Wildfire and Beetle Kill Across the Rocky Mountains

By Josh McDaniel
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February, 2009 Lodgepole pines throughout the Rockies are dying. The culprit is a tiny beetle, no bigger than some of the letters on this page that girdles the trees and also releases a fungus that interrupts water flow within a tree. The mountain pine beetle has killed 1.5 million acres of lodgepole pine in Colorado alone since 1996, and in 2007 the beetles killed an estimated 3.9 million acres of lodgepole pine across the Rocky Mountain region. The extent of beetle kill has raised concerns that the risk of catastrophic fires is spreading along with the outbreak.

“The trees are turning red and dying, and the public expects us to do something about it,” says Phil Bowden, a fuels specialist with the White River National Forest in Colorado. Bowden now spends almost all of his time working on the impacts of the mountain pine beetle epidemic. “We get calls everyday asking us what we are going to do about the fire threat.”

The red trees have definitely gotten the public’s attention, and the general perception is that all those dead trees are just waiting to go up in a disastrous fire. Senator Ken Salazar (D-CO) called the mountain pine beetle the “Katrina of the West,” and has claimed that the outbreak could lead to a fire of epic proportions.

Intuitively, this seems to be the case. Bowden leads me on a tour of some of the forests surrounding the town of Vail. Most of the surrounding mountainsides are covered in red, dying trees seemingly primed for ignition. However, research is quickly emerging showing that the outbreak has not significantly increased the risk of a devastating wildfire.

“It is not a foregone conclusion that you are going to have large, widespread fires after an outbreak,” says Tania Schoennagel, a researcher with the Department of Geography at the University of Colorado. “But, we are in a multi-year drought, and so if a fire was going to occur, with or without mountain pine beetle, this would be a prime time.”

Schoennagel says that the risk of ignition in lodgepole forests likely goes up in what is called “the red phase” after lodgepole pines are attacked and dead, dry needles are still on the trees, but that only lasts for 1 to 3 years after the tree is attacked. In “the grey phase,” characterized by dead standing trees with no needles, the risk of ignition and the risk of crown fires actually go down, and that lasts for 10 to 20 years after the tree is attacked.

Red Trees - the telltale sign of mountain pine beetle in lodgepole pine. Photo courtesy of Tom Veblen.

"The real fire risk comes when the trees start falling down to the ground—about 20 years after attack—and you get the build-up of the thousand hour fuels—those are the fuels that burn hot and can become difficult to control," says Schoennagel. But, Schoennagel adds that fire risk is always high in lodgepole systems even before they are impacted by beetle outbreaks.

"This landscape was fire-prone before the beetle even came to town," says Schoenagel. "Lodgepole pine systems are high fire risk systems. The probability of a fire in any year is low, but when one does come it is going to be devastating. So, yeah, the beetles might elevate fire risk somewhat in the red phase, but that fire risk didn't come from nowhere. Even in the green phase, this is a high risk system."

The Role of Climate

Tom Veblen, director of the Biogeography Lab at the University of Colorado, has been looking at the historical relationship between fire and past beetle outbreaks in Colorado forests. Specifically, he looked at a beetle outbreak in the 1940s that wiped out 90 percent of spruce-fir forests in northwest Colorado, and then used historical records and a case study of a fire in the beetle kill area in 2002 to see if fire frequency and fire behavior were impacted by the outbreak.

"It seems counter-intuitive to us, but the historical record is clear. After the 1940s outbreak, we did not have an increase in fire occurrence in the beetle kill forests," says Veblen. "The general explanation is that these high elevation spruce-fir forests are dependent on exceptional drought to burn, which doesn't come along very often."

Veblen is quick to note that the current beetle outbreak is primarily affecting lodgepole pine forests in Colorado and other parts of the Rockies, and lodgepole forests are very different from spruce-fir. Surprisingly, though, outbreaks do not dramatically increase the risk of more frequent or more severe fires in either forest type.

Tom Veblen looking for evidence of growth releases following insect kills of adjacent trees. Photo courtesy of Tom Veblen

Unlike many other forests, the dense stands of lodgepole pine found throughout the Rocky Mountain region are not an artifact of fire suppression. Historical research shows that these stands have always burned infrequently under large, severe “stand replacement” fires that are followed by the development of young dense stands. Veblen says that the infrequent, large, severe fires have led to a distinctive even-aged structure in lodgepole. The forests tend to be relatively uniform in size with little understory or “ladder fuels” that can carry fires into the canopy.

“So, when you get beetle outbreaks in these forests, it results in a radical change in stand structure,” says Veblen. “In the red phase you get a lot of dead, dry foliage, and then dead, standing trees. But, after about 10 to 20 years, those trees start to come down, and this creates more ladder fuels that can potentially carry the fire from the ground into the canopy.”

Old-growth, spruce-fir forests in contrast, have a much more mixed structure. There are lots of dead and down trees—ladder fuels—in these forests. In fact, Veblen says that a mature spruce-fir forest looks a lot like a forest that has been hit by beetles. These forests also seem primed for large fires, but the reality is that they burn infrequently, and when they do burn, the cause is more likely to be extremely dry weather conditions than any build-up of fuels, either from a beetle outbreak or from natural cycles.

So, these forest systems have to be dry to burn, and when they are dry it doesn’t matter if the trees are green or dead—they will burn hot.

