Tree killers, yes, fire starters, no: Mountain pine beetles get a bad rap, study says

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Following wildfires in 2011, a UW-Madison research team studied lodgepole pine trees in the Northern Rocky Mountains to examine whether earlier outbreaks of mountain pine beetles changed the ecological impact of the wildfires. Credit: Turner Lab

Mountain pine beetles get a bad rap, and understandably so. The grain-of-rice-sized insects are responsible for killing pine trees over tens of millions of acres in the Western U.S. and Canada over the last decade.

But contrary to popular belief, these pests may not be to blame for more severe wildfires like those that have recently swept through the region. Instead, weather and topography play a greater role in the ecological severity of fires than these bark-boring beetles.

New research led by the University of Wisconsin-Madison and the Washington State Department of Natural Resources provides some of the first rigorous field data to test whether fires that burn in areas impacted by mountain pine beetles are more ecologically severe than in those not attacked by the native bug.

In a study published this week in the *Proceedings of the National Academy of Sciences*, UW-Madison zoology professor Monica Turner and her graduate student, Brian Harvey, show pine beetle outbreaks contributed little to the severity of six wildfires that affected more than 75,000 acres in the Northern Rocky Mountains in 2011. They also show that the beetle outbreaks, which occurred from 2000 through 2010, have not directly impacted post-fire recovery of the forests. The study does not, however, address fire behavior, such as how quickly fires spread or how dangerous they are to fight.

While the findings may exonerate the insect scapegoats, they should also help ecosystem managers better respond to changes in the face of climate-driven disturbances, like drought and warmer temperatures.

Large, severe fires are typical in the lodgepole pine forests found throughout the region, even without mountain pine beetle outbreaks. However, as the climate has warmed, outbreaks and big fires have both become more common. The phenomenon of more beetles has meant more dead trees, and some have grown concerned about how beetle attacks and wildfires may interact.

"The conventional wisdom is that a forest of dead trees is a tinder box just waiting to burn up," says Turner, who has long studied the forest landscape of the Mountain West. "There were very little data out there but a lot of concern."

Forests attacked by bark beetles—which burrow into the bark of lodgepole pines to mate and incubate their larvae—can seem nothing more than ample kindling for a raging blaze, with their dead wood and dry, reddish-brown needles.

The burrows the beetles carve under the bark of pines, called galleries, choke off water and nutrient circulation in the trees. The trees die and, for the first couple of years, they hold on to their dry, lifeless needles. Scientists call this the "red stage," and some believe these trees could fuel more severe fires.

By year three, most beetle-attacked trees have entered the "gray stage," dropping their once green pine foliage, becoming needleless wood carcasses.

Earlier studies from Turner's group suggested that beetle outbreaks would not lead to more severe fires. But without actual fires, the interaction could not be tested.

However, in 2011, wildfires throughout eastern Idaho and western Montana—in forests that had experienced varying mountain pine beetle outbreak impacts—provided opportunity for the research team to begin to answer the question: Do the two disturbances, beetle attacks and wildfire, together change the ecological response of the forest to fire?

Fortunately for the team, among the burned areas studied were pine stands that had not been attacked by beetles. These areas served as controls. Others suffered a range of mortality from the beetles; in some stands, beetles killed nearly 90 percent of the trees prior to wildfire. The fires that raged also ran the spectrum of severity, allowing the researchers to compare a number of variables.

Some study plots comprised mostly live trees, while others contained mostly red-stage or gray-stage trees—allowing the researchers to assess whether plots with red-stage trees (with dry needles) experienced greater levels of fire severity than plots with mostly gray-stage trees (no needles), as they and others had expected.

The study team examined ecosystem indicators of fire severity, such as how many trees were killed by fire and how much char covered the forests.

Engaging in what Harvey calls "post-fire detective work," in 2012, the scientific team evaluated fire severity in each study plot and stripped sections of bark from over 10,000 trees to determine what killed them, beetles or fire. Beetle galleries can remain visible under the bark even after fire.

As they sifted through the blackened trees and forest floor, the team became covered with ash and soot.

"We looked like coal miners when we were done," says Harvey.

They found that the severity of the outbreak and whether trees were in the red or gray stage had almost no effect on fire severity under moderate burning conditions.

Only under more extreme fire-burning conditions—when it was hot, dry and windy—did areas with more beetle-killed trees show signs of more ecologically severe fires, such as more deeply burned trunks and crowns (the part of the tree that includes its limbs and needles). The presence of more gray-stage trees actually had a stronger impact on fire severity than the amount of red-stage trees, to the surprise of the scientists.

Overall, however, Turner says the effects of beetle outbreaks on fire severity took a back seat to stronger drivers—primarily weather and topography. Fire severity increased under more extreme weather, regardless of pre-fire outbreaks, and forest stands higher in the landscape burned more severely than those at lower elevation as fires moved uphill, building momentum.

"No one says beetle-killed forests won't burn," says Turner. "The data set looks at whether they burn with different severity compared to unattacked forests burning under similar conditions."

The team was also interested in whether beetle outbreaks slowed the recovery of the forests after fires. Lodgepole pines are adapted to fire, containing two types of seed-carrying cones: those that release seeds as soon as they mature and those that require fire to open, blanketing the forest floor with potential new life following a blaze.

By counting the number of post-fire tree seedlings in their plots, the researchers found very little beetle-related impact. Tree seedlings were most numerous where more of the fire-killed trees bore the fire-adapted, or serotinous, cones. Beetle-killed trees likely contributed to post-fire seedling establishment, too, as their seeds remain viable in cones if they are not consumed in fire. Only high-reaching char from tall flames reduced the number of seed-spreading cones.

The scientists emphasize the results may differ in other forest types or with different lengths of time between beetle outbreaks and fire.

"These are both natural disturbances, fire and beetle outbreaks," says Turner. "It's not surprising the ecosystem has these mechanisms to be resilient. What we as people see as catastrophes are not always catastrophes to the ecosystem."

More information: Recent mountain pine beetle outbreaks, wildfire severity, and postfire tree regeneration in the US Northern Rockies , *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1411346111

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