

Beetles winning biological battle with trees

Tiny insect killing huge swaths of mountain forests.



An exposed section of lodgepole pine reveals the markings mountain pine beetles have bored into the tree during a mass attack last year. In order to successfully overtake a pine tree, the beetles coordinate large scale attacks by emitting pheromones that provide a scent trail for other beetles. NEWS&GUIDE PHOTO / TRAVIS J. GARNER

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This is the first part of a three-part series examining the impacts of mountain pine beetles on forest ecosystems. – Eds.

With the edge of her ax, U.S. Forest Service entomologist Kjerstin Skov gently chips away a thin slice of bark from a lodgepole pine a few yards from the end of Trail Creek Road in Wilson.

Underneath, a network of bug-sized tunnels called a gallery fans out in the phloem, the part of the tree that transports carbohydrates.

In one of the tunnels, a tiny black beetle emerges. It stumbles about on Skov's finger then rolls on its back, its nearly microscopic legs flailing uselessly.

The critter is no bigger than a single letter in this sentence, but it and its kin have embarked on a frenzy of destruction through swaths of conifers over most of the Rocky Mountains.

The mountain pine beetle and, to a lesser extent, the Douglas fir beetle, the spruce beetle and the pine engraver beetles, have Forest Service officials worried. The pests are killing trees across millions of acres of forest, affecting everything from wildfire management to logging.

The epidemic, in combination with blister rust, is also threatening whitebark pine with extinction. By some estimates, as much as 80 percent of whitebark pine trees have disappeared from their native range.

In addition to threatening the health of the forests and boosting fire danger, the blight is ugly. People don't like to look at red and gray hillsides with dead trees.

Unlike invasive species such as blister rust, Canada thistle and spotted knapweed, these beetles are native. They're supposed to be here. But this latest beetle epidemic, which started 10 to 15 years ago, is worse than most. Biologists aren't sure why predators, weather and the trees themselves haven't kept the beetles in check, but they think a combination of drought, fire suppression and warm temperatures resulting from climate change have played a role.

At first glance, the tree where Skov found the beetle looks healthy and green. But a closer inspection reveals bulbs of white-yellow sap, like pustules emerging from the diseased bark, where the tree has tried to evict its unwelcome house guests. She points to one successful "pitch out," a glob of sap with an ousted beetle stuck in the goo.

All around the base of Teton Pass, trees show these same signs of this life-and-death struggle. Trees that fail wear a thin layer of sawdust around the base of their trunks.

"If you just see plain old pitch, the tree won," Skov says. "If you see boring dust, the tree is a goner."

"We call that tree dead, even though it's still green," Skov says. "It has a death sentence. It's an irreversible process."

In a year or so, the needles will turn red. By that time, the next generation of pine beetle will have long since flown to the another tree.

The battle between the tree and the beetle is just one portion of the mountain pine beetle's yearlong life cycle.

Sometime between late June and September, depending on factors such as moisture and temperature, a given beetle will bore out of the bark and fly, hunting for a new tree to infest. So-called pioneer beetles are the first to explore new trees. When the pioneers find a vulnerable tree, usually a tree at least 10-inches in diameter that is stressed by drought or a pathogen, it sends out a chemical, called an aggregator pheromone, that signals other beetles to attack en masse to overwhelm the tree's defenses.

"Lots and lots of beetles have to attack at the same time," Skov says. "These are little, tiny beetles trying to kill a giant tree."

The female beetle then bores into the phloem and waits for a mate. Skov says mountain pine beetles are monogamous.

"They'll work together in the gallery," she said, adding that the adults bore through the phloem vertically, with the female laying eggs in niches to each side.

When enough insects have attacked the tree, the beetles send out another chemical called an anti-aggregator pheromone, a signal to any latecomers that the tree is full.

The eggs hatch, and the larva eat horizontal tubes until the temperatures begin to drop.

"The larva eat straight out so they don't eat each other's food," Skov says.

When it gets cold enough, the larva enter what's called a quiescent phase, when they begin to develop an antifreeze-like substance in their tissues that keeps their cells from bursting when their body temperatures drop below freezing.

As the larva make this transition, once in the fall and back again in spring, they're vulnerable to an extreme cold snap if the temperatures drop to about 30 degrees below zero.

Some lament the lack of severe cold in recent winters, saying beetles have benefitted. But Skov says the extreme cold weather was likely never a significant check on the beetle population because the insects are vulnerable for only such a short time in the warmer parts of spring and fall.

In June, the larva pupate, similar to a caterpillar spinning a cocoon, eventually yielding a fully formed adult. Since the tree's needles are still receiving water from another set of transport tubes called the xylem, the needles often remain green long after the beetle has left the tree.

Liz Davy, timber and silviculture program manager with Bridger-Teton National Forest, says scientists and land managers have tried a number of tactics to deal with the infestations. For small areas, such as campsites, individual trees can be protected with chemicals that imitate the anti-aggregator pheromones. Often dispensed in white patches that are secured to the tree trunk, chemicals like verbenone can protect individual trees but are too expensive and their application too time consuming to protect whole sections of forest.

An insecticide called carbonyl can also protect high-value trees if it's applied before the beetles fly, but it requires heavy machinery to generate enough pressure to saturate the trunk.

Davy says a lack of natural fires has led to uniform swaths of trees with little age or species diversity that stretch for miles without a gap that might otherwise stop the beetle. Beetles can fly about a half mile to find a new tree, farther if they are carried by the wind.

She says the need for breaks in tree cover and more tree diversity might be a good justification for more logging and more fire on the forest.

"We don't have as much of a mosaic," she says. "The [Caribou-]Targhee had a huge outbreak in the '50s and '60s and they clear cut the spot out of the forest. They don't have the pine beetle like we do."

Davy says disturbance is good for the forest.

"If you have different age classes, you're not going to have whole watersheds dead," she said.

In addition to a lack of fire and logging, Davy also thinks warmer temperatures might be to blame.

"A similar thing happened in the 1930s," she says. "Central Idaho was really hit hard in the Sawtooth National Recreation Area. They found it was very warm in the 1930s when it was going on."

"We've never experienced global warming before," Davy says. "So maybe [the epidemic] is lasting longer. These trees will be more susceptible sooner or for a longer period of time. They'll be stressed throughout their entire life."

Regardless, she says the current epidemic is likely to result in a similar situation in the future.

"What's going to stop the epidemic is when the beetles run out of food," Davy says. "We're leaving this similar landscape for our great-grandchildren. It's difficult to educate people that, in 150 years, we're setting ourselves up for the same thing."