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Silviculture in Times of Global Changes and Uncertainty: What is on the Horizon?

BY KLAUS PUETTMANN

Future forestry operations will face a variety of developments—often summarized under the label "global change"—that provide new challenges to forest management. Most of these developments result in increased uncertainty of future environmental, biological and social conditions.

For example, projected global climate change with increased temperatures and changes in precipitation patterns will likely result in increased local climatic variation, more extreme weather events and a shift in disturbance regimes. With increased travel and trade, the likelihood of introduced insects or diseases will increase and some of these introductions may have fast and drastic impacts, like those currently observed with the emerald ash borer in the Midwest. The species composition of forest ecosystems will change as new plant species invade and existing species respond to changing environmental and competitive conditions. New marketing opportunities for wood and other forest products are continuously developing, while existing markets change rapidly in response to regional, national and global demands, and environmental and trade policies. Furthermore, opportunities for silvicultural entries are becoming more limited due to increased economical, ecological and social constraints. Together, these trends suggest that foresters will have to accept constantly changing and highly unpredictable future conditions. This begs the question whether traditional silvicultural approaches are still appropriate to manage future forests.

PHOTO COURTESY OF DAVID COATES

This interior cedar-hemlock forest type 40 miles west of Smithers, B.C. shows a transitional forest type between the more interior forests around Smithers and the wetter coastal forests of British Columbia.

Forest managers have a long history of adapting practices to accommodate new situations and conditions. In the last few decades, this often meant improving the efficiency of wood production by homogenizing species composition and growing conditions through weed and pest control, planting, thinning and other silvicultural practices. These efforts have been quite successful, but they assume that future social, economic and environmental conditions are predictable and largely constant. The pace and nature of global changes challenge these basic assumptions, suggesting that silviculture may need a new conceptual framework. But what might this be? Let me explain further.

Forestry is not the first field to face these types of challenges. The search

(CONTINUED ON PAGE 2)

Silviculture in Times of Global Change and Uncertainty

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to see how other disciplines have addressed issues of uncertainty leads to a concept known as complexity science. Complexity science is a rather new field that was originally developed by physicists. It has been used to deal with similar challenges in fields such as neurology, transportation systems and economics. Complexity science involves thinking carefully about the types of interactive processes that occur within the system and how they enable a system to resist stress or self-organize as it adapts to new conditions. Complexity science may therefore provide interesting insights into new approaches for managing forests.

Forest ecosystems are a prime example of *complex adaptive systems*. One of the key characteristics of these systems is self-organization, defined as changes in ecosystem level structures, processes and functions that are driven solely by interactions among lower-level components. See Table 1 for a more complete list of complex adaptive systems characteristics with forest ecosystem examples.

Table 1. Selected characteristics of complex adaptive systems and examples of these characteristics as found in forest ecosystems.

Characteristics of complex adaptive systems	Forest ecosystem examples
Diversity of components and processes	Multiple mechanisms to respond to fires including thick bark, sprouting ability, serotinous cones, seed banking
Hierarchical interactions	Food webs
Localized interactions	Neighborhood competition among trees or among overstory and understory vegetation
Nonlinear relationships	Threshold crown bulk densities when fires spread from crown to crown
Feedback loops	Plants provide energy to decomposers, which in turn, drive nutrient cycling, which is crucial for plant survival and growth
Emergent properties	Trees
Self-organization	Frequency and severity of small-scale fires influence the occurrence of large catastrophic fires, as evident by similar shapes of fire frequency/area curves under a wide variety of management practices and environmental conditions

How will managing forests as complex adaptive systems allow silviculturists to better deal with future changes and uncertainties? Forest ecosystems have adapted to changing conditions for millennia and much can be learned from assessing how they naturally adapted to changes.

Of specific interest for forest managers is what determines the capacity of forest ecosystems to respond to changes in the environment or disturbances with minimal negative impacts on ecosystems processes and functions, especially as they relate to the provision of desired ecosystems goods and services. One key component to change or adaptation is having options or alternatives, which is why the topic of biodiversity has received so much attention. Options and alternatives could include redundant mechanisms or species. For example, different species that provide high value timber or multiple species that can fix nitrogen. But this does not mean that any forest with higher species or structural diversity is necessarily better able to adapt to new conditions.

To judge whether the desired ecosystems goods and services can be provided while the ecosystem adapts

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to new conditions requires more information about the diversity of species, size classes or canopy layers. For example, it requires an assessment of the diversity of morphological and physiological traits that allow species to perform under a wide variety of environmental conditions. For example, mixed species forests are not necessarily more likely to achieve timber production and ecosystem goals while adapting to future conditions if all tree species are sensitive to the same environmental conditions or disturbances. Instead, managing forests as complex adaptive systems implies selections of species with different moisture and nutrient requirements or species with resistance to different disturbances. During the adaption process these stands would have a higher likelihood of containing some species that are adapted to the new environmental and ecological conditions. The subsequent shift in species makeup reflecting the change in conditions is part of the self-organization of ecosystems and an indicator of adaptability. Thus, managing forests as complex adaptive systems shifts the emphasis away from relying on silvicultural practices to deal with future challenges, such as pest control practices. Instead, the silvicultural emphasis shifts toward increasing the inherent adaptive capacity of forest ecosystems.

How does managing forests as complex adaptive systems relate to conventional forestry practices? Figure 1 puts the role of "traditional" forestry and managing forests as complex adaptive systems in the context of gradients of management intensity and expectations of future uncertainty. The lighter portions highlight areas along these gradients for which traditional forestry appears quite suitable, as evident in the success of silvicultural practices in improving production efficiency. These lighter portions are characterized by higher future predictability and/or higher ability to implement silvicultural practices.

