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Science FINDINGS

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"Science affects the way we think together."
Lewis Thomas

Woodpecker Woes: The Right Tree Can Be Hard to Find

Teresa Lorenz

A female black-backed woodpecker perches at a nest excavated in a live ponderosa pine in central Washington. Although the tree diameters used by this species for nesting differed (ranging from 8 to 34 inches), it consistently selected nest sites with softer interior wood.

"In order to see birds, it is necessary to become part of the silence."
—John Keats

Somewhere in Washington's eastern Cascade Range a bird perches motionless against a burned tree. It's an American three-toed woodpecker (*Picoides dorsalis*), sporting black back feathers, a white mustache stripe, and a yellow cap. About the size of a large banana, the bird has evenly spaced white flecks on the sides of its chest and on its primary and secondary feathers.

The bird was extracting beetle larvae from another burned tree when a larger, louder black-backed woodpecker (*P. articus*) drove it away. But here, on this burned tree, it drums, "This one is mine. Stay away."

Soon it will pick a spot on the tree, say 30 feet above the forest floor, and bore rapidly into the wood with its chisel-like bill until it excavates a deep pocket. The bird and its mate will roost and nest in this safe place until its favorite food runs out, perhaps in 4 or 5 years. By then, another forest fire might provide a new supply of wood-boring insects.

IN SUMMARY

Woodpeckers and other cavity-excavating birds worldwide are keystone species. These birds excavate their nests out of solid wood, and because their nests are often well protected against predators and the environment, other species use and compete for their old, vacant nests. The presence of cavity-excavating birds in forests has far-reaching effects on species richness and ecosystem health.

Given the species' importance, Teresa Lorenz, a research wildlife biologist with the U.S. Forest Service Pacific Northwest Research Station wanted to find out why cavity-excavating birds do not use many trees seemingly suitable for nesting. This puzzle has eluded researchers for decades. Lorenz and her colleagues also wanted to know what role wood hardness plays in the birds' nest site selection.

The resulting study in the eastern Cascades of Washington found that cavity-excavating birds preferred to nest in trees with significantly softer interior wood. The researchers also found that at-risk species were nesting within burned areas where up to 96 percent of the trees had unsuitably hard wood. This suggests that many trees and snags previously considered suitable for cavity-excavating birds actually may not be.

In dry forests, prescribed mixed-severity fire may be a useful tool for creating suitable nesting habitat for cavity excavators.

In the woodpeckers' absence, other birds or small mammals like owls, squirrels, and bats move in. The new tenants disperse seeds and spores that help new plants and fungi grow. When the dead, burned trees—also called snags—fall to the ground, wood-living bees and wasps take up residence. Fungi and lichens flourish on the fallen tree's gnarly surface, and occasionally a marten hides behind the log.

Because of the woodpeckers' crucial role in maintaining healthy forests, researchers want to understand how these cavity-excavating birds choose trees to nest in. When forest managers know what these birds like, they can take steps to ensure that forests have these kinds of trees.

"Woodpeckers are ecosystem engineers," says Teresa Lorenz, a research wildlife biologist with the Pacific Northwest Research Station. "Many small animals compete for their vacated nests because they are so protected from the elements and other predators."

Ecosystem engineers are organisms that significantly modify, maintain, or destroy a habitat. In the woodpeckers' case, the species help build and maintain a habitat for other species by excavating nests in live and dead trees. When forest managers find many different woodpecker species in a forest, it often signals the presence of a thriving and diverse community of plants and animals.

KEY FINDINGS

- Across 818 snags in Yakima, Kittitas, and Chelan Counties in Washington's eastern Cascade Range, trees not used by birds had wood five times harder than trees that were. Such trees could not be used by birds simply because their wood was too hard for the birds to excavate.
- Within burns used by at-risk woodpeckers, the majority (86 to 96 percent) of seemingly suitable trees contained unsuitably hard wood; wood hardness limits nest site availability for these declining species.
- Researchers found no reliable visual cues to distinguish between suitable and unsuitable trees. Currently, the most effective management solution is to provide large numbers of snags, which can be difficult without the aid of fire.
- In dry forests, a mixed-severity fire that kills trees is an important but underappreciated strategy for providing enough snags for cavity-dependent species. Low-severity prescribed fires may not provide enough snags for these species.
- Suitable snags are limited, such that snag availability drives landscape-level habitat-selection by some species. For example, white-headed woodpeckers selected severely burned patches for nesting, which was initially puzzling because this species does not characteristically forage in burns.