“The take home message is that weather and climate trends are the overwhelming drivers in these systems of both individual events and long term trends,” says Veblen.

Life Cycles

Unlike many of the West’s problems, Mountain pine beetles are not some invasive species, attacking another species without adaptations and resistance. In fact, the beetles have a very synergistic relationship with lodgepole pine. Periodic beetle outbreaks can kill large areas of trees, and make it easier for fire to come through and help regenerate a new generation of lodgepole.

Jesse Logan, a retired Forest Service entomologist, has been researching the spread of mountain pine beetles in high elevation whitebark and limber pine forests in the Greater Yellowstone area. While beetle outbreaks are relatively common in lodgepole, they are rare in the higher elevation pine forests due to the cold temperatures. And, unlike lodgepole forests which have adapted to the beetles, the slow-growing whitebark pines only have the cold temperatures at high elevations to help them fend off the beetles. However, warming temperatures in the West have taken away even that defense.

“In the past, you would get short outbreaks at high elevations if you had suitable warm conditions for a year or two,” says Logan. “Now, those suitable warm conditions are the norm.”

Logan says that the warmer temperatures are allowing adult beetles to reproduce in the summer, and then survive the winter to reproduce again the following spring. This is vastly increasing their reproductive potential.

Logan says that lodgepole forests are resistant to these types of large scale disturbances, and he expects that within a century or two lodgepole will bounce back and occupy its present range once again. However, the high elevation whitebark pines have not historically been subjected to these types of disturbances. He says that the whitebark pines depend on Clark’s nutcracker seed caches for reproduction, and this could be lost.

“The prognosis for the whitebark pines is bleak,” says Logan. “We are completely losing the cone-bearing canopy trees, and even the younger trees are being attacked. If Clark’s nutcracker switches to another food source, it may never come back in genetically significant numbers.”

What Can Be Done

No one knows how long the current outbreak will last. It all really depends on climate. If the warming trend continues, the outbreak is likely to continue until the food source is gone. If cold temperatures return to Rocky Mountains, then the outbreak could be slowed and stopped. So, the options for slowing the outbreak itself are almost nonexistent, but there are options for dealing with the fire threat.

Fuel buildup in a lodgepole stand under attack from mountain pine beetle. Photo courtesy of Tania Schoennagel.

Logan doesn't feel like logging and thinning are viable options for dealing with the threat, and can actually increase the negative impacts of forest loss. He says that the ecological function of the forest is not lost with outbreaks (about 60 percent is lost), but with logging and thinning you can lose the rest and these are primarily watershed protection functions.

All of the researchers cautioned against trying to thin our way out of the problem, especially away from communities and high value resources, but they emphasize that when fires occur in these systems, there is little that can stop them from spreading.

"I am not suggesting that we shouldn't do logical fuel treatments around communities," says Veblen. "Treatments can reduce the chance that a fire in an average year will spread and become severe, but in an extreme drought year like 2002 it is questionable as to how effective mitigation can be under extremely dry conditions."

Given the nature of these fire-prone systems, the fire threat suggests that more attention needs to be paid to controlling development and growth in proximity to forests at risk for large, severe fires. The expansion of the wildland-urban interface is one of the greatest problems facing wildland fire managers, and the Rocky Mountain region is no exception with its rapidly growing mountain resort communities and expanding suburbs and exurbs in places like Colorado's Front Range. Many of these communities are expanding directly along the boundaries of national forests and in areas most at risk from fire.

In a study of 11 western states, Patricia Gude and her colleagues found that only 14 percent of the available "wildland interface" in the West is currently developed, leaving great potential for new home construction in the remaining 86 percent. This study is being seen by many as a call to arms to prevent an even larger demographic disaster from unfolding in relation to western forests.

Tania Schoennagel adds that promoting Firewise principles for reducing ignitable surfaces around individual residences may be the best available option for reducing the risk of homes to wildfire. She also points to Jack Cohen's illuminating research showing that home ignitability is the principal cause of home losses during wildland-urban interface fires. She says that "hardening" existing homes, and preventing the

spread of WUI into more fire-prone landscapes would do a great deal to solve the wildfire “problem” in many parts of the country, including the areas impacted by beetle kill.

In the meantime, many communities in the Rocky Mountains that are seeing the dead trees spread up to their doorsteps have decided to invest heavily in fuel treatment buffer areas.

“We can’t chase the bugs, but we can put in some buffers and try to protect communities from the fire hazard created by the dead trees,” says Phil Bowden, the fuels specialist with the White River National Forest.

Bowden leads me up to a 14 acre clearcut above the town of Vail, Colorado on the Forest boundary. The clearing is designed to create a 200 foot fuel break between the dying lodgepole pine forest above and the homes below by promoting the regeneration of a strip of less-flammable aspens. “The mountainside is so steep that the only way to get the trees out was to use helicopters. They lifted the trees down to a landing near the road below where they were hauled out by truck.”

The 14 acre project cost an astounding $250,000, and is a small part of a five year plan to put in fuel breaks and promote less-flammable aspen buffers around Vail, covering a total area of 1,500 acres. In this case, the Forest Service partnered with the town of Vail to complete the project. The Forest Service paid $50,000, and Vail chipped in $200,000.

“A few years ago, the city would have fought us over any prescribed burn proposal. Now, they are stepping up and actually paying for thinning and logging operations to create buffers,” says Bowden. “That is a big change.”
