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INSIDE

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

IT'S NOT EASY BEING GREEN:
THE TRICKY WORLD OF SMALL-DIAMETER TIMBER

Scattered across the intermountain West are millions of acres of tightly packed, small-diameter trees, previously unmanaged, unimaginable as timber. No one has good figures on exactly how much of this scruffy kind of forest is out there: Enough to matter. Mostly the talk is about fire hazard, insects, and disease.

But small-diameter stands also are associated with achieving the demanding ecological objectives now thrust upon our Federal forests. The term "small diameter" is taking on a whole new meaning to managers. The use of small-diameter trees conveys much about the "being green" concept.

Being green, however, is not free, or even cheap. Do we know yet how to pay for it? Judging by the large number of no-bid sales for such stands on Federal land—as much as 20 percent—we're still clambering up the learning curve.

Life in the Forest Service was a lot simpler when timber was pouring out of Federal forests. Congress set the quotas, districts planned and supervised the sought-after sales, and the big trees were hauled out to hungry mills.

Fast forward via spotted owls and ecosystem management: With timber no longer heading the list of Federal forest management objectives, desirable outputs today include healthy riparian areas, connected blocks of late-successional forests (think big trees), habitat for threatened and endangered species, and high-quality recreational experiences. No more business as usual. Life in the Forest Service has become massively complicated.

The ensuing questions are fundamental. Can these densely packed, small-diameter stands be used to develop highly desirable late-successional stand structures in National Forests? How do we manage increasing fire and disease hazards while also honoring ecosystem values? Does commercial logging have a place in today's landscape ecology?

The millions of acres of densely stocked stands of small-diameter trees populating the region between the Rockies and the Cascades, Canada and northern California and Nevada, provide a place for some of these lines of thought to intersect. The small-diameter stands offer opportunities to improve biological diversity and ecosystem health through thinning and other silvicultural treatments. And logging can sometimes be a cost-effective way to accomplish ecological objectives.

Sometimes.

The intermountain West has millions of acres of unmanaged, densely stocked, small-diameter trees. More than havens for fire hazards, and insect and disease damage, they may offer a path to improved biodiversity, aesthetics, and wildlife habitat.

USDA
United States Department of Agriculture
Forest Service

EDITOR'S NOTE

Big shifts have been made over the last decade in how society thinks forest lands should be managed. Forest policy has subsequently changed. Land managers now grapple with how to make society's intentions work in the forests of today.

This issue of PNW Science Findings presents the Colville study's examination of the vast forests of small-diameter wood in the intermountain West. In this region, land managers are working to decrease the risk to forest health from fire, insects, and disease while improving wildlife habitat and aesthetics. In doing so, they are considering how to create the structure of late-successional forests in dense, small-diameter, and simple-structured stands.

The results of the study show that certain treatments can speed up the development of healthy stands. The treatments of best result were clearcuts with green tree retention and thinnings.

The study examined whether or not the treatments could be economically made in these stands that in the past were considered unprofitable for logging. A product of the study is a software tool to help planners and logging operators make this economic determination themselves for particular places. The study also explores existing and potential products that can be manufactured from the small-diameter timber.

This study's success is largely from close collaboration among the Forest Service, universities, and private industry. It is this type of collaboration that is key to providing future generations with forests that reflect today's best knowledge.

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DENSE STAND, ECOSYSTEM MANAGEMENT, AND WOOD PRODUCTS

"There's a mistaken notion that if anyone just takes the timber off a sale, they're going to make a profit on it. With 10 years of experience dealing with small-diameter timber, we've been doing our best to educate the Forest Service about the real value, and the real difficulty, of this kind of sale," says Duane Vaagen, president and CEO of Vaagen Brothers Lumber in Colville, Washington.

Vaagen Brothers was the successful bidder on the Rocky II sale in the Colville National Forest in 1994. The Rocky II sale was used by the Pacific Northwest (PNW) Research Station to investigate the silviculture, ecology, utilization, and economics of small-diameter densely stocked stands. What if some ecosystem objectives could be met in the dense stands while producing wood products? This question, essentially, was the genesis of the Colville study: Wood Utilization for Ecosystem Management.

"We believed the issue of small-diameter wood would become increasingly important as the Forest Service moved away from timber for its own sake to other ecological goals. We wanted to take the lead in finding out the implications, rather than waiting till they overtook us," says Jamie Barbour, wood and fiber scientist with the PNW Research Station and team leader for the project.

"Many of the stands in question originated after stand-replacement fires, with abundant natural regeneration and minimal self-thinning. Traditionally, these stands have been marginal for economic operations and have been left alone while stands with larger trees have been harvested," Barbour explains.

