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INSIDE

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

DEAD AND DYING TREES: ESSENTIAL FOR LIFE IN THE FOREST

Credit: E.Bull

Hollow logs are used by martens, black bears, and smaller mammals for den sites and shelter.

"In the place where the tree falleth, there it shall be."

Ecclesiastes 11:3

In an old-growth forest you are surrounded by death and dying. More than likely, you're tripping over it, you're marveling at the weird growths on trees, you're listening to the hammering of woodpeckers, without knowing how much death you're actually witnessing. In its undisturbed state, a forest offers standing dead trees, live trees decaying because of various fungal infections or insect attack, and a cornucopia of logs.

"The truth is, the system depends on it, depends on the death of trees," says Torolf Torgersen. "The more we learn, the better we understand that the connections in the life and death cycle from trees to logs are not only wonderfully complex but also quite confounding. What is clear is that the forest absolutely requires death to survive."

Torgersen is an entomologist who worked with wildlife biologist Evelyn Bull and plant pathologist Catherine Parks, all from the Pacific Northwest Research Station's Forestry and Range Sciences Laboratory in La Grande, Oregon, to produce a report—now much in demand—on the elements of death and their role in east-side forests. The report is titled "Trees and Logs Important to Wildlife in the Interior Columbia River Basin." It effectively upgrades a 20-year-old publication on wildlife habitat in managed east-side forests, on which many current Forest Service standards and guidelines are based.

IN SUMMARY

Twenty years after publication of a report on wildlife habitat in managed east-side forests, Pacific Northwest Research Station scientists Evelyn Bull, Catherine Parks, and Torolf Torgersen, are updating that report and discovering that the current direction for providing wildlife habitat on public forest lands does not reflect findings from research since 1979. More snags and dead wood structures are required for foraging, denning, nesting, and roosting than previously thought. In this issue of Science Findings, Bull, Parks, and Torgersen, share their latest findings, which include the fact that snags and logs are colonized by organisms representing a broader array of plants, invertebrates, and vertebrates than was previously recognized.

The challenge their research results have posed to managers is simple: "As complex as the management challenge already is, and as much as we already know about snags and logs, we need to keep adjusting our understanding of the dead tree components," says Parks. "If we manage only for the living component in a forest, we're making it too simple, and the system won't function properly—in other words, it won't be sustainable in the long term."

In particular, the management of death in the forest must stretch beyond the current notion of managing for quantity, she explains—just meeting the quotas for snags and logs won't ensure sustainability. We need to differentiate among types of dead components for the latter to serve wildlife and other forest functions.

KEY FINDINGS

- Living trees with internal pockets of decay, top dieback, or broken tops can all serve as wildlife habitat. These trees often stand longer than snags, thus providing habitat over longer periods.
- Hollow living trees are special structures in forested habitats; many species of wildlife use these trees and the hollow snags and logs that result from them. The decay process that hollows these trees can occur only in living trees; thus some trees need to be left on a site to become recruits for future cadres of hollow trees.
- Witches' brooms caused by dwarf mistletoes, rust fungi, or a needle cast fungus provide unique, largely unappreciated habitat for a host of wildlife. These trees have a place in healthy forests and need to be viewed more broadly than the current notion of "always bad."
- Snags and logs are colonized by organisms representing a broad array of plants, invertebrates, and vertebrates, more than previously have been recognized. Snags also are important structural components, and logs ultimately contribute to the nutrient reserves and chemical and physical characteristics or forest soils.

THE WORK OF DEAD TREES

Forest managers have only recently acknowledged the value of the right mix of logs and standing dead trees, or snags, in a forest, and Bull was a pioneer in recognizing their crucial role several decades ago. But she is quick to point out the limitations in what was known at the time.

"We did not appreciate, for example, the value of hollow trees as roosts—we did not know that woodpeckers use a variety of roost trees through the seasons and may have to change trees because of blowdown or predator occupation," she says. "Similarly, we did not appreciate the value and diversity of downed wood. Guidelines prescribed six to eight logs per acre, but we're finding anywhere from 50 to 140 in undisturbed forests."

So what exactly do the best dead or dying trees, standing or fallen, do for wildlife?

