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FINDINGS

INSIDE

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

SEEING THE BIGGER PICTURE: LANDSCAPE SILVICULTURE MAY OFFER COMPATIBLE SOLUTIONS TO CONFLICTING OBJECTIVES

J. Nakae

The Gotchen Late-Successional Reserve covers almost 15,000 acres on the southeastern slopes of Mount Adams (foreground) in the Washington Cascade Range. Mount Rainier is in the background. The Aiken lava flow, which bisects the reserve, is a distinctive feature of the otherwise forested landscape.

"Discovery is adventure. There is an eagerness, touched at times with tenseness, as man moves into the unknown...When one moves through the forests, his sense of discovery is quickened."
—William O. Douglas

Evergreen tree canopies, layered one atop another, are a defining characteristic of older forests in the Pacific Northwest. In most cases, multi-storied forests develop after the pioneer cohort of trees has grown tall and light has begun to leak through gaps in their foliage. Slow-growing, shade-tolerant species then soak up sun and unexploited radiation to ascend from the understory. Protracted change and turnover of plant and wildlife species are hallmarks of forest succession. Spotted owls seem to favor the tiered canopy structure that develops late in the process. Not surprisingly, therefore, canopy layering is typically a valued trait within the network of old-growth protection zones, called late-successional reserves, which were designated by the Northwest Forest Plan.

Most late-successional reserves are west of the crest of the Cascade Mountains, in temperate rain forests. A minority of reserves, however, are on the east slope of the Cascades, which is drier and dominated by mixed-conifer forests of firs and pines. Historically, these forests were burned by mixed-severity fires, which kept conditions patchy. But for the past several decades, fire has been suppressed and tree canopies have become more continuous. Now, when federal forest managers working in these reserves look up, they see more than owl habitat—they also see a ladder of fuel rising from the ground to the tree tops, creating conditions for stand-replacing wildfire.

Forest managers are required to protect reserves from large-scale human and natural disturbances while simultaneously

IN SUMMARY

Some federal forest managers working in late-successional reserves find themselves in a potential no-win situation. The Northwest Forest Plan requires that the reserves be protected from large-scale natural and human disturbances while simultaneously maintaining older forest habitat. This is a challenge for managers working in drier reserves, where forest types are prone to frequent wildfires. In such places, managers are faced with potentially conflicting objectives: thin trees to reduce the fire threat, or leave trees to provide spotted owl habitat.

A case study of the Gotchen Reserve in Washington suggests that the potential for compatibility between fire and habitat objectives could be increased through landscape silviculture. Taking their cue from historical disturbance dynamics, researchers developed prescriptions for individual units but evaluated them collectively according to management objectives for the entire reserve. The places where treatments contributed most to accomplishing both objectives were identified by using simulation modeling. Solutions included sets of treatments that, when evaluated in aggregate for the entire reserve, could reduce the threat of high-severity fire, maintain older forest structure, and break even in costs and proceeds from timber harvest over the next 30 years. In this scenario, trees removed were mainly in the 7- to-16-inch size classes of grand fir, a shade-tolerant conifer.

maintaining habitat for species, like the spotted owl, that favor older forests. Therein is the dilemma: Managers are concerned that if they thin trees to manage fire hazard, they will also be reducing owl habitat. On the other hand, if they retain trees for the sake of habitat, then old forests could be lost in a stand-replacing wildfire.

Conserving old forests in fire-prone areas is a potential no-win situation.

"People seek ways to evaluate the tradeoffs between fire and habitat management," says Susan Stevens Hummel, a research forester at the Pacific Northwest Research Station in Portland, Oregon.

Hummel and several colleagues have been working to resolve these seemingly opposing goals on the Gotchen Late-Successional Reserve, which lies on the east slope of the Cascade Range, covering about 15,000 acres of the Mount Adams Ranger District on the Gifford Pinchot National Forest. Like other reserves in the drier region of the Northwest Forest Plan area, the Gotchen Reserve includes a mix of older, mixed-conifer forests and younger, single-species plantations. Over time and over large areas, historically patchy vegetation patterns are growing into more uniform ones.

"The problem of potentially conflicting effects from forest management is not confined to reserves" says Hummel. "Throughout fire-adapted forest ecosystems of the Western United States, federal land managers seek ways to promote conditions like those that existed in the past while also preserving some of the attributes of older forests that people have come to value."

