Willmore and asynchrony in offspring development times among neighbouring patches in Banff.

However, the spectre of global warming may reduce Alberta's natural resistance to mountain pine beetles. Models developed by the US Forest Service predict that with the projected increase in temperature in the next few decades, mountain pine beetle populations may develop sufficiently quickly and synchronously to reach outbreak proportions in Alberta and to survive further north than its current

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range. If the beetles spread into the range of jack pine, they could then spread eastwards across the boreal forest.

Are mountain pine beetle outbreaks bad? Certainly they can be costly and disruptive to the forest industry that relies on the same trees that the beetles do. Beetle-killed trees remain of good quality for lumber for only a few years after death. Ecologically, however, beetles are a natural part of lodgepole pine ecosystems over most of lodgepole's range. The exact nature of their impact on ecological processes is surprisingly poorly understood. For example, they are often linked with fire, either by responding to fire because of the production of weakened trees, or by increasing the risk of fire after an outbreak. Neither of these relationships has been well substantiated, although work is currently underway in western Canada to address these questions. Other expected impacts, such as on overstory and understory forest dynamics, on nutrient dynamics, and on predators such as woodpeckers also remain to be more clearly understood. So while the sight of dead trees may seem alarming, they actually reflect the success of another, less visible part of the natural forest community.

Options to reduce beetle outbreaks are fairly limited because the beetles are usually well-protected beneath the bark of trees. In the short term, small numbers of trees can be treated with a systemic insecticide applied to individual trees that kills beetles at a certain stage of development. The tree can then remain standing in the forest. Somewhat larger number of trees can be burned, often after felling them, but the insulative bark may mean only a proportion of beetles are killed, though perhaps enough to reduce their effectiveness in mass-attacks. These control measures can be used on baited trees to concentrate beetles into the management area. In the longer term, landscape manipulation has been considered as a means of reducing the continuous spread of host trees of suitable size. The design of such landscape patterns is currently handicapped because we know relatively little about the dispersal capabilities of mountain pine beetles and their response to forest stands of different ages and composition.

The decision about how to respond to these Alberta beetles is tricky. Mountain pine beetles are a natural component of lodgepole pine ecosystems, though rarely in this province. Their current increase may or may not expand into an extensive outbreak, for reasons that may or may not be related to a warming climate. Management options are not guaranteed to be effective. The problem is compounded because forest companies expect access to all the trees the beetles can potentially use, leaving little room to accommodate beetles. Perhaps the prudent response to dealing with ecological "surprises", of which mountain pine beetle is just one possible one, is to leave more land and resources unallocated, particularly with the increased uncertainty caused by climate change.

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