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INSIDE

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

DEAD WOOD ALL AROUND US: THINK REGIONALLY TO MANAGE LOCALLY

Credit: J. Ohmann

Down wood in the Hoh Valley, Olympic Peninsula, Washington, at various stages of decay, becomes part of the regional carbon budget.

IN SUMMARY

Dead wood is a crucial component of healthy, biologically diverse forests. Yet basic information about the distribution and characteristics of snags and down trees in forests of the Pacific Northwest is lacking. Such information is needed to assess wildlife habitat, carbon stores, fuel conditions, and site productivity. Current guidelines for dead wood management are based on limited or dated scientific data.

A recent study by the Pacific Northwest Research Station delved into existing resource inventories to create new information estimating density, volume, and percentage cover for dead wood across about 49 million acres of upland forests in Oregon and Washington. To estimate the natural range of variability in snags and down wood in upland forest habitats, researchers also analyzed plots containing no evidence of harvest activity.

The findings are being used in dead-wood management models and to provide information about wildlife habitat and ecosystem health. Another study assesses the amount of biomass and carbon stored in dead wood, providing information on carbon dynamics for global climate change and criteria and indicators specified in the Montreal Process. The Montreal Process is an initiative started in 1993 to develop a way to measure the outcomes of forest management.

"*We are edge-dwelling children of this forest. We cannot tell if we evolved for it or it for us.*"
David Kelly, "Old Growth Forest," 1988

"Incredibly complicated." It is not often that such wording is found in the scientific literature. More often the statistical and computing tools of science are used to simplify the complex and illuminate the unimaginable. To render the natural world, indeed, less complicated.

But when it comes to counting, evaluating, and explaining the distribution of dead wood in our forests, it is, to put it mildly, incredibly complicated, as two Pacific Northwest (PNW) Research Station scientists acknowledge in upcoming papers.

"For over 25 years, there has been a move for the regional inventory programs to measure all vegetation, not just timber resources, so there was already an effort underway to inventory standing and down dead wood," Janet Ohmann explains.

"However, our analysis was a first," Karen Waddell continues. "We had access to valuable information that had been collected in Forest Service and Bureau of Land Management inventories for years, but had not yet been compiled into a 'dead wood database.' People were extrapolating from very small studies, in order to understand what the dead wood component of Oregon and Washington forests is."

"Initially, dead wood data were collected to address wildlife habitat issues," Ohmann adds, "but more recently dead wood is considered relevant to issues of forest health, site productivity, fuels, and carbon stores as well. We took the opportunity to analyze extensive inventory data to look at these issues on a regional basis."

Waddell, a research forester based at the PNW Research Station Portland, Oregon, Forestry Sciences Laboratory, and Ohmann, a research forest ecologist at the Forestry Sciences Laboratory in Corvallis, Oregon, worked together on the most comprehensive study yet available of dead wood across both managed and unharvested forests of all ownerships in the Pacific Northwest. The study is based on over 16,000 field plots distributed across nine wildlife habitats.

KEY FINDINGS

- Dead wood generally increased with forest succession. Snag levels tracked recent disturbance and forest development. Down wood was more closely associated with long-term history and site productivity than were snags.
- Large snags were more than twice as dense in forests that have never been harvested than in those that have been harvested. Levels of large down wood were greater in harvested forests than in unharvested forests at high elevations. At lower elevations, down wood levels were similar between harvested and unharvested forests.
- Dead wood populations vary tremendously, presenting unique challenges for research and management.

WHERE DEAD WOOD RULES

Many small- and large-scale studies have shown that dead wood plays a far more significant role in forest ecosystem function than was ever believed. Dead wood is home to invertebrates and micro-organisms and the better known vertebrates, Waddell points out. Soil structure, nutrient cycling, carbon storage, fuels, and forest health also respond to dead wood dynamics; all are directly affected by and in turn affect the massive tonnages of dead wood standing and lying in Pacific Northwest forests.

Although their findings throw light on the volume and distribution patterns of dead wood in Oregon and Washington forests, the researchers recognize they are only scratching the surface of understanding the dead wood picture.

Their study sought to describe current patterns of dead wood distribution—both standing as snags, and down wood as logs and debris on the forest floor—in Oregon and Washington, by analyzing data collected on regional grids of field plots.