Given the apparent conflict within any one management unit, or stand, Hummel decided to take a broader perspective. She stepped back from the one-stand-at-a-time approach to analyze treatment effects over broad landscapes and decades-long time scales. She has been developing methods to match the scale of the problem. "We investigated how various suites of treatments might change fire behavior and impact old-forest structure across the reserve, and if treatment expenses could be offset by revenue generated from the harvested wood," she says.

KEY FINDINGS

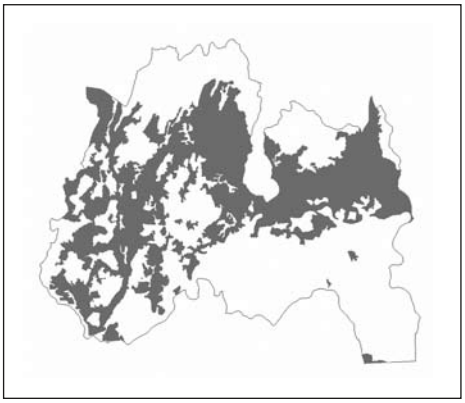
- Fire threat is projected to increase sharply within the coming decade in the Gotchen Late-Successional Reserve. Fuels are increasing on hundreds of acres annually as trees die in association with persistent insect defoliation.
- Treating more area of young, noncomplex forest reduced fire threat more effectively in the Gotchen Reserve than did treating structurally complex old-forest patches.
- Treatments sometimes lost money and sometimes made money at the scale of an individual unit. However, when the treatments were evaluated in aggregate for the entire Gotchen Reserve, they could break even over the 30-year analysis period while supporting reserve objectives for maintaining old-forest structure and reducing fire threat. In contrast, requiring landscape treatments to earn a profit negatively impacted both habitat and fire objectives over the same analysis period.
- In landscape treatments that generated revenue to offset implementation costs in the Gotchen Reserve, wood volume came mainly from grand fir in the 7- to 16-inch diameter classes.

LANDSCAPE SILVICULTURE

Hummel uses the term "landscape silviculture" to describe the process of developing management prescriptions for individual stands but evaluating them collectively according to objectives for an entire reserve. Silviculture, a term rooted in the Latin word for forest, is the practice of managing forests for what people want.

"Our intent in taking this approach was to expand silvicultural decisionmaking beyond a unit-by-unit approach and instead to consider adjacent units and landscape objectives explicitly," says Hummel.

To characterize the Gotchen Reserve at stand and landscape scales, she and her colleagues used a combination of aerial photo-interpretation and field sampling. "Once we had a database representing existing vegetation, we turned our attention to modeling forest structural dynamics as they related to fire and to owl habitat," explains Hummel.



Pattern of late older forest structure in the 15,000-acre Gotchen Reserve estimated in 2001. Gray areas are older forest, white areas are younger forest. The Aiken Lava flow (see photo on page 1) is evident as the deep indentation in the top center of the image.

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S. Hummel

Forest composition in the Gotchen Reserve varies with elevation and slope. In many places, shade-tolerant conifers like grand fir are filling in the growing space surrounding large, centuries-old Douglas-fir and ponderosa pine trees. Broomed trees (upper left) offer unique habitat.

R. McClure

Mixed-severity wildfires have historically occurred in the forests of the Gotchen Reserve. Although ponderosa pine has thick, fire-resistant bark (pictured), it can be susceptible to basal scorching if fuelbeds are deep, such as in the 2004 McDonald Ridge fire.

R. Mazza

Hundreds of inventory plots were measured in the Gotchen Reserve to add empirical data to photo-interpreted units.

"At the outset, we wanted to use a technique that could recognize the contribution of individual trees to forest structure at both within-stand and among-stand—or landscape—scales. We used a simulation model that could track stand structure over time following a silvicultural treatment and record all trees cut both by size and species," says Hummel. "In addition, because wildfire can potentially affect several stands, we wanted the model to have geographic capabilities so that the influence of neighboring stands on fire behavior could be included."

She and her collaborators simulated stand and landscape dynamics along several pathways, including a "no treatment" pathway. Management scenarios and forest development were forecast 30 years into the future. In evaluating the simulated landscape, Hummel focused on changes in forest structure, or the arrangement and variety of living and dead vegetation. It is a common denominator between fire behavior and owl habitat.