Up to a point, forest managers can deal with increased uncertainty by intensifying silvicultural practices. For example, shorter rotations reduce expectations of future uncertainties by reducing the planning horizon. Shorter rotations also increase management flexibility due to frequent reforestation opportunities. Also, environmental changes that make a site less suitable for a species partially can be overcome by intensive planting, weed control and thinning operations. Alternatively, artificial regeneration allows selection of genetic material that is better adapted to future climate conditions than the currently present vegetation. Other examples include successful fire prevention and suppression that can eliminate the need to consider ecosystem adaptations to fires.

However, such intensive management practices sooner or later reach their limits. For example, by now it is generally accepted that even with more resources, fuel treatments and fire suppression won't solve the fire concerns in the western United States. Alternatively, while small-scale insect outbreaks can be fought with sanitation cuts and pheromone and pesticide applications, we don't even attempt at this stage to fight such large-scale infestations as the mountain pine beetle outbreak in British Columbia.

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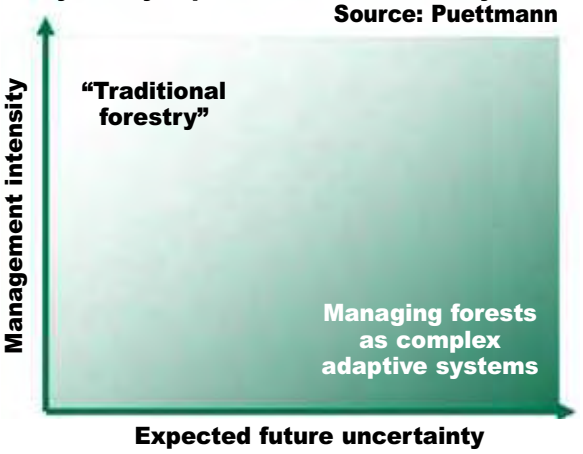
For one, as conditions keep changing, forests may eventually grow into novel conditions, i.e., into conditions for which we have no historic equivalent. In these circumstances, our ability to predict responses to silvicultural interventions will decline or be uncertain. Furthermore, intensive forest management practices come under greater scrutiny because of their costs, environmental concerns and lack of social acceptability. As intensive management practices become less effective and more difficult to justify, managing forests as complex adaptive systems will become more attractive, as highlighted by the darker portions of Figure 1.

But doesn't Figure 1 simply suggest a reduction in management intensities? Accepting an increased importance of ecosystem adaptability does not mean taking a hands-off approach. Under some circumstances, managing forests as complex adaptive systems could mean less silvicultural intensive activity, such as accepting plantations that include spots with high seedling mortality. In other cases it could mean additional management activities, such as precommercial thinning in regeneration areas to ensure a species mixture that maintains future adaptive capacity.

Rather than a shift in management intensity, the important distinction is the shift in focus of management activities from increasing production efficiency under the assumption of a constant predictable future to a focus on increasing the adaptive capacity of forests under the assumption of an unpredictable future.

Another way to look at this is to assess current silvicultural practices as to their impact on the whole adaptation process. For example, thinning prescriptions typically have the focus of providing optimal growing conditions for residual trees. Managing forests as complex adaptive systems suggests that prescriptions also consider how thinning affects the forest's ability to respond to sudden, unexpected changes. First and most obvious, thinnings impact tree vigor and resistance to insect, wind or fire disturbances. Second, thinnings likely alter understory vegetation and thus impact ecosystem functions, such as nutrient retention after larger disturbances or nitrogen fixation. Third, through improvement of tree vigor and seed production, thinning may increase the probability of natural regeneration after disturbances. Consequently, managing forests as complex adaptive systems would not necessarily imply less thinning activities, but modifying thinning prescriptions to include the whole suite of the above-mentioned aspects. Such modifications may include protecting an especially valuable understory component during the thinning operation, e.g., nitrogen-fixing plants or shrubs that provide habitat for mosses and lichens. It could also lead to more intensive thinnings that open up the canopy above these components to encourage their future vigor.

Figure 1. The suitability of conventional forestry (light areas) and managing forests as complex adaptive systems (dark areas) as it is influenced by management intensity and by expected future uncertainty.
Source: Puettmann



Obviously, managing forests as complex adaptive systems does not lend itself to generic or recipe-like prescriptions, and a lot of questions still need to be worked out to make this approach practical. The earlier examples provide a glimmer of how accepting the importance of adaptability and managing forests as complex adaptive systems would change a silviculturist's approach to management. We will never know when we have enough adaptability, but ongoing research can provide information whether silvicultural practices encourage or discourage ecosystems adaptability. This research might include developing "adaptability indices." Further challenging questions include determining how we manage different aspects of diversity and how important these aspects really are for adaptability. Our discipline has a long tradition of adapting to new conditions; we owe it to ourselves and others to seriously consider how to best address future challenges. This essay is aimed at encouraging all forestry professionals to do so with an open mind. ◆

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Additional Reading

For more detail about managing forest ecosystems as complex adaptive systems, see: Puettmann, Coates and Messier. 2009. A Critique of Silviculture: Managing for Complexity. Island Press.

For more information about complexity science, see: Norberg and Cumming. 2009. Complexity Theory for a Sustainable Future. Columbia University Press.