The Rocky II sale was typical of many stands that need management to achieve ecological objectives. Management objectives such as creating late-successional forest structure; decreasing forest health risk from fire, insects, and disease; improving wildlife habitat by providing large green trees and snags; and improving stand aesthetics by decreasing stand density may be applicable to such a stand.

What kinds of silvicultural treatments might lead toward these objectives? Which might lead away? And could we, in the real world where research dollars aren't involved, pay for those treatments by selling the timber?

To address these questions, the Colville study was divided into four technical focus areas: silviculture and ecology, forest operations, timber conversion, and economics.

"The key to success in this endeavor," Barbour notes, "was the effort of getting different groups of scientists working together who don't generally interact. We were juggling and collaborating with the National Forest System, researchers, industry, universities, and environmentalists."

The stands within the Rocky II sale offered high densities of trees less than 9 diameters at breast height with a mix of lodgepole pine, ponderosa pine, western larch and Douglas-fir, with understories of grand fir and western redcedar.

FOR FURTHER READING

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PURPOSE OF PNW SCIENCE FINDINGS: Provide scientific information to people who make and influence decisions about managing land.

CUTTING TREATMENTS PROMOTE ECOSYSTEM OBJECTIVES

The silviculture and ecology portion of the research projected the development of the small-diameter stands over 150 years under five forest management regimes: no treatment, group selection, single tree selection, thinning, and clearcut with green tree retention.

One of the aims of the study, Barbour says, was to demonstrate that existing analytical tools could be used to examine these options. Specifically, the Forest Vegetation Simulator (FVS) model was used to assess the range of treatments possible at Rocky II and clarify which would lead toward or away from, the desired objectives.

"FVS is the best model currently available to address this question for this part of the country," says Roger Fight, principal economist with the PNW Research Station. "We of course also do a sniff test of reasonableness once we have the data from the model and can look at them in the light of reality."

What the model showed was that certain treatments did indeed speed up the development of healthy stands better able to provide habitat for cavity-nesting birds, improved aesthetics, and structural and biotic diversity.

The simulations also suggested that meeting stated ecosystem objectives will require some form of management intervention. The clearcut with green tree retention and thinning treatments achieved the best results, in encouraging growth of large trees. Notably, the no-treatment option rarely achieved any of the objectives, because it did not produce large trees.

"There are some types of stands where even 150 years won't produce the types of features such as large trees that the staff on the forest say they want," explains Barbour. "The fact is, some areas are just not ideal for intervention, because the cost of treatment is so high."

The clearcut with green tree retention and thinning treatments achieved the best results.

FINANCIAL EVALUATION OF ECOSYSTEM MANAGEMENT TREATMENTS

For the Forest Service, given the ecosystem values that now must be planned into every Federal timber sale, the layout of potential sales is becoming an increasingly complex, time-consuming, and expensive process. The bidders can ill-afford to make mistakes in assessing the profit or loss potential in any sale. The rise in no-bid sales is mute testimony to this business risk.

No-bid timber sales result from a complex set of variables: high costs of harvesting, transportation, manufacturing, and stand treatments; lack of mills close by that can handle small-diameter material; and low or unpredictable product prices, according to Peggy Kain, group leader of vegetation management and forest products for the National Forest System.

For a harvesting and processing company, the balance between bidding and walking away is a fine one. "The Forest Service approach too often has been to throw all the small-diameter stems in with the mix just to get the bids. We have to make sure we don't walk into a losing sale, but at the same time, if we don't bid, there's more chance there will be fewer sales offered in the future," says Vaagen.

For the Forest Service, the Colville study FVS simulations will help forest managers better understand whether ecosystem goals can be accomplished with a timber sale, Fight says, and if so what kinds of treatments will produce the best results.

"One of the key outputs of the economics segment of the Colville study will really help the sale planners and the bidders know in detail what they're working with," says Fight. He is referring to the development of software called the financial evaluation of ecosystem management activities, or FEEMA.

The major value of the software, according to Fight, its chief developer, will be to provide a means to explore such variables as alternative harvesting systems, product options, and tree selection, along with economic evaluation of different processing technologies and products.

"FEEMA is intended to be a tool in the planning process, before any actual sale is planned," Fight explains. "Planners will be able to look at representative stands in the planning area, identify those that do not have enough value for purchasers, versus those where the management objectives are achievable through profitable logging activities. The third group is those areas that are marginal, but with alternative treatments might move sales into the profit category for bidders.

Operators will be able to use FEEMA to make their own customized calculations about stands within a sale. This ability is crucial because so much is site-specific about sales, Fight says, such as stand conditions, type of treatment proposed, hauling costs, current market conditions, arrangements for leave-behind material, and road requirements. The customizable nature of the program, which draws on 30 years of product recovery data, is new to the market and particularly important for the relatively untested (in the U.S.) world of making small-diameter logs pay.