Treatments were identified that reduced fire threat or retained old-forest structure. But what's a forest manager to do when those treatments conflict?

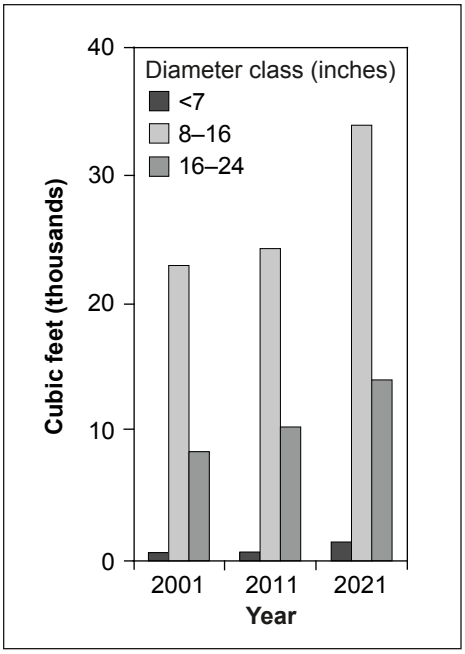
To reveal the tradeoffs, Hummel teamed up with David Calkin, a researcher with the Forest Service Rocky Mountain Research Station in Missoula, Montana. Calkin is an economist who specializes in developing "production possibility frontiers." These are essentially curves on a graph that identify the cost of increasing the level of one item in terms of what is forgone in units of another item.

"In our case, the production curves show the amount of fire hazard reduction gained in terms of older forest structure given up, and vice versa," explains Hummel.

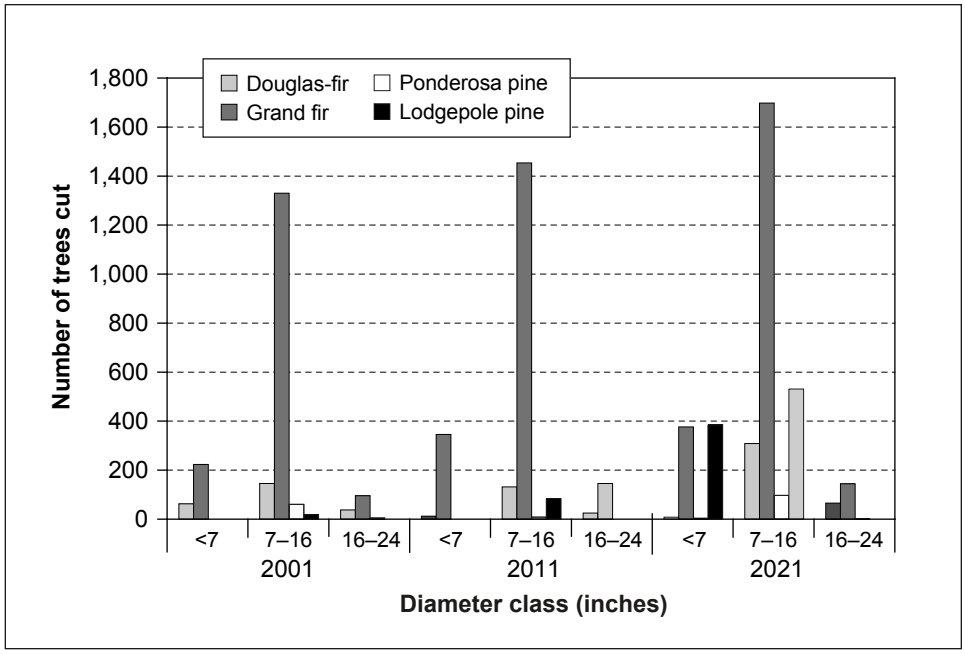
In a typical economic assessment, items are valued along the production frontier in terms of dollars and cents. For Hummel and Calkin, though, the shared currency between conflicting landscape objectives was forest structure. This, according to Hummel, is a strength of the technique—it doesn't require that items be priced, which is often difficult or contentious for nonmarket goods, like old forests and fire risk.