Silviculture—Plantation Establishment from a Private Forestland Owner's Perspective

BY DAN NEWTON

For most of my life, I have been involved with growing trees. As a kid, I was given opportunity to work with my father (Mike Newton) on his tree farms west of Corvallis, Ore. After I graduated from OSU with a degree in forestry, my wife Kathy and I purchased our own brush thickets to practice brush field reclamation on. In addition, my professional career as a forester at Lone Rock Timber and Roseburg Forest Products in southwest Oregon has evolved around a primary focus of tree growing.

Yes, I still get excited when I see plantations *leap* out of the ground, because high-leaping youngsters grow into large, healthy adults!

Almost all of my 30-plus years of experience has been with even-aged silviculture in western Oregon. I have relied on a number of valuable sources of information, including my dad, my former boss Harry Spencer, and other foresters I have worked with. A great source of information has been the Vegetation Management Cooperative at Oregon State and their research, some of which was summarized in the last issue of the *Western Forester*.

PHOTO COURTESY OF NEWTON FAMILY

Dan Newton in a 13-year-old plantation on his family's tree farm near Yoncalla, Ore.

Owning forestland is a wonderful stewardship responsibility. Land is a precious resource, and our westside forests are some of the world's most valuable forestlands. It is a privilege to have them to care for!

Before cutting existing trees or beginning the discussion about plantation establishment, perhaps a few questions are appropriate:

1. What do you want the forest to look like?
2. What species will meet your objectives?
3. Are you trying to maximize the return on investment?
4. Do you look at the dollars spent

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SAF Position Statements Discuss Silvicultural Tools

Some silvicultural tools can be controversial—clearcutting and herbicides easily come to mind. Both national SAF and many state and regional chapters have adopted position statements that can help members articulate and share their views about these tools with policy leaders and the interested public.

With forestry under increasing scrutiny, it's important to emphasize that the profession draws from a strong foundation of experience and scientific expertise, and that society's needs and objectives are best achieved when a broad array of silvicultural options remain available.

Oregon and Washington SAF position statements can be found at www.forestry.org/position.php; other state and regional statements at www.eforester.org/fp/ssstatements.cfm; and national SAF positions at www.eforester.org/fp/positionstatements.cfm.

in reforestation as a cost or an investment? This may influence how willing you are to spend money on intensive forestry.

A front-loaded approach may improve performance without much increase in establishment costs

1. Intensive management during the first few years (a front-loaded approach) can yield significant increases in tree survival and growth. I am talking about providing a nearly weed-free environment for a few years, using well-planted, high-quality planting stock, and prevention of unacceptable animal damage. While upfront investment costs may be higher initially, there may be offsets (lowering) of some subsequent stand management expenses. I like to think of plantation establishment as a chain with a number of critical links. The strength of the chain (plantation performance) depends on the strength of the weakest link. For example, you can do a terrific job of planting, but if there is heavy grass left untreated on a south aspect, survival and growth may suffer.

2. I have always viewed dollars spent to enhance growth as an investment, rather than a cost. The critical question is whether the returns are acceptable, not whether the costs are too high. With this in mind, it is quite possible to spend too little or too much. Investing in activities that can demonstrably increase the return on investment has always made sense to me, and reforestation investments are no exception. When you are building the chain to success, each critical link has an influence on the total investment returns. Look for the weakest link.

Whether you are establishing trees for profit, wildlife habitat, fish habitat or all of the above, getting the seedlings off to a good start is a good idea

Ingredients for successful plantation establishment and increased growth:

1. In my experience, the most effective and economical approach to improve plantation performance on most sites is to emphasize weed control in the first two to three years and to carefully plant large, healthy and genetically well-adapted seedlings. In many cases, this will be facilitated by site preparation prior to planting, followed by two to three years of grass and herbaceous treatment after planting. Remember, competition can come from hardwoods and shrubs as well as grass and herbs.

2. How to economize? Before you decide to reduce upfront costs, consider all of your costs through until the end of your rotation. If you defer treatment of shrubs and grass, will you have to plant additional seedlings in order to achieve the target number of trees per acre? Will you have additional areas to interplant if you cut back on your initial effort? How many years will it add to your rotation age? The last places I would cut costs would be weed control, planting stock quality and supervision of reforestation activities. These things matter.

The bottom line is that I believe there is a premium for doing it right the first time and that good upfront reforestation practices can lead to offsetting savings later in the life of the plantation. These reductions in costs can include less interplanting (or ini-

tial planting density) and fewer release treatments. If good practices lead to higher survival, then savings can come from reductions in the trees per acre planted needed to achieve the target density of established seedlings. If higher survival can lead to lower planting density, then this can lead to fewer acres that will need precommercial thinning.

Does all this intensive management really lead to increased tree growth?

Yes. I have seen systematic increases in growth resulting from an integrated program of good site preparation and careful planting of large and healthy planting stock, followed up with herbicides to control weeds. I have seen increases in the average size (cubic volume) of two-year-old plantations by more than 300 percent as compared with plantations established using less intensive reforestation practices. All of this requires careful execution by foresters, with attention to detail, and careful supervision of contractors.

Other benefits of intensive reforestation:

1. Quicker green up and visibility of the planted seedlings.

2. Less time will be needed to achieve a tree size and volume per acre desirable for final harvest, leading to the option of shorter rotations, or to greater volume per acre at final harvest or both. In addition to fast growth of the planted trees, there may be greater uniformity.

Is it possible to reduce costs?

With all the above caveats, it seems reasonable to reduce costs if it can be done without sacrificing long-term benefits, whatever the plan calls for. This leads to a few questions:

1. If you are consistently getting more than 350 surviving, well-distributed trees per acre, is there an opportunity to reduce planting density, especially in areas where a commercial thin may not be feasible (e.g. steep ground)? Put another way, are you planting excess trees that will have to be precommercially (PCT) thinned out?