"Preliminary work focused on dead wood abundance in wildlife habitats of upland forests," Waddell says. "The goal was to provide basic information about ecological patterns, as context for management decisions at many scales, as well as for analyzing forest policies at regional and national levels."

The analysis combines and approximates conditions across large areas so does not provide guidance for managing at the site level. But at a landscape level, these data can provide input for much sought-after guidelines for managers.

"The findings have implications for the development of management guidelines for public lands, and for incentive programs and forest practice regulations for private lands," Ohmann explains. "They also have implications for wildlife planning and management at local and subregional scales, where it is important to consider a broader, regional context."

Also, at the forest policy level, the data will contribute to assessments that address criteria and indicators of biodiversity and global carbon cycles for the conservation and sustainable management of temperate and boreal forests, developed through the Montreal Process.

Purpose of PNW Science Findings

To provide scientific information to people who make and influence decisions about managing land.

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HOW MUCH IS OUT THERE?

For the area studied, fire was the predominent natural disturbance before European settlement, but in the last 100 years, timber management and wildfire suppression have significantly altered forest succession and the distribution of dead wood. For example, on the east side of the Cascade Range, fire suppression has allowed fire-sensitive and late-successional tree species to increase in density, while selective harvests have influenced forest composition.

LAND MANAGEMENT IMPLICATIONS

- The findings have implications for developing management guidelines for public lands, and for incentive programs and forest practice regulations for private lands.
- Findings also have implications for wildlife planning and management at local and subregional scales, where it is important to consider a broad, regional context.
- The range and distribution of dead wood within unharvested forests provides clues, but not definitive amounts, to levels that may have been present historically. This becomes a reference point for current levels and distributions of dead wood.
- Regional summaries of dead wood have implications for fuel loadings and fire risk in western forests, and can be translated into information on carbon stores for considering the effects of global climate change.

"Based on over 16,000 field plots distributed across nine wildlife habitats, average density of snags at least 10 inches in diameter ranged from 3 to 91 trees per acre, and down wood at least 5 inches in diameter ranged from 47 to 670 pieces per acre," Ohmann says. "High-elevation habitats had the greatest snag densities, while the lower elevation habitats west of the Cascade crest had the greatest concentrations of down wood."

There were notable distinctions between standing and down wood. Generally speaking, Ohmann explains, snags more closely tracked forest succession and recent disturbance, particularly harvest. Large snags were more than twice as dense in forests that have never been harvested than in forests that have had any kind of harvest in the past.

Down wood, on the other hand, was more closely associated with long-term history and site productivity. "Levels of large down wood were similar in harvested and unharvested forests except in the high-elevation habitats, where volume was greater in harvested than in unharvested forests," she says.

And the overall number of snags was significantly lower than that of down wood. "We surmise that snags have been knocked down or felled for safety reasons over the years, and don't have the longevity of down wood by their very nature. Many trees fall soon after death, from natural disturbance such as windthrow or root disease. Other snags reach some intermediate stage of decay, and then simply break and fall to the ground," Ohmann points out.

WHAT IS "NORMAL?"

A popular forest management strategy is to mimic natural forest disturbance processes and their effects. To estimate a proxy for the "natural range of variability" in dead wood that may have been present in Pacific Northwest forests prior to European settlement, the researchers examined a number of plots with no evidence of harvest activity.

"Rather than providing definitive numbers of 'how it used to be' though, what we have been able to estimate is more like a reference point, how things might have been in the past," Ohmann says. "We have provided something with which current conditions can be compared, but not with a purpose of returning to some known state." Current dead wood conditions west of the Cascade Range, where wildfire return intervals are much longer, are more likely still within the natural range of variability than are forests east of the Cascade Range, where effects of fire suppression are much more pronounced.

This segment of the study highlights the importance of legacies in the dead wood world: without a source of snags and down wood, a forest will be starved of a key source of nourishment, in many senses. This is especially a concern for larger dead wood, which will not be re-created under current rotation ages.

What may be a surprise to many was the large quantity of dead wood still surviving on industrial land, Ohmann says. "This is largely due to the huge legacy from the original old-growth forests, and also from the much lower utilization standards in the early days of logging. There are numerous large, decayed stumps still showing springboard notches high above the ground."