More than 80 species of birds, mammals, reptiles, and amphibians use living trees with decay, trees with brooms (most commonly dwarf mistletoe), hollow trees, snags or standing dead trees, and logs in the interior Columbia River basin, the researchers note in their report. These structures are used for foraging, nesting, denning, roosting, and resting, often serving multiple squatters simultaneously.

Bull notes that although we have learned to recognize snags and logs as important to wildlife, we have more recently recognized the value of two more categories of deadwood: living trees containing decay and hollow trees.

Living trees with decayed heartwood allow woodpeckers to excavate through the sound layer of sapwood and form nest chambers in the soft heartwood. Trees with dead tops provide good resonating towers from which drumming woodpeckers can proclaim their territorial boundaries, or they provide hunting perches for raptors. A tree with decaying wood close to the ground, caused by wounding or scarring, often is colonized by ants, and woodpeckers forage for this food source.

Decay in living trees can have a variety of causes. "Heart-rot fungi are specialized decomposers and decay the heartwood of living trees," Parks explains. "What we call saprophytic fungi are generalist decomposers and are usually found only on already dead parts of trees, snags, or logs." Conks, or external fruiting bodies of fungi on a tree, generally indicate decay within, as do broken tops, wounds from other falling trees, and scars.

In managed forests with shorter rotations, trees do not get sufficiently old to develop decay, Parks points out. So researchers are investigating ways to add decay back into

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these stands, providing wildlife habitat without jeopardizing the surrounding trees.

"Field trials are being conducted to test ways of getting trees to decay, like blasting their tops or girdling them," she says. "But actually inoculating the right fungus directly, for example by inserting an infected piece of dowel, may jump-start the process. Initial research found it will take a tree 5 years or more to soften enough for woodpeckers to excavate, but then you have a cavity tree that will stand perhaps for hundreds of years." Ideally, this tree might be hollowed out by heart rot, and it then could spend time as part of the standing dead inventory, eventually falling to become a hollow log. Additional studies are evaluating whether inoculation is a viable management tool.

MANAGEMENT IMPLICATIONS

- Current direction for providing wildlife habitat on public forest lands does not reflect findings from research since 1979; more snags and dead wood structures are required for foraging, denning, nesting, and roosting than previously thought.
- Hollow trees have been found to provide benefits to many wildlife species, but no framework for their management currently exists.
- Dwarf mistletoe benefits to wildlife are starting to be recognized, but the threat of spread to whole stands is still largely regarded as too great a risk. With creative management, selected trees with brooms can be retained with minimal risk.
- Logs play roles in wildlife habitat, nutrient cycling, water economy, and soil structure that suggest they are more important than previously recognized. Current planning guidelines call for as few as six to eight logs per acre, when some inventories in late- and old-seral stands show 50 to 140 logs per acre.

POPULATING HOLLOW TREES

Because the hollowing process is quite specific, it has to begin early in the life of a stand, and start on a living tree, according to Parks; an already-dead tree not previously infected with heart-rot fungi will not become hollow. A hollow tree is created, she explains, when heart-rot fungi invade the heartwood of a living tree, and decay progresses to the point that the cylinder of decayed heartwood eventually detaches from the surrounding layer of sapwood and slumps downward. A hollow chamber results.

Black bears find den sites, and the females and young are safer from predacious adult males. Pileated woodpeckers roost here at night, and the holes they excavate allow access to flying squirrels, bushy-tailed woodrats, bats, American martens, northern flickers, and Vaux's swifts. Martens use the trees for denning, resting, and hunting. Swifts use them for nesting and roosting.

"To be most useful, the chamber must be large enough for a swift to fly up and down, for a pileated woodpecker to enter, or for a bear to occupy," Bull explains. What's more, all these wildlife species typically use entrances from 30 to 80 feet off the ground, where the heartwood cylinder must be large enough to provide a suitable chamber.

Credit: E.Bull

Hollow logs of various species and size classes are important components to favor in forest management.

Retaining large, hollow trees, she hopes, should not be a serious management challenge. "In most areas, these trees are uncommon, probably occur on less than 3 percent of the landscape, have little commercial value, and have high wildlife value," she says.

In the case of brooming, the management choice may not be so simple.