2. How much is being spent on slash disposal per acre? Yes, I believe in cleaning up slash only well enough to get a good distribution of well-planted seedlings, as well as to reduce fire hazard. The removal of slash beyond a certain point may have a lower benefit/cost. Assuming that competing vegetation has been effectively treated, light and even moderate levels of slash may be compatible with excellent growth and may not be the weakest link in the chain; slash can sometimes even be an obstacle to browsers.

As a forester who has practiced silviculture in western Oregon for more than three decades, I have had the pleasure of watching plantations grow into impressive timber stands that I helped to reforest. These forests are very productive and beautiful. Today, we have the knowledge and the tools to grow trees even better and I look forward to seeing further refinements in our future tree growing. ◆

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Silviculture on the Willamette National Forest

BY NORM MICHAELS

I first came to the Willamette National Forest in Eugene, Ore., in 1980 and have spent almost one third of my career there in three different silviculture positions; I am currently the forest silviculturist. During this time I have seen major changes in management of our national forests from intensive management focused on wood production to extensive management focused on the management of habitats and species. This article will discuss the Willamette's current silvicultural practices and the reasons for them.

The differing values of the public for the management of our national forests have led to conflicting desires. There is a continuum of values from the want for pristine forest that has no impact from humans to a desire for utilizing the forest for strictly economic uses. Within these values, national forests must develop objectives for management that address the needs of the entire public.

Commercial thinning is the dominant harvest activity on the Willamette National Forest (WNF) today, with a target to sell about 70 MMBF annually. Most of this occurs in stands that were clearcut and planted in the 1960s and earlier, as these stands are ready for stocking control and have merchantable products. There is little or no regeneration harvest occurring on the forest. We are planning to thin the same stands in the future as they approach densities at which they will experience competition mortality. We anticipate the need to institute some level of regeneration harvest to provide early seral habitat for species such as birds that nest and forage in young plantations and ungulates that need browse.

PHOTO COURTESY OF ERIC ORNSBERG

Heavy thinning on a Young Stand Thinning and Diversity Study plot.

One of the objectives of the WNF is to provide for a diversity of habitats and stand structures. One way we increase diversity is to create gaps of one-quarter to one acre in the stands that we thin. This provides for some early seral habitat, along with increased resource availability for the trees on the edge. In many cases, these gaps are located in root rot pockets, and followed by planting of species that are more resistant to root rot such as western redcedar and western white pine. These two species, along with others, are often missing from planted stands, which historically contained those species. Western redcedar requires protection from ungulate browsing, usually in the form of flexible netting or rigid tubes.

Another way we add diversity is by varying the density in our thinning. The goal is to have some trees that have more space to grow, and some trees that have less space. This leads to some differentiation in stand structure and provides for a wider variety of habitats.

Most of the silviculturists on the forest use Rieneke's stand density index (SDI) as a measure of stocking density when writing their prescriptions. Most prescriptions reduce den-

sity to the range of 30-40 percent of maximum SDI, while there are some prescriptions that are either higher or lower to meet a variety of stand objectives. The objectives for our stands can be as diverse as growing individual trees faster to develop large trees for wildlife habitat, or growing trees for higher stand volume to supply products in the future.

Most of our commercial thinning uses Designation by Description (DXD) to designate the trees to be cut. With this technique, the desired stocking is determined, and then spacing is determined to meet the stocking density. The DXD prescription requires that the largest tree within the designated distance be left, and all other trees are harvested. Since determination of DBH is somewhat difficult after a tree is felled, the stump diameter is used to determine the largest tree. In most cases, the desired distance between trees to obtain the stocking density is 1.5 times the designated distance. To illustrate, if the desired spacing is 16.5 feet, the designated distance for a DXD prescription would be about 11 feet.

Most of our sales are scaled, predominately weight scale since most sales are uniform Douglas-fir. If there is a diversity of species or sizes, we use a roll-out scale. The Willamette sells all sales standing volume; the forest does not hire a logger to harvest and then sell the resulting logs.

With little regeneration harvest, our planting program is driven by the need to reforest after fires and the need to re-establish species that are not represented at historical levels. Our planting program averages about 500 acres a year. After a fire, we regenerate with the dominate trees in the area, usually by planting. When in an area that we expect abundant natural regeneration, we rely on seed fall rather than planting for reforestation efforts. Lodgepole pine is an example of one of the species that we can reliably expect natural regeneration.

Since there is very little regeneration harvest, and since most of our sites do not develop shrub competition that would result in tree mortality, the Willamette has very few conifer release projects. Our current objectives do not emphasize early rapid tree growth, and we desire a high diversity of species in our forest, so we accept some loss of growth to obtain a variety of other objectives.

The Willamette continues to have a precommercial thinning program, treating 7,000 acres a year for the last several years. Funding for this program comes from a variety of sources, including appropriated funds, KV funds, and funds from the Secure Rural Schools Act. As with our commercial thinning, precommercial thinning projects have a diversity objective. This leads to the creation of gaps in a stand and leaving some trees of minor species even if they are not the most dominant tree. At this stage in the life of a plantation, hardwoods usually are subordinate to the conifers; consequently, they are usually ignored in spacing requirements, leaving those species for habitat diversity.

The Willamette has a unique relationship with the research community, centered on the H. J. Andrews Experimental Forest. This experimental forest is located on National Forest land in the Blue River area, and is managed jointly by the Pacific Northwest Research Station, College of Forestry at Oregon State University, and WNF. Three long-term studies should be of interest to silviculturists: Long Term Ecosystem Productivity (LTEP), Young Stand Thinning and Diversity Study (YSTDS) and Uneven Aged Management Study (UAMP).