Once these legacies are gone there will be a gap in time where there is nothing being provided to the forest floor. Ohmann sees the gap as inevitable, particularly in intensively managed forests where no legacies are likely to be produced in the future. The ramifications of this are unclear, but it does suggest that landscapes will begin to diverge over time based on ownership and the objectives that attach to each. Federal and state lands are likely to have larger supplies of dead wood; private lands less, although the variation on the latter will probably be high.

WRITER'S PROFILE

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

GETTING DATA TO MANAGERS

Demand for information on dead wood distribution is high and increasing, Ohmann says, with regular calls pleading for any information at all on what is "normal" for a certain area, and what kinds of numbers are best for certain wildlife management objectives.

So the study is timely, and will feed directly into a new model being designed to allow managers to consider their objectives on a regional level and in a comprehensive way. The Decayed Wood Advisory Model, or DecAID, is a multidisciplinary management tool under development, integrating wildlife use, dead wood distributions, and other factors into its database.

The researchers summarized dead wood data to help describe the range of variability of dead wood in unharvested forests as a proxy for what may have existed prior to European settlement, an approach that works better for west-side than east-side forests. It also describes variation across all ownerships and forest conditions over the regional landscape to assess current landscape conditions. The goal of DecAID is to advise managers on the density, size, and decay class of dead wood needed to maintain wildlife habitat and ecosystem functions in forest habitats.

"While providing advice on maintaining wildlife habitat will be a main objective of the model, the model will be ecosystem-based and also include information on ecosystem functions performed by dead wood, such as soils, roles of insects and disease in the creation and dynamics of dead wood, and management of fire likelihood," Ohmann explains. "The modeling process will also help identify gaps in our knowledge of dead wood as wildlife habitat and its role in ecosystem processes."

STORING AND RELEASING CARBON: THE DEAD WOOD FACTOR

The dead wood data summaries can also be translated into information on carbon stores, important when studying the effects of global climate change. Dead wood releases carbon to the atmosphere—becoming a carbon source—during microbial respiration from decomposer organisms. But in ecosystems with cool climates, microbial activity is restricted and decomposition is very slow, so dead wood tends to accumulate and act as a long-term carbon storage site and net ecosystem sink, Waddell says.

Put another way, biomass accumulation on a site represents the balance between additions through tree death, breakage, or transport, and losses through processes of decomposition and fire consumption.

"Historically, dead wood volume, biomass, and carbon have been estimated with predictive models using stand-level inventory data as an input," she explains. "Both local and national carbon budgets have been developed with these methods. In some cases, dead wood simply was excluded from forest carbon budgets because data were unavailable."

Dead wood volume, biomass, and carbon differed substantially among the forest types studied. Overall, conifer forest types contained almost twice the carbon of broadleaf forests, and the researchers surmised that this was partly a result of decomposition rates: decay is most rapid in trees with high nutrient content and small diameter, factors typical of broadleaf trees.

Carbon stored as down wood was about six times that stored in snags, Waddell says. But, if you only look at forests that have not been harvested, down wood carbon was much less—about 2.7 times that stored in snags.

THE OWNERSHIP EFFECT

"Forest management practices may partially explain the differences in standing and down wood biomass in the current landscape," Waddell says. "Snags, and some live trees, often are cut and left on site during logging and silvicultural treatments such as thinning, thus transferring carbon pools from snags or live trees to down wood. Snags retained on harvest units in accordance with forest practice regulations are typically just a proportion of pre-existing snags before harvest."

Differences among ownerships became apparent as the data were compiled, Waddell notes. Total carbon stores were greatest on national forest lands and lowest on other private lands. Carbon stored as snags was substantially greater on national forests (3.8 tons per acre) than on the other ownerships (0.5 to 1.4 tons per acre). Down wood carbon was also greatest on national forests (13.1 tons per acre), intermediate on other public (9.9 tons per acre) and forest industry lands (11.3 tons per acre), and least on other private lands (3.3 tons per acre).

The study has allowed scientists to provide more quantifiable sources of information to carbon models and budgets being developed for global warming studies and the Montreal criteria and indicators, Waddell says. Their ability to answer more specific questions is vastly improved: How much carbon is being stored, and how is it stored—in live trees, standing dead trees, or down wood?