Cavity-nesting birds typically nest in recent burns. More than 50 years ago, studies suggested that woodpeckers picked trees solely based on external tree- or habitat-level factors, like the size of the tree, the tree species, or what the vegetation cover is like near the nest.

Other studies pointed to wood decay, but used only visual indicators to assign a snag decay class as a proxy for measuring this. Lorenz felt there was a missing piece: few studies actually measured wood inside the trees where cavity-excavating birds had chosen to nest.

Purpose of PNW Science Findings

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Kevin Lucas

A pine marten looks out of a pileated woodpecker nest cavity. Many species require or prefer vacated woodpecker cavities, but cannot excavate the cavity themselves. Thus, they rely on woodpeckers to construct habitat for them.

Matsuoka's Method

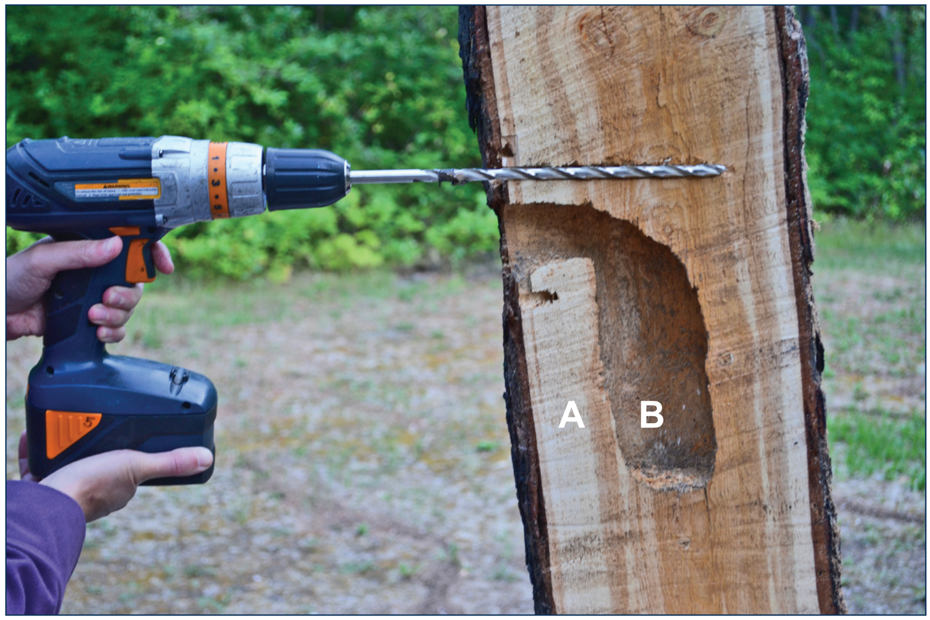
The idea for the study came to Lorenz and her colleagues in summer 2011, when they were investigating how far woodpecker nestlings wandered from their nests soon after they fledge. Using hole saws, they drilled into trees to get to the nestlings, to band them. "We noticed an enormous variation in the thickness of the wooden plug," Lorenz says. "Sometimes the nestling would be just inside the bark of the tree. Other times we had to drill through 4 inches of wood. We had all these hypotheses as to what was going on."

A colleague suggested that the variation could be due to the properties of the wood in the tree. Intrigued, they checked the literature. What if wood hardness had something to do with the birds' preference when looking for trees to nest in? Lorenz and her colleagues did not find many studies that addressed this question. "We were surprised that nobody had considered that this wood inside the tree was influencing where the birds were nesting," Lorenz says. So, she decided to investigate the question for her Ph.D. dissertation at the University of Idaho.