WRITER'S PROFILE

Sally Duncan is a science communications planner and writer specializing in forest resource issues. She lives in Corvallis, Oregon.

BROOMS FOR WILDLIFE

Many interior Columbia River basin forests are home to conifers infested with dense misshapen branches. This "brooming" is caused most often by dwarf mistletoes, but also can be caused by rust fungi or a needle cast fungus. Wildlife use dwarf mistletoes in several ways, consuming shoots and fruits, foraging for insects, and establishing cover and nesting sites.

Dwarf mistletoes are perennial parasitic plants that take water and nutrients from their host trees. There is no question that they stunt the growth of trees: heavily infested trees grow more slowly in diameter and height than do lightly infected or uninfected trees, and some may die. Over several years, infection increases on individual trees and in stands.

But they need to be recognized as a coevolved element of mixed-conifer forests in the Columbia River basin, according to Parks. "There's starting to be a transition to a new view of brooming," she says. "First we used to preach 'sanitizing' to save the stand. Then the biologists realized that there were wildlife values, and they wanted to keep all the broomed trees, without acknowledging the damage being done to timber stands. I'm encouraged to see wildlife biologists and silviculturists starting to come together on this. This is another example of the compatibility among diverse interests. We don't have to face all-or-nothing choices. With care, we can get some of each value."

The real promise of management as it is played out around dwarf mistletoe infections, says Bob Rainville, La Grande District Ranger, is that it demands a more holistic view. "How do we incorporate the benefits of mistletoe trees for wildlife into the silvicultural benefits of tree growth and health? The issue calls for cooperation and collaboration between biologists and foresters, because neither one has the entire answer."

Dwarf mistletoe spread from tree to tree by way of an explosive fruit mechanism. Fruits from female plants are expelled in late summer or fall. Usually each tree species is host to only one dwarf mistletoe species. Thus other species can be managed underneath infected trees. Brooms caused by broom rust or Elytroderma disease, may provide broom habitat without the same concerns of spread.

"Dwarf mistletoes can spread to the point that they adversely affect wildlife habitat by limiting tree growth, causing extensive tree mortality, and increasing the risk of crown fire," Parks says. "To limit spread, infected trees reserved for wildlife can be grouped and surrounded by a buffer of trees that are nonhosts, or by a treeless buffer, to slow the spread into the surrounding stand."

A current experiment designed by Bull has 60 squirrels radiotagged to see how often they use brooms in selected stands. Subsequent treatment will remove all broomed trees in some areas and a limited number in other areas. "We are hoping to persuade managers to retain some trees as a routine practice if they desire to achieve these wildlife benefits." Bull says.

THE STANDING DEAD BECOME THE FALLEN DEAD

Snags now are widely appreciated and managed as nesting, roosting, denning, foraging, resting, and shelter sites. "Specific causes of tree death, such as fire, disease, and insects, may target different tree species and age classes; thus a mix of snag species and sizes occurs naturally across the landscape," Bull says.

But although much has been known about their ecosystem roles for several decades, thanks largely to Bull's efforts, more recent data point toward the need to increase the number of snags per acre if these wildlife uses are to be achieved. Forest Service districts are responding where possible, but she notes, "we still need new information to complete our models, including the higher numbers of snags, their fall rates, and new downed log density numbers."

The most notable group of wood users in snags are the primary cavity nesters, woodpeckers and nuthatches that excavate nest cavities in the decayed wood of standing trees. When they leave, other birds and mammals are waiting in line as tenants. Both primary and secondary cavity nesters, however, are doing more than just apartment hunting. They prey on forest insects and thus play a central role in regulating those populations.

So consider the spruce budworm scourge of so many east-side forests. It kills trees, which become snags and then the foraging substrate for primary and secondary cavity nesters, many of which feed on the budworm. In time the snags fall, becoming logs. Many are colonized by ants, which also prey on the budworm and in turn become food for woodpeckers.

Thus the circle connects at many points. And in a similar manner, Torgersen was led to his log studies when he came to eastern Oregon.

Torgersen was studying mortality factors affecting budworm when he first arrived and had identified 13 species of ants as budworm predators. Eleven of those species he knew to be associated with deadwood. Meanwhile, Bull's studies of woodpeckers had been finding ants in woodpecker scat. Together she and Torgersen designed a study to begin to fill the continuing gaps in their knowledge of the deadwood component of forests.