By using the results of simulated treatments to develop the production possibility curves, Hummel and Calkin identified multiple sets of solutions that could reduce the threat of stand-replacing fires while maintaining the overarching goal of the late-successional reserve, which is to sustain older forests. They added limits on how much area could be treated in any given decade, in keeping with the Northwest Forest Plan guidelines. "Our analysis helped identify those areas within the reserve where opportunities exist to minimize conflict between the dual landscape objectives," explains Hummel.

Of course, simulation models create opportunities even as they introduce limitations. Hummel emphasizes that it is the relative differences among the production curves and their shapes that are most informative, rather than their absolute values.



Volume (cubic feet) per decade and tree diameter class removed in the breakeven landscape silviculture treatments in the Gotchen Reserve.



Number of trees cut per decade by species and diameter class in the breakeven landscape silviculture treatments in the Gotchen Reserve.

LARGE-SCALE PROBLEMS REQUIRE LARGE-SCALE SOLUTIONS

The simulations indicated that, in the absence of a new management strategy, fire severity would increase sharply over the next decade in the Gotchen Reserve," says Hummel. Forest fuels are increasing on hundreds of acres annually as some trees continue to grow into the understory and other trees die from persistent insect defoliation.

The simulations traced out areas for treatment and selected prescriptions based on their ability to minimize conflict between habitat and fire management goals at the scale of the entire reserve. Hummel notes that, "as the spatial scale of analysis increased, opportunities for compatibility between the two landscape objectives also increased."

"The potential conflict between owl habitat and fire management was, in part, related to the acreage goal for old-forest structure in the study reserve. When the acreage goal remained at about 40 percent, fire management treatments had relatively low impact on old-forest objectives. In contrast, if a higher percentage of old-forest structure were required in the reserve, our results imply that fire management treatments would increasingly conflict with owl habitat objectives," says Hummel. Although solutions were identified that could reduce fire threat in the Gotchen Reserve, fire threat still increased over time because of the limits set on how much area could be treated.

This is the real power of landscape silviculture. When the two objectives—maintain owl habitat and reduce fire threat—were considered within any given stand, it seemed like a no-win situation. But when those same objectives were analyzed among stands, over the entire landscape, the potential for direct conflict diminished.

"All decisions involve weighing tradeoffs," remarks Hummel. "Methods like ours can reveal potential impacts to different objectives and provide information to decision-makers and others who care about land management."

BREAKING EVEN OVER THE LONG TERM

The silvicultural prescriptions differed in the species, size of trees removed, intensity, and thus the residual forest structure left after harvest. Depending on the existing forest structure, some treatments created patchy openings and others kept conditions fairly uniform. Hummel tracked revenue produced from each treatment to determine whether—after subtracting for log hauling, road maintenance, site preparation, and reforestation—it broke even or was profitable or unprofitable.

"Treatments sometimes lost money and sometimes made money at the scale of an individual stand," explains Hummel. "However, when the stand treatments were evaluated in aggregate for the entire reserve, they could break even over the 30 years while still supporting reserve objectives for maintaining habitat and reducing fire threat. In contrast, requiring landscape treatments to earn a profit negatively impacted both habitat and fire objectives over the analysis period."

The mixture of treatments in the break-even scenario included a large component of wood volume from trees in the 7- to 16-inch size class of grand fir, a shade-tolerant conifer. Many of these trees likely established in the Gotchen Reserve after forest managers began suppressing naturally occurring wildfires.

"Although removing the medium-sized trees may seem intuitive with respect to reducing fire hazard, our approach gave us additional information about tradeoffs with other landscape objectives. Namely, the removal of such trees may not directly conflict with owl habitat objectives for old-forest structure at the scale of the reserve. This is informative, given the uncertainty surrounding the compatibility of fire and habitat objectives in the drier provinces of the Northwest Forest Plan," says Hummel.