The LTEP study is looking at long-term productivity, including the effects of different levels of down wood and different tree species composition. YSTDS is exploring the effects of differing thinning densities and small openings on the development of diverse structures that are found in unmanaged older forests. UAMP is studying the economic and ecological tradeoffs in converting young forests into mixed species and unevenaged stands.

The Willamette continues to strive to provide the products and values that the public desires. This is a challenging place to work and provides for an interesting place to practice silviculture. ◆

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Uneven-aged Management in a Mixed-conifer Forest in Northeast Oregon: A Case Study

BY STEPHEN A. FITZGERALD AND PAUL T. OESTER

Stephen A. Fitzgerald

Paul T. Oester

Little is known about the application of uneven-aged management methods, like Individual Tree Selection (ITS), for managing mixed-conifer forests in the Northwest. Many family forest landowners and state and federal managers are interested in ITS because it provides a continuous forest canopy, reduces reforestation costs, is aesthetically pleasing and avoids clearcutting. However, how do you go about implementing ITS and how does the stand, including the regeneration, respond to periodic harvest entries? Does ITS promote a shift in species composition to shade-tolerant species? What kind of board foot production is possible with ITS on mixed conifer sites?

For those of you who may be little rusty on uneven-aged management methods, here is a refresher: Uneven-aged management, using ITS, creates a stand with three or more age classes resulting in a "reverse J-shaped" curve (of trees per acre by diameter class), with progressively fewer larger trees up to some maximum diameter. Harvest entries are frequent and designed to thin both commercial- and precommercial-sized trees to maintain the J-shaped stand condition. Timing of frequent harvests (every 5-20 years) are intended to maintain good tree growth so that small trees eventually replace the larger, harvested trees. Each harvest entry is designed to maintain enough open growing spacing that regeneration continually establishes and has space to grow, thus uneven-aged stands are managed at levels below full stocking.

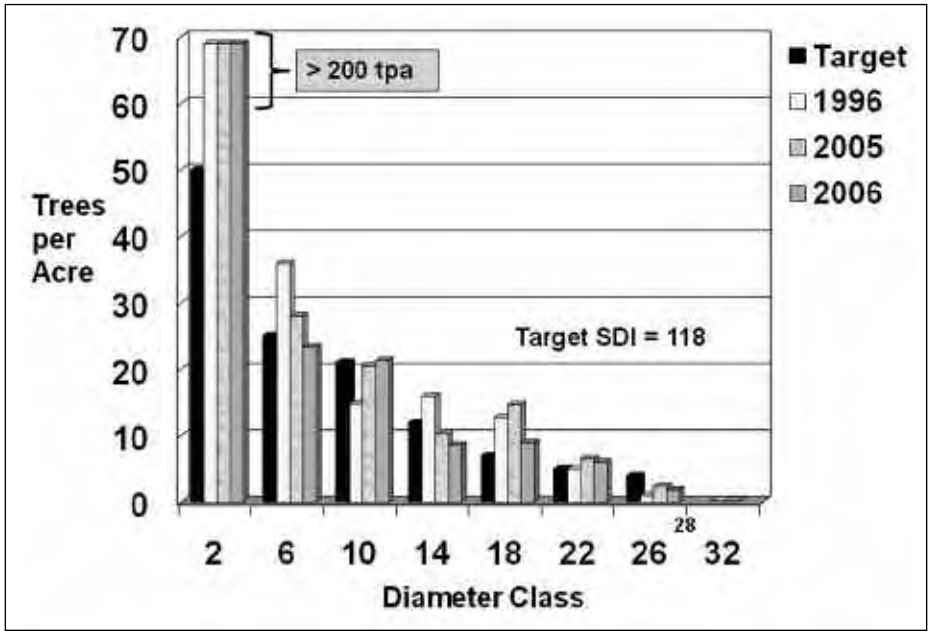
In 2005 we implemented an ITS case study in a 50-acre dry mixed-conifer forest on the Oberteuffer Research and Education Forest near Elgin, Ore., which is a satellite research forest of Oregon State University College of Forestry. Bill and Margaret Oberteuffer, who owned the land for 20 years and were proponents of "all-age, all-species management," donated this 113-acre parcel to OSU in 1994. A series of permanent plots were established across the entire property in 1996. Twenty permanent plots are within the 50-acre ITS study, which serve as a basis for measuring growth and development and assessing ITS treatment effects on regeneration and overstory trees. We estimate that growth across the entire property is approximately 400 board feet per acre per year.

The 50-acre stand contains primarily ponderosa pine (59 percent) and Douglas-fir (33 percent), with small amounts of grand fir (4 percent) and western larch (4 percent). Some light thinning had been done by the Oberteuffers previously, and a small salvage harvest of blow-down timber occurred in 1995.

In 2005 the stand was marked for a harvest based on maintaining a Stand Density Index target of 118 allocated across seven, four-inch diameter classes resulting in a "reverse J-shaped" curve (see black bars in Figure 1). We specified a maximum tree diameter of 28 inches. This maximum diameter was chosen based on site productivity, species, aesthetics and economics. For example, ponderosa pine is one of the primary marketable species on the site and it really doesn't pay to grow and sell small trees, so we wanted to grow higher premium, large logs (although the value difference could change in the future).