"I had spent my whole career looking up at the canopy, stumbling over logs, and using expletives, and now I find myself down on my hands and knees studying life in those logs," he laughs. "I would never have believed this 5 years ago."

Their study sought to establish data on species and size classes of logs, soundness or amount of decaying logs, whether they are being foraged on by woodpeckers, whether they are colonized by ants, and if so what kinds of ants.

"Other wildlife biologists have found that the percentage of the forest floor covered by logs is related to many populations of small mammals," he says. "We are learning how many kinds of mammals are found in each dominant snag class, numbers in each species of log and which kinds have ants in them. Of course, the woodpeckers are already wise about this in ways we cannot possibly fathom."

Logs have been the subject of study for several decades, but Torgersen still has the sense that only the surface has been scraped. "There is so much going on in logs—bumblebees, yellow jackets, amphibians, beetles—and all we're touching is the ant part. It has involved a lot of sleuthing to ferret out the story thus far and has strongly encouraged work from a variety of disciplines."

PERSPECTIVES ON DEATH IN THE FOREST

There are many views of a forest, but the problematic one here is how deadwood is perceived. In a region riven with battles over "forest health," with emphasis on insect and disease attacks and the vast quantities of fuel available for wildfire, the prevailing view long has been negative.

Is a standing dead tree more valuable as wildlife habitat than it is risky as wildfire fuel? What about a whole ridge loaded with such trees?

"Our ongoing research brings out the direct conflict between retaining deadwood for wildlife and reducing fuels for wildfire," says Bull. "Obviously land managers have to make some compromise decisions to manage large areas."

"We are trying to achieve sustainable forest ecosystems on a landscape basis," says District Ranger Rainville. "Adjusting to new guidelines as they are developed is necessary in all that we do because we don't have all the answers."

Torgersen poses the predominant, and apparently simple, question faced by managers: How much is enough? "We have quantified the resource, we are working on making managers aware of the value of the resource; now we have to ask, What do the numbers mean? How much is enough?" Specifically, he adds, if we're finding 120 logs per acre today, is this an accurate picture of the "natural" state of the forest? What about the effects of 50 years of fire suppression, or of logging? What should we be managing for?

Rainville's management response is to take what we know, then thoughtfully implement, monitor, assess, and reevaluate. It is adaptive management at its best when the terribly important relation linking scientists and managers can be fostered. "Linkage of the two groups can be difficult, given the scientists' need for experimental designs that will yield reliable results, and the managers' economic and contractual limitations. There is no reward system for collaboration."

Old photos show ponderosa pine forests that are wide open and quite clean from frequent underburns. Conversely, mixed-conifer stands dominated by grand and subalpine firs may have had many accumulations of logs between episodes of stand-replacement fires. This suggests that snags and logs moved through these systems differently when fire was a natural component, or it may simply be a limited snapshot in time. We can't know for sure, Torgersen says, and that's the current challenge.

It's a challenge attracting the attention of all kinds of forest managers. Private companies such as Weyerhaeuser are interested in new data, state and BLM managers are calling, public utilities need to mitigate for power line installation, municipal parks seek to protect the resources they already have, universities want to pursue research, and other private landowners and tribes seek responsible management solutions.

The data also are being incorporated into a model called DecAID, which is compiling all available east- and west-side empirical data on wildlife use of snags and logs, along with habitat-specific inventory data to interpret wildlife needs. The model is still under development. But so far, according to Kim Mellen, wildlife ecologist with the Mount Hood National Forest who is working on the model, the data appear to support a management conclusion that current Forest Service land management standards and guidelines are inadequate.

It seems management will never be easy again, if it ever was, because forests are so complicated. It might also be said that in forests, as in life, the only sure things are death and taxes.

Credit: EBull

Douglas-fir dwarf mistletoe may form large brooms.

"The Governor was strong
upon the Regulations Act:
The Doctor said that Death
was but a scientific fact:
And twice a day the Chaplain
called, and left a little tract."

Oscar Wilde 1854-1900

FOR FURTHER READING

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