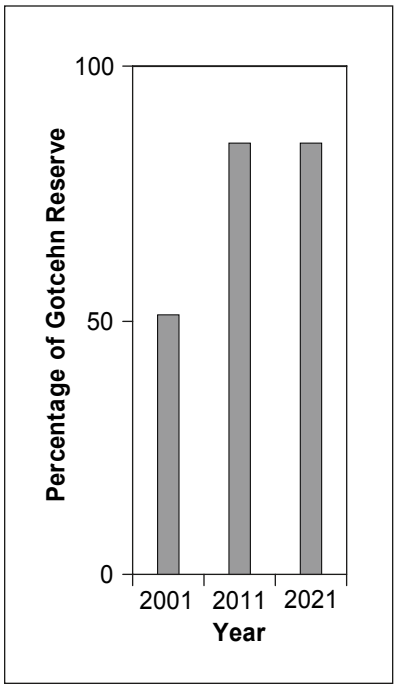
TURNING SIMULATIONS INTO REALITY

The findings from the Gotchen Reserve analysis were incorporated into the Gotchen Risk Reduction and Restoration Environmental Impact Statement, which was adopted without appeal in 2004. Treatments are now being implemented through the use of stewardship contracts.

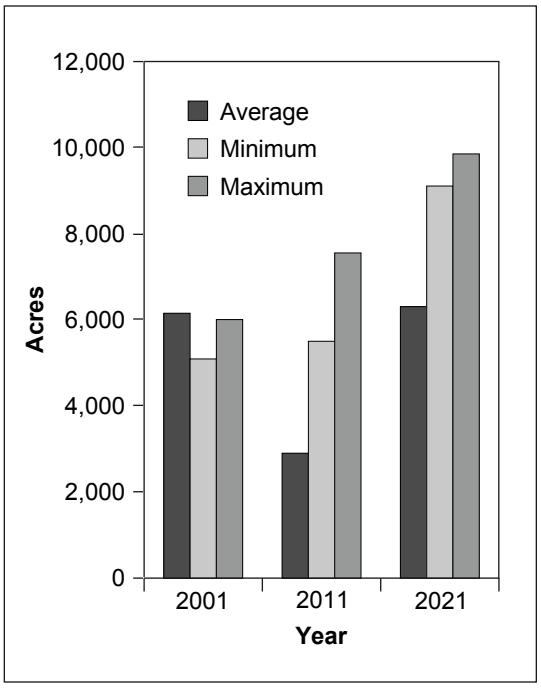
This is promising, given that past attempts to address the fire hazard in the Gotchen Reserve were met with opposition, meaning no work got done on the ground.

What makes this case different is that Hummel and her colleagues linked mid-scale analyses of landscape change with stand-level treatments to reveal the potential for conflict or compatibility between landscape objectives. By matching the spatial and temporal scales of analysis to the scale of the objectives, possible solutions became evident.

That is a useful finding, and forest managers—who are frequently bound between conflicting objectives—have taken notice.



Percentage of Gotchen Reserve projected to be in high fire threat in each of three decades without any treatment.



The estimated area of late-seral forest (LSF) structure in the 15,000-acre Gotchen Reserve varied by decade and by analysis method. Average estimated area of LSF structure remained below 50 percent, but the range of estimates varied over time.

LAND MANAGEMENT IMPLICATIONS

- The silvicultural treatments chosen to support landscape objectives for fire and habitat management emphasized reducing the density of shade-tolerant trees established since effective federal fire suppression began.
- The potential conflict between owl habitat and fire management was related to the acreage goal for old-forest structure in the study reserve. When the acreage goal remained at about 40 percent of the Gotchen Reserve, fire management treatments had relatively low impact on existing old-forest structure or on owl habitat objectives. In contrast, if a higher percentage of old-forest structure were required in the reserve, study results imply that fire management treatments would increasingly conflict with owl habitat objectives.

Some of the methods from the Gotchen Reserve study are being adapted for use in the planning process for the B&B Fire area on the Deschutes National Forest in central Oregon.

"While results from the Gotchen Reserve case study are applicable only in the study reserve, the method we used—linking landscape dynamics and patterns of forest structure to stand-level silvicultural treatments by considering the treatments collectively rather than on a unit-by-unit basis—could be used anywhere that multiple management objectives share a common basis in forest structure. For example, the tradeoffs between wildfire risk and home sites or between recreation opportunities and wildlife habitat could be similarly analyzed," says Hummel.

Given the potential to turn apparent problems into potential solutions, it is likely that forest managers will be taking a look at landscape silviculture and the Gotchen Reserve planning process.

"If a book isn't written, no one needs to burn it—ignorance can dance in the absence of fire."

—William Stafford

FOR FURTHER READING

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