Figure 1 shows diameter distributions in 1996, 2005 after nine years of growth, and 2006 after the harvest. Approximately 161,220 board feet (80 percent ponderosa pine, 19 percent Douglas-fir, and 1 percent grand fir and western larch) was harvested across the 50-acre stand, or about 3,200 board feet per acre. The average delivered log price was $447/MBF. The operator was restricted to designated skid trails and there was very little damage to trees

Figure 1. Diameter distribution in 1996, 2005 (before harvest), and 2006 (after harvest) compared to the target or desired stand distribution. There are greater than 200 trees per acre in the two-inch diameter class.
Source: Fitzgerald and Oester



from the logging operation. Logging costs ran $227/MBF, which included felling, skidding, hauling, slash cleanup and grass seeding of skidtrails. Immediately after the harvest, saplings were precommercially thinned. See photos that show the stand before and after harvesting.

From the graph in Figure 1, you can see that the 2006 harvest came very close to our target stand structure, except in the regeneration size class where we have a large excess of seedlings and sapling. We also have a deficit in the 26-inch class, but that will correct itself over time as excess trees in the 22-inch class grow and move up into the larger diameter class. Although spot precommercial thinning was conducted after the 2006 harvest to reduce the number of seedlings and saplings, they are still far above the target and many of these are small Douglas-fir seedlings. To prevent a species shift to Douglas-fir, future precommercial thinning will require cutting them out to favor ponderosa pine.

What's next? In the fall of 2011 we will conduct the five-year post-harvest measurements. Based on those measurements and an analysis of diameter growth in the larger trees and height growth in the regeneration, we may initiate another light commercial thinning to further reduce overstory competition. In addition, precommercial thinning will be needed to reduce the overabundant regeneration.

Although this study is not replicated, it will provide a good case study on how a typical northeast Oregon mixed-conifer stand responds to long-term management using ITS. Its value as a case study will increase as the stand matures and additional harvests and measurements are conducted. Tours and educational materials are planned outputs in the future. ◆

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PHOTOS COURTESY OF STEPHEN A. FITZGERALD

The photo on the left shows the Oberteuffer uneven-aged stand before harvest in 2005; photo on the right is the stand after harvest in 2006.

Best Management Practices to Reduce the Effects of Forest Fragmentation

BY PAUL D. RIES, STEPHEN A. FITZGERALD AND SARAH FOSTER

Foresters working in the Pacific Northwest's urban-rural interface are focusing attention on the issue of forest fragmentation. Recent USDA Forest Service publications such as *Forests on the Edge* have explored the issue of forests being converted to development. With the number of forest owners increasing by as much as 150,000 per year nationally as forested parcels are subdivided and sold, management challenges presented by this trend can be expected to increase.

Research conducted by the Forest Service has identified several implications for forest fragmentation, including loss of wildlife habitat, decline in timber production, increased firefighting costs, impacts to watersheds and loss of carbon sequestration. Quantifying the effects of this fragmentation will take additional research. A key relationship in this effort is understanding the pressures on watersheds and dealing with the multi-jurisdictional issues found in fragmented forests.

Using a grant from the Forest Service's Western Competitive Grant process, the Oregon Department of Forestry and Washington State Department of Natural Resources have initiated a project to explore best management practices (BMPs) for dealing with the effects of forest fragmentation in the Portland and Seattle metro areas and surrounding urban-rural interfaces. While the promotion and use of BMPs is a common approach for dealing with natural resource management issues, this concept hasn't been widely applied to the forest fragmentation situation in the Northwest or elsewhere.

BMPs—Policy and Planning Approaches

In many forested parts of urbanizing America, land values exceed timber value. This creates an interesting dilemma for landowners—development is more profitable than forest management from a monetary standpoint, though not necessarily from an ecological one. Income from development is more immediate than income derived from long-term forest management, which may be appealing to forest owners who are of retirement age or don't have heirs to continue management of the parcel.

Promoting BMPs at the planning and policy levels involves educating elected and appointed officials that influence the land use planning process and can encourage the retention of intact forests. In Wilsonville, Ore., for example, a creative city development policy encourages landowners to leave forests intact prior to submitting annexation proposals. The policy states that annexation decisions will consider the manner in which the natural resources on a property have been maintained. If they have been preserved or restored consistent with the

We Remember

Henry (Hank) Kipp
1930-2009

Hank Kipp was born December 14, 1930, in Pittsburgh, Penn. He passed away unexpectedly June 29 of a heart attack while pruning a tree in his backyard in Olympia, Wash.

He was educated at Shady Side Academy in Pittsburgh; Trinity College in Hartford, CT (B.A. in History, 1954); the University of Idaho in Moscow (B.S. in Forestry); and the University of Montana (M.A. in Natural Resources Management, 1972).

Working on summer trail crews in Glacier National Park (1950-51) sparked a passionate interest in pursuing forestry as his profession. Hank began formal study at Duke University in Durham, North Carolina (1956-58) and received his degree from Idaho in 1960. He completed additional studies in range management there during 1961-62, at which time he met Elaine, then working as a librarian at the University of Idaho.

Following a honeymoon trip to Banff, Alberta, he began a 32-year professional forestry career with the Bureau of Indian Affairs on the Blackfeet Indian Reservation in Montana. Further assignments took them to the Flathead Reservation and Rocky Boy's Reservation.

Following a year in Missoula, Hank returned to Rocky Boy's as the tribe's natural resources specialist.

In May 1983 Hank was transferred to the Jicarilla Apache Reservation in Dulce, New Mexico, and in November 1985 he was promoted to his final assignment at the U.S. Department of the Interior in Washington, D.C.