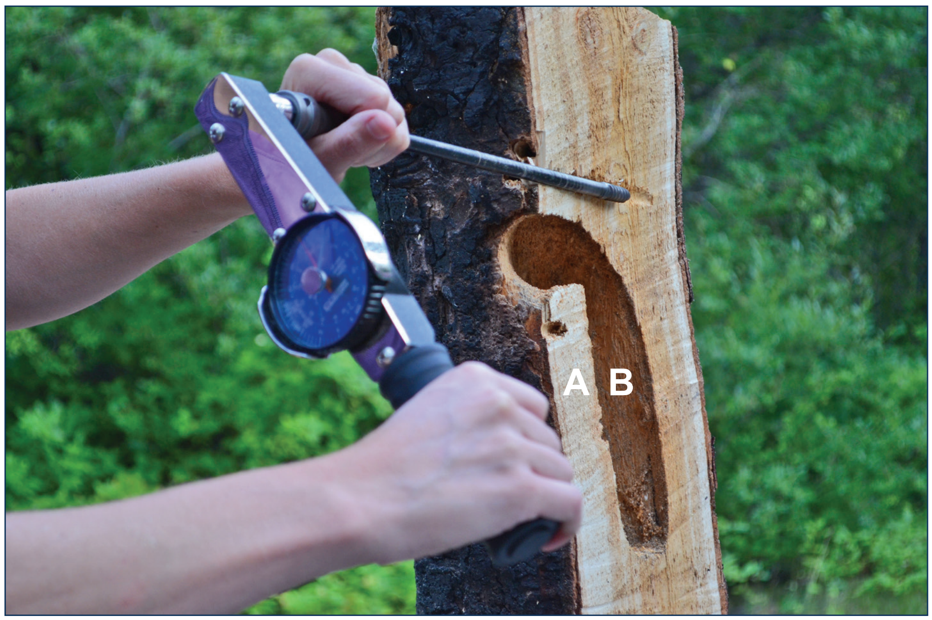
The problem was there weren't many reliable methods for measuring wood hardness in a forest setting. "But we found an obscure article in the *Japanese Journal of Ornithology* and this guy had figured out an ingenious way to measure the hardness of wood inside a tree, using a cordless drill, a foot-long drill bit, and an increment borer, without destroying the nest or harming the tree," Lorenz says.

An increment borer is a tool used by foresters and other researchers to extract a section of wood tissue so they can count a tree's annual rings and determine its age. Japanese researcher Shigeru Matsuoka's method involves inserting this tool into a pre-drilled hole above the nest cavity opening. The torque required to spin the increment borer would represent wood hardness. With the most important aspect of her field methods squared away, Lorenz set out with colleague Philip Fischer to gather field data in the eastern Cascade Range in Washington.

Lorenz had selected six species of cavity-excavating birds for the study. She picked three strong excavators: the three-toed woodpecker, the black-backed woodpecker, and the hairy woodpecker. She also picked a weaker guild of excavators, namely the northern flicker (*Colaptes auratus*), the white-headed woodpecker (*Picoides albolarvatus*), and Williamson's sapsucker (*Sphyrapicus thyroideus*).



Teresa Lorenz



Teresa Lorenz

This photo shows the longitudinal section of an American three-toed woodpecker (Picoides dorsalis) nest and the procedure the study used to quantify wood hardness. First, the researchers use a drill to create a small hole about one-third inch in diameter above the nest cavity opening (top). Then they record the torque required to spin an increment borer into the predrilled hole (bottom). The area marked "A" represents the nest sill, and the area marked "B" represents the nest cavity body.

They searched for nests in all major forest types for 3 years from March to July, 2011 through 2013, hiking through ponderosa pine, Douglas-fir, and western hemlock in lower elevations and through higher elevation forests of grand fir, subalpine fir, and western larch. Lorenz and Fischer located adult birds by broadcasting playbacks of their calls and drumming. "Then, we followed the adults until they led us to their nest cavities," Lorenz says. They marked the locations of occupied nests on portable GPS units. If they noted fresh woodchips on the ground surrounding the nests, they marked those as current-year excavations. They found nests in forest patches ranging from unburned to severely burned.

Lorenz and Fischer covered a lot of ground. Each of their 10 study sites were 1,483 to 7,413 acres in size. "You get in really good shape," Lorenz says.

Soft Pockets

Each carrying about 30 pounds of equipment, Lorenz and Fischer returned in summer to make their measurements. After ensuring the nests had been vacated by the birds, the researchers would scale a tree on climbing ladders to measure wood hardness. They drilled 2 inches above the nests because Matsuoka's study suggested this spot would be representative of the excavated wood.

"In the beginning, we had assumed that wood at the nests would be entirely soft, but that wasn't the case," Lorenz says. "There was some variability when we first started drilling into the trees. Some had hard surfaces. But when you get into the tree a bit, that's when you find these soft pockets. Other times, the soft pockets were close to the surface of the tree, and other times the tree was soft from the get go."