KEY FINDINGS

- **Vegetative management activities are necessary to achieve most ecosystem goals in densely stocked small-diameter timber stands.**
- **Alternative harvesting systems exist that remove small-diameter timber in an ecologically sound manner, but costs are higher than traditional methods.**
- **Both species and material size are important in the recovery of wood products.**
- **Effective evaluation of the relative merchantability of different types of treatments requires detailed financial analysis of all treatment types, and of harvesting systems, species, material size, and many other factors specific to a site.**

HARVESTING COSTS AND WOOD PRODUCT VALUE

So back to the standing timber in the scruffy forest: how do you make harvesting and processing these "matchsticks" pay? That would be a bidders question. For the Forest Service, it's a different spin: can limited commercial logging operations help offset the cost of meeting ecological objectives?

The forest operations segment of the Colville study evaluated harvesting alternatives for various silvicultural prescriptions and also provided information on the costs and productivity of different harvesting systems. The goal was to minimize soil degradation and any damage to the residual stand.

Does commercial logging have a place in today's landscape ecology?

A "cut-to-length" system was the harvesting solution required for parts of the Rocky II sale. The cut-to-length system processes trees at the stump, thus leaving nutrients on the site for recycling. The system also places shorn limbs and needles on the harvesters path, which act as a cushion to prevent soil compaction during thinning.

"Because only processed logs are taken to the landing, most nutrients remain on the site, where they are well distributed in the mat," says Barbour. "The resulting fuels are compacted and present only a minor fire hazard after 1 or 2 years."

But cut-to-length systems are expensive, and cost differentials are crucial in small-diameter stands. "We found that changes in average stand diameter of as little as half an inch can result in large differences in harvesting cost and wood product value," says Barbour. "The general trend is that as average stem size drops below 10 inches, potential buyers face increasing difficulty operating profitably on sales where these [special] harvesting systems are specified."

Fight cautions that this profitability point should not be seen as an absolute. The real cutoff point in profitability can be more nearly approached with such a tool as FEEMA.

The final piece in the profitability puzzle for small-diameter timber was addressed by the timber conversion segment of the Colville study. The goal here was to explore the range of existing and potential products that can be manufactured from the small-diameter resource. The products evaluated included lumber, veneer, composites, pulp, and engineered products.

The study showed that tree diameter does not affect the quality of the wood. Densely packed trees are slower growing, with fewer, smaller branches and proportionately less juvenile wood.

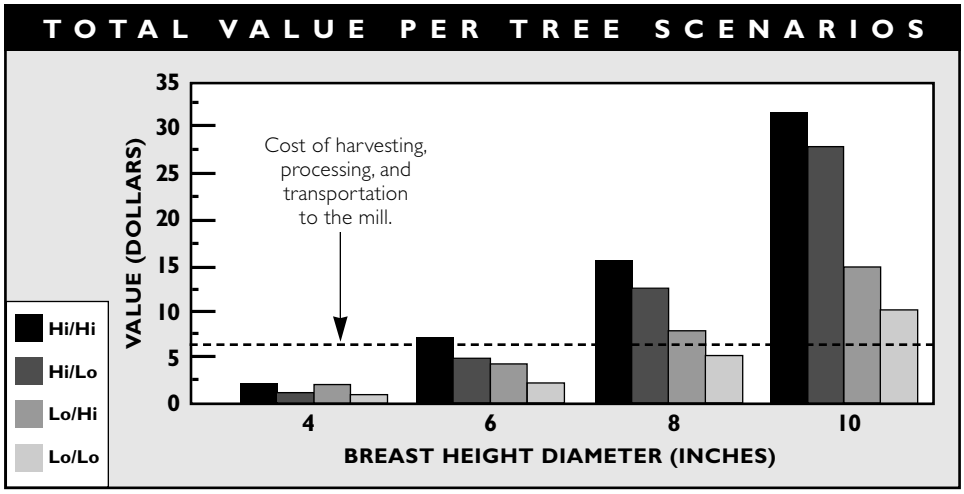
Nonetheless, smaller diameter logs are not the easy sell of large logs. Far fewer mills are able to handle the really small sizes. Vaagen frequently comes across mills claiming to handle small-diameter logs that can't process anything smaller than 12 inches. "Our average diameter is around 6 inches, and we can handle 10,000 stems a day. We've learned a lot from techniques in Finland and Sweden, where they've been working with this kind of timber for 200 years," he says.

Processing is basically a linear procedure, with logs traveling through the system at a fixed rate regardless of size. For example, a 10 d.b.h log takes the same time as a 4 d.b.h log to be processed, but produces about three times the amount of wood. Thus, although manufacture of a wide range of products from this smaller wood may be feasible technically, costs may be prohibitive.

There are other differences in merchantability, however, depending on species. The results of exhaustive testing of the products in question extended into a second phase of the Colville study.