Between 1985 and April 1994 he researched and published *Indians in Agriculture: An Historical Sketch (1583-1987)* and *A Short History of Irrigation on Indian Agricultural Lands of the United States* (1988), and also served as BIA's sole representative on an early government task force studying global climate change.

Hank and Elaine retired to Olympia in October 1994, where Hank took immense pleasure in developing a full-fledged "arboretum" on their half-acre property, while also serving as secretary for the local chapter of the Society of American Foresters, an organization to which he belonged for 49 years, joining as an undergraduate in 1960. He was proud to be a Certified Forester. He was also an accomplished artist, particularly with pen and ink and oil paints, and an avid musician who played both acoustic guitar and boogie woogie piano.

The family suggests donations in memory of Hank Kipp be made to the Southwest Washington Chapter of the SAF, c/o Adrian Miller, 724 Columbia St. NW, Olympia, WA 98501. ◆

PHOTO COURTESY OF PAUL RIES

As cities expand, maintaining green infrastructure is one way to help reduce forest fragmentation.

policy, it will help the proposal; if all the trees have been removed and grades changed, that could contribute to its rejection. The result is an incentive for landowners to leave the green infrastructure of their parcels intact, which results in more canopy cover retained.

Other approaches to encourage working forests in interface landscapes include conservation agreements and easements whereby landowners give up development rights in exchange for tax benefits, and utilizing state and county land use planning laws and special legislation. For example, a study showed that in Oregon, land-use planning that concentrates and allows for more orderly development has protected some 1.2 million acres of forest and agricultural land. An example of special legislation to preserve working forests involves a large chunk of forestland just west of Bend, Ore., called Skyline Forest. Legislation is fostering a partnership between the corporate owners of this 33,000-acre former industrial tree farm and a local land trust that would allow for limited development rights on 3,000 acres and permit the sale of the remaining 28,000 acres to the land trust. This deal is still in process, but it should be noted that it took an act of legislation to get it this far—illustrating the high profile these projects can take.

BMPs—On-the-Ground Management Practices

On-the-ground BMPs involve retaining native forest remnants or groves through fencing and minimizing changes to waterflow and understory vegetation. Most successful tree retention or protection strategies start out in the site planning stage. Often, maintaining green infrastructure is easier and more effective if done by clustering development or clustering leave trees. However, these strategies can fail if all parties on the construction site aren't in sync with the tree retention plans. While BMPs for tree retention on construction sites are available, they aren't widely promoted. By the end of 2009, the state forestry agencies and extension services in Oregon and Washington will produce a new pocket guide illustrating BMPs for retaining trees on construction sites. This publication will be made available for builders, developers, planners and others working in interface landscapes (to request a copy, email dpeden@odf.state.or.us).

Conclusion

Maintaining or preventing fragmentation of forests is important to us all. BMPs that help preserve forest and agricultural lands maintain the values that we all want from our forests and agricultural lands. There is no one solution to reduce fragmentation. Preventing further fragmentation of forests will require a mixture of on-the-ground tree preservation BMPs, easements, municipal ordinances for forestland within their boundaries, county land use planning, and, at times, special legislation. ◆

Paul D. Ries is Urban and Community Forestry Program manager, Oregon Department of Forestry, Salem. He can be reached at 503-945-7391 or pries@odf.state.or.us. Stephen A. Fitzgerald is the eastern Oregon silviculture and wildland fire education specialist for the Oregon State University Extension Service. He can be reached at 541-548-6088 or stephen.fitzgerald@oregonstate.edu. Sarah Foster is Urban and Community Forestry Program manager, Washington State Department of Natural Resources, Olympia. She can be reached at 360-902-1704 or sarah.foster@dnr.wa.gov.

Calendar of Events

Learn ArcPad in One Day, Oct. 8, Tigard, OR. Contact: Resource Supply, LLC, 503-707-6236, jon@resourcesupplyllc.com.

OFIC Annual Meeting, Oct. 11-13, Sunriver, OR. Contact: OFIC, 503-371-2942, ofic@ofic.com.

Management Planning for NRCS Technical Service Providers, Oct. 14, Corvallis, OR. Contact: Amy Grotta, amy.grotta@oregonstate.edu, 503-397-3462

Professional Timber Cruising Seminar, Oct. 21-22, Beaverton, OR. Contact: Atterbury Consultants, 503-646-5393, pwroe@atterbury.com, www.atterbury.com.

Understanding and Managing Tree Growth, Oct. 31, Veterans Memorial Museum, Chehalis, WA. Contact: Donna Loucks, www.watreefarm.org, loucksd@localaccess.com, 360-736-2147.

Planning Workshop, Nov. 4-6, Corvallis, OR. Contact: Forest Biometrics Research Institute, 541-754-1200, www.forestbiometrics.com.

Partners in Community Forestry National Conference, Nov. 9-11, Portland, OR. Contact: Arbor Day Foundation, 888-448-7337, conferences@arborday.org.

Practical Applications of Wildlife Management on Working Forests, Dec. 2, Eugene, OR. Contact: Fran Cafferata Coe, 503-224-3445, fcoe@masonbruce.com.

WSSAF Legislative Breakfast, Jan. 12, 2010, Olympia, WA. Contact: John Walkowiak, 360-567-3206, johnwa@dor.wa.gov.

PNW SAF Forestry Leadership Conference, Jan. 28-30, 2010, Pack Forest, Eatonville, WA. Contact: John Walkowiak, 360-567-3206, johnwa@dor.wa.gov.

Send calendar items to the editor, *Western Forester*, 4033 SW Canyon Rd., Portland, OR 97221; fax 503-226-2515; rasor@safnwo.org.