"With these data, scientists will be able to look at the balance between sources and sinks of carbon, and see where various forests lie on that spectrum," Waddell explains. "When these data are added to carbon models being developed or updated for the whole country, we expect our ability to predict the amount of carbon stored in dead wood to improve."

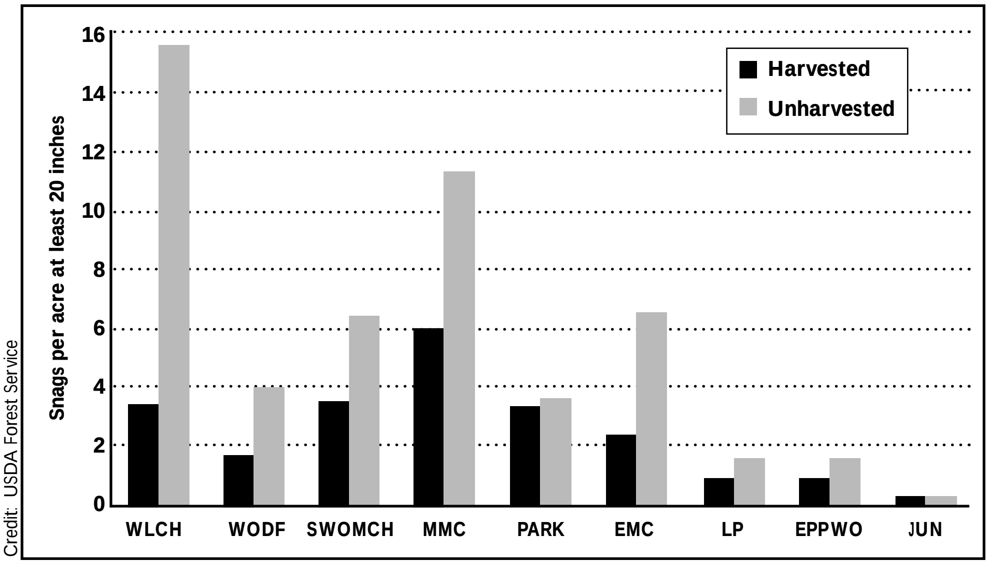
LIMITATIONS AND COMPARISONS

Both researchers acknowledge inherent limitations in their study. Ohmann notes that their reliance on empirical data is both a strength and a weakness, meaning that although their numbers are firmly grounded in reality, some habitats are very understudied in terms of sample size, such as riparian and wetland forests. A limitation of the inventory plot data is that they can't assess spatial arrangement of dead wood within a stand or across a landscape.

"Our biggest concern is with the imperfect information available for the plots on disturbance history," she says. "We must be cautious in using our regional data to describe potential presettlement characteristics of large dead wood, because other than recent harvesting and road-building activities, the disturbance history of the sample stands is unknown."

Direct comparisons with published estimates are challenging because of differences in geographic location, vegetation types, and disturbance histories among studies sampled. "Also, because our estimates describe average conditions integrated across a wide range of sites and disturbance histories, it is problematic to compare our numbers to studies conducted at local sites," Waddell adds.

Credit: USDA Forest Service



Snags in harvested and unharvested forests of Oregon and Washington. WLCH = westside lowland conifer-hardwood, WODF = white oak-Douglas-fir, SWOMCH = southwest Oregon mixed-conifer-hardwood, MMC = montane mixed-conifer, PARK = subalpine parkland, EMC = east-side mixed-conifer, LP = lodgepole pine, EPPWO = east-side ponderosa pine-white oak, JUN = western juniper.

Working at a regional scale with very large sample sizes does keep their standard errors fairly low, the researchers point out. However, plot-level biomass was extremely variable, reflecting a naturally high variability through time and across the landscape in the many interacting environmental and disturbance factors that influence dead wood on a site, Waddell says.

Further research holds promises to clarify an incredibly complex set of questions about dead wood. The data now available, however, bring better focus to both questions and answers than policymakers, land managers or scientists had previously. Today's decisionmakers will be better informed than yesterday's.

Credit: J. Ohmann

Ponderosa pine snags in central Oregon provide valuable wildlife habitat.

FOR FURTHER READING

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Her research interests include studying the many facets of dead wood—snags and down wood—in forests and habitats across the country.

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