Results so far indicate that both species and type of raw material (small trees, submerchantable logs, and sawmill residue) are important in determining the recovery and value of some fiber products. For example, lodgepole pine is an excellent raw material for oriented strandboard or kraft pulps, but it isn't very good for thermomechanical pulps.

Continuing studies of paper quality, additional composites, and mechanically tested lumber and veneer will provide more data to incorporate into FEEMA software, further improving bidders ability to assess the real market potential of upcoming sales.



Total value per tree under four scenarios: high lumber/high chip prices (Hi/Hi), high lumber/low chip prices (Hi/Lo), low lumber/high chip prices (Lo/Hi), and low lumber/low chip prices (Lo/Lo).

WRITER'S PROFILE

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

"We have a number of options on small-diameter stands," says Barbour. "We can continue to choose no treatments, and the Colville study suggests that we will not meet our ecosystem objectives that way. We can try to pay for the treatments through budget appropriations. Or we can find ways to better prepare sales to make them attractive as commercial operations, while successfully meeting our stated objectives."

Barbour believes that the Forest Service must work towards the latter outcome as current wood markets are global. "Unless a concerted effort is made to keep and nourish the necessary infrastructure for processing this kind of timber, investors could hardly be blamed for choosing instead to go to developing countries, where labor is cheap and the cut is guaranteed," he says.

The number of no-bid sales on densely stocked small-diameter stands is actually dropping slowly, as Forest Service managers and private industry learn, both separately and together, how to approach the world of small-diameter timber. Says Fight, "Barring major policy change, we're going to be plagued with small-diameter timber from here on. We'd better learn how to work with it."

COLLABORATORS

Colville National Forest, Idaho Panhandle National Forest, Forest Products Laboratory, Pacific Northwest Research Station, USDA Forest Service; Vaagen Brothers Lumber; Boise Cascade Corporation; Riley Creek Lumber Company; Oregon State University; University of Washington; University of Idaho; and Washington State University.

The harvester-forwarder is used to reduce impacts, such as soil compaction, erosion, and road-building, on a timber sale. In densely stocked forests of small-diameter trees, the high cost of this harvesting method must be weighed carefully against the market value of smaller logs.

LAND MANAGEMENT IMPLICATIONS

- Forest staff and local industry need to communicate as clearly as possible to understand each others needs with regard to management intervention on densely stocked small-diameter stands; current market conditions and design of the sale become crucial elements in these conditions.
- Opportunities exist to improve ecological health and biological diversity through thinning and other selected silvicultural treatments; with careful pre-sale analysis, commercial logging can be used to underwrite some ecosystem objectives.
- Small-diameter timber is part of the future for the Forest Service, which has a key role to play in nurturing local and regional infrastructure to keep smaller trees merchantable.

Note: The FEEMA software will be available sometime in June, 1998.
It can be accessed from the Forest Service website:

http://www.fs.fed.us/pnw

"The winners of tomorrow will deal proactively with chaos, will look at the chaos per se as the source of market advantage, not as a problem to be got around."

Tom Peters, Thriving on Chaos 1988

"You can't be beaten by a piece of timber; it isn't princely in a man to be beaten by a piece of timber."

Christopher Fry 1907

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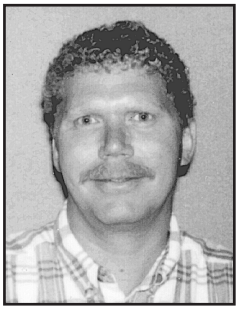

JAMIE BARBOUR is a wood and fiber scientist with the PNW Research Station. He has worked for 15 years on basic wood quality and resource utilization questions. Current research includes investigating the implications of different types of treatments to develop late-successional structure and riparian reserves and their wood product potential, and also how to take data for stand-level wood product potential and extrapolate them to the landscape level.

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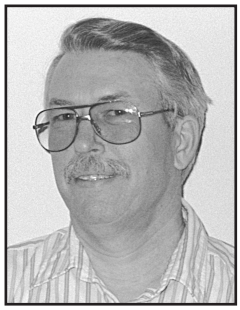

ROGER FIGHT, a research forest economist with the PNW Research Station, has been studying the economics of forest management in the Pacific Northwest for more than 25 years. He is team leader for economics of joint production where he has developed analysis and software related to pruning to improve wood quality, management of noble fir for Christmas greenery, and other forest management practices. His current focus is on financial analyses related to management of stands with a proliferation of small-diameter trees.

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PLEASE NOTE: Other scientists key to this project include ***SUE WILLITS***, Pacific Northwest Research Station; ***JOE McNEEL***, University of British Columbia; and ***STEVE TESCH*** and ***DAVE RYLAND***, Oregon State University. Because of space limitations, only two scientists received profiles.