Policy Scoreboard

Editor's Note: To keep SAF members informed of state society policy activities, Policy Scoreboard is a regular feature in the Western Forester. *The intent is to provide a brief explanation of the policy activity—you are encouraged to follow up with the listed contact person for detailed information.*

Thinning Position Adopted; Public Leaders Tour Held. In August, the OSAF Executive Committee voted to adopt a position statement titled "Thinning on Public Lands in Oregon." The statement was prompted in part by recent policy proposals that would limit timber harvesting on public lands solely to thinning. Strict age- or diameter-based harvest restrictions also have been a key feature of some current or proposed policies, and raise concerns that silvicultural prescriptions under such restrictions may not achieve desired management objectives. The position highlights the many benefits of thinning as well as the fact that professionals must closely monitor forest conditions and vary prescriptions over time and specific locations to best achieve long-term objectives.

Also in August and related to the thinning issue, OSAF members led a field tour targeted toward Oregon's Congressional delegation and other public leaders on "Forestry on Public Lands in Oregon." The tour was held at OSU's McDonald Forest and featured speakers and research studies that highlighted how various silvicultural strategies can be more or less effective in achieving diverse management objectives. The new position on thinning, as well as a PDF of the Forestry Issues booklet with all of the other OSAF position statements, can be found at www.forestry.org. Contact: Paul Adams, OSAF Policy chair, 541-737-2946; paul.adams@oregonstate.edu.

WSSAF Approves Position Statements. On July 23, the WSSAF Executive Committee reviewed and approved five position statements. These position statements will also appear on the fall election ballot. The five are: Sustainable forest management can achieve and maintain healthy and productive forests in the state of Washington; Addressing the threat of wildfire in the wildland-urban interface (WUI); Management of federal lands in the state of Washington; Revision of the Olympic National Forest Plan; and Considering the contributions of Washington's forests involving carbon sequestration.

Decision makers at the federal, state and local levels need concise and up-to-date information and recommendations from experts to know what policy options will achieve their desired goals. WSSAF position statements serve the following functions: (A) Identify issues of importance to WSSAF members; and (B) Provide WSSAF feedback and recommendations to decision makers on these issues. With WSSAF membership support this fall, the WSSAF Policy Committee plans to present these position statements in poster format at the January 12, 2010, Legislative Breakfast and to other decision makers as opportunities arise.

The WSSAF Executive Committee is also reviewing the recently completed UW report to the Washington State Legislature entitled: *Wood to Energy in Washington: Imperatives, Opportunities, and Obstacles to Progress* by C. Larry Mason, Richard Gustafson, John Calhoun, Bruce R. Lippke, and Natalia Raffaeli, available at www.ruraltech.org/pubs/reports/2009/wood_to_energy/index.asp. This comprehensive study gives a thorough review of the opportunities and obstacles to increasing wood use for energy in Washington.

Other Washington Policy News. The Washington State Forest Practices Board is reviewing an option to add a fixed-width riparian buffer option for forested riparian areas adjacent to Type S and F waters. A fixed-width riparian buffer option could eliminate the requirement to conduct extensive tree counting and use of a growth model.

On Sept. 1-2, Governor Christine Gregoire, Brian Cladoosbsy, President of the Association of Washington Tribes, and Commissioner of Public Lands Peter Goldmark convened a group of representative leaders from tribes, industrial and family forest landowners, environmental advocates, land trusts, state and federal agencies and local governments to kick-off a Forest Ecosystem Collaborative at Lake Quinault Lodge.

Inland Empire SAF partners with Montana SAF and the Intermountain SAF. Featuring the related topics of wood bioenergy and climate change, and designed to attract an audience from outside the forestry community, a workshop was held in Missoula, Montana, on September 22-24 in conjunction with the Plum Creek Lecture Series. Featured speakers included Dr. Elaine Oneil, University of Washington, and Dr. Dan Richter, Duke University. A second, follow-up workshop is being planned for Boise, Idaho, in January 2010. Contact: Jay O'Laughlin, IESAF Policy chair, 208-885-5776, jayo@uidaho.edu. ◆

OSAF Supports High School Forestry Programs

The Oregon Society of American Foresters has distributed grants to two Oregon high schools to support the advancement of their forestry programs. Recipients are Knappa High School and Santiam Christian School.

These funds support Oregon public and private high schools that commit to providing educational opportunities in the field of forestry, integrating wood products, silviculture, fisheries, wildlife, water, soils, recreation, and the management of other forest-related natural resources of Oregon. These programs have committed to promote post-secondary education opportunities in forest-based natural resource programs.

The SAF sub-fund is housed within the Oregon Natural Resource Education Fund Association (ONREFA, www.onref.org) framework, an "umbrella" fund administered by the Oregon Community Foundation (www.oregoncf.org). Two SAF member representatives serve as additional advisors to the sub-fund. Foxie Proctor and Eric Kranzush make distribution recommendations along with the ONREFA advisors to OCF based on grant applications.

Following are details of this year's distribution:

• Santiam Christian School (Corvallis, OR): $330 will be used for establishment of a forestry unit and forestry classes including curriculum and equipment support.

• Knappa High School (Knappa, OR): $220 will support a comprehensive beginning and advanced forestry program. These funds will be used to acquire resources for construction of a community forestry interpretative trail (with classroom integration).

The fund's distributions are based on asset balance. If you are interested in making a tax-deductible contribution to grow this fund, please send a check made payable to: ONREFA OSAF Sub-fund of OCF, c/o The Oregon Community Foundation, 440 East Broadway, Suite 160, Eugene, OR 97401. ◆

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