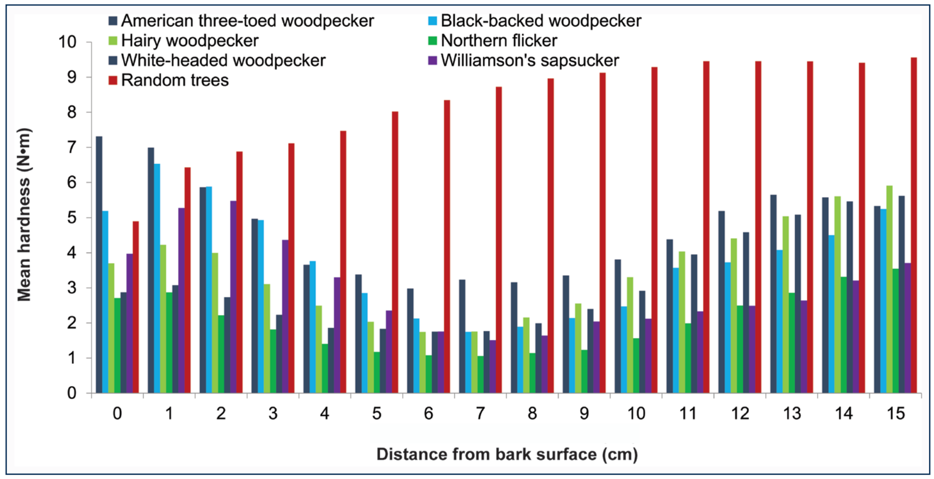
To determine if a tree's external features are reliable indicators of interior wood hardness, the researchers measured wood hardness in random trees within different decay classes.

Then the researchers measured vegetation features that were hypothesized to influence cavity-excavating birds' nest site selection in past studies, such as diameter at breast height of the nest tree; nest and tree height; orientation of the nest cavity entrance; proportion of the ground covered by shrubs; tree and snag density at the nest sites; and tree species. For nests found in snags, they examined the remaining bark, tree growth form, and other features to determine the tree's species.

"It was a pretty brutal field season," Lorenz says. "We worked from 6 a.m. to 4 p.m. And it got really hot in these sites."

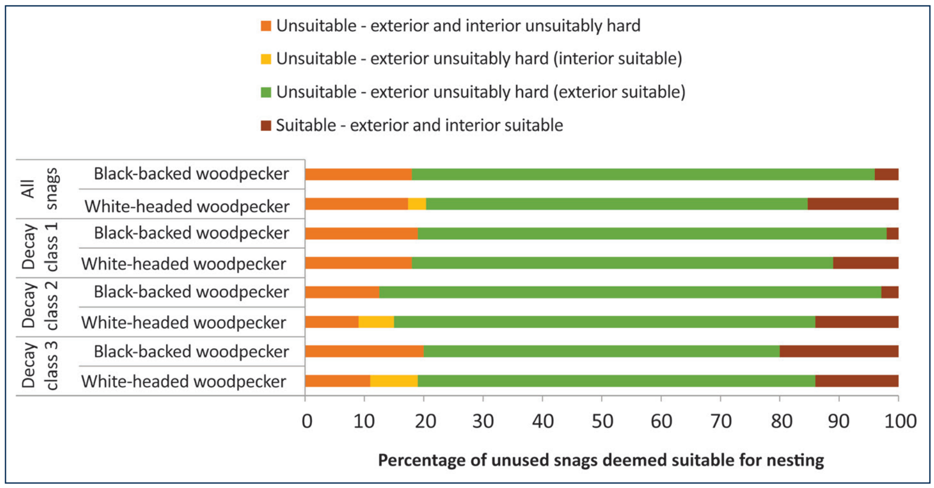
Lorenz and Fischer also used remote sensing data. To estimated prefire canopy cover at nest sites found in snags, they used gradient nearest neighbor classified Landsat satellite imagery captured between 2 and 8 years prior to each fire.

Lorenz was concerned about seeing an effect in nature, measuring it, but finding a lot of variability. "What if we went to another tree and that pattern didn't hold?" Lorenz says. "But in this study, we were able to measure so many trees that we were confident that the effect we were seeing was real. And it has major management implications."



Lorenz et al. 2015

Mean hardness at nests for six species of woodpecker compared to random sites in central Washington, from 2011 to 2013.



Lorenz et al. 2015

A small percentage of snags are suitable for woodpecker nesting. This chart shows the percentage of 360 unused snags in black-backed woodpecker and white-headed woodpecker nesting territories that were deemed suitable for nesting, based on wood hardness, in central Washington, from 2011 to 2013.

Drawn to Snags

Lorenz and her colleagues found that cavity-excavating birds preferred to nest in trees with significantly softer interior wood. They found that across 818 snags, trees not used by birds had wood five times harder than trees that were. These trees could not be used by birds simply because of the birds' physical limitations in pecking ability.

They found that at-risk species, namely the black-backed and the white-headed woodpeckers, were nesting within burns that contained 86 to 96 percent of trees with unsuitably hard wood. This suggests that past studies that did not measure wood hardness counted many sites as available to cavity-excavating birds when actually they were unsuitable. "By not accounting for wood hardness, managers may be overestimating the amount of suitable habitat for cavity-excavating bird species, some of which are at risk," Lorenz says.

In their study plots, the researchers did not find reliable visual cues to distinguish between suitable and unsuitable trees. Snag decay class was a poor indicator of internal wood properties—and this was not the first study to demonstrate that fact, although it was the first study to do so in ornithology (past studies had been done by foresters and published in forestry journals).

"Currently, the best solution we can recommend is to provide large numbers of snags for the birds, which can be difficult without fire," Lorenz says. According to the researchers' calculations, if one of every 20 snags (approximately 4 percent) has suitable wood, and there are five to seven species of woodpeckers nesting in a given patch, approximately 100 snags may be needed each year for nesting sites alone. This does not account for other nuances, like the fact that most species are territorial and will not tolerate close neighbors while nesting, or the fact that species like the black-backed woodpecker need more foraging options. Overall, more snags are needed than other studies have previously recommended.

Based on their results, Lorenz and her colleagues see the critical role that mixed-severity fires play in providing enough snags for cavity-dependent species. Low-severity prescribed fires often do not kill trees and create snags for the birds. In addition to benefiting the cavity nesters, a mixed-severity prescribed burn could also aid species that, historically, did not prefer to nest in snags. During their field work, Lorenz and Fischer observed that white-headed woodpeckers, a species traditionally associated with old-growth forest, used prescribed burns presumably because of shortages in suitable nest sites.

"I think humans find low-severity fires a more palatable idea. Unfortunately or fortunately, these birds are all attracted to high-severity burns," Lorenz says. "The devastating fires that we sometimes have in the West almost always attract these species of birds in relatively large numbers."

Many studies have shown that a severely burned forest is a natural part of western forest ecosystems. Snags from these fires attract insects that love to burrow beneath charcoal bark. And where there are insects, there are birds that love eating these insects.

Lorenz and her colleagues stress that providing snags that woodpeckers can excavate is crucial for forest ecosystem health in the Pacific Northwest, where more than 50 wildlife species use woodpecker-excavated cavities for nesting or roosting.

"This study was just the beginning of what I hope will be decades of research," Lorenz says. Picking up on what she learned in this study, Lorenz is now collaborating with Forest Service colleague Michelle Jusino to investigate a kind of fungi that follows forest fires. "There is some mechanism by which the death of a tree somehow enables some species of fungi to decay the wood," she says. The research is bound to take her back into the forests of the Pacific Northwest, where woodpeckers follow forest fires in a timeless cycle of change.

"The powerful play goes on and you may contribute a verse."
—Walt Whitman, *Leaves of Grass*

LAND MANAGEMENT IMPLICATIONS

- Providing snags that woodpeckers can excavate is important for forest ecosystem health in the Pacific Northwest, where more than 50 wildlife species use woodpecker-excavated cavities for nesting or roosting.
- Mixed-severity prescribed-fire may be useful in creating breeding habitat for the white-headed woodpecker, a species traditionally associated with old-growth forest.

Teresa Lorenz

The prescribed burn conducted in this stand flared up in patches, creating a mosaic of burned and unburned trees (a mixed severity burn) that is still used by white-headed woodpeckers and black-backed woodpeckers 10 years after the fire. Tree death is usually required to initiate the process of wood decay—which softens the wood, making it suitable for woodpecker excavation.

For Further Reading

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