WHITE PAPER

USDA Forest Service Pacific Northwest Region Umatilla National Forest

WHITE PAPER F14-SO-WP-SILV-33

Silviculture Facts[1]

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Initial Version: **MAY 2001**
Most Recent Revision: **FEBRUARY 2017**

[1] White papers are internal reports receiving only limited review. Viewpoints expressed in this paper are those of the author – they may not represent positions of USDA Forest Service.

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INTRODUCTION

Originating, growing, and tending stands of trees is called silviculture. Silvicultural activities are used to meet diverse objectives and values of society. On the Umatilla National Forest (NF), silviculture helps sustain health and productivity of forest ecosystems administered on behalf of American people.

During a pioneer era of Euro-American settlement in the Pacific Northwest, harvesting timber contributed to economic development. Our forests were considered limitless, and there was little consideration or knowledge about forest values other than timber production.

Over time, societal expectations for our forests have evolved. Non-timber ecosystem services, such as fish and wildlife habitat, water quality, recreational settings, and visual aesthetics, are now appreciated and demanded by society (Fedkiw 1998). At the same time, foresters are learning more about the complexities and interconnectedness of forest ecosystems (Botkin 1992).

The USDA Forest Service no longer manages national forests to emphasize timber production. Our current mission is to sustain health, diversity, and productivity of our Nation's national forests and grasslands to meet needs of present and future generations.

In response to changing values and expectations, timber harvest levels have varied substantially. Figure 1 shows that timber harvest began increasing after World War II to address post-war housing demand, although the highest harvest levels occurred in mid-1970s and late-1980s. It is also obvious from fig. 1 that low harvest levels were associated with a custodial era occurring before World War II, and in response to a recent emphasis on wildlife protections and other non-harvest values (from mid-1990s to present).

SURVEYS

Before silvicultural activities are used, a planning process occurs first. A first step in project planning is to assess existing conditions by completing surveys. Plantation and thinning surveys, and stand examinations, are examples of silvicultural surveys.

About 10,000 acres of the Umatilla NF receive a silvicultural survey each year. Survey information is entered into database systems to make it available for project planning and monitoring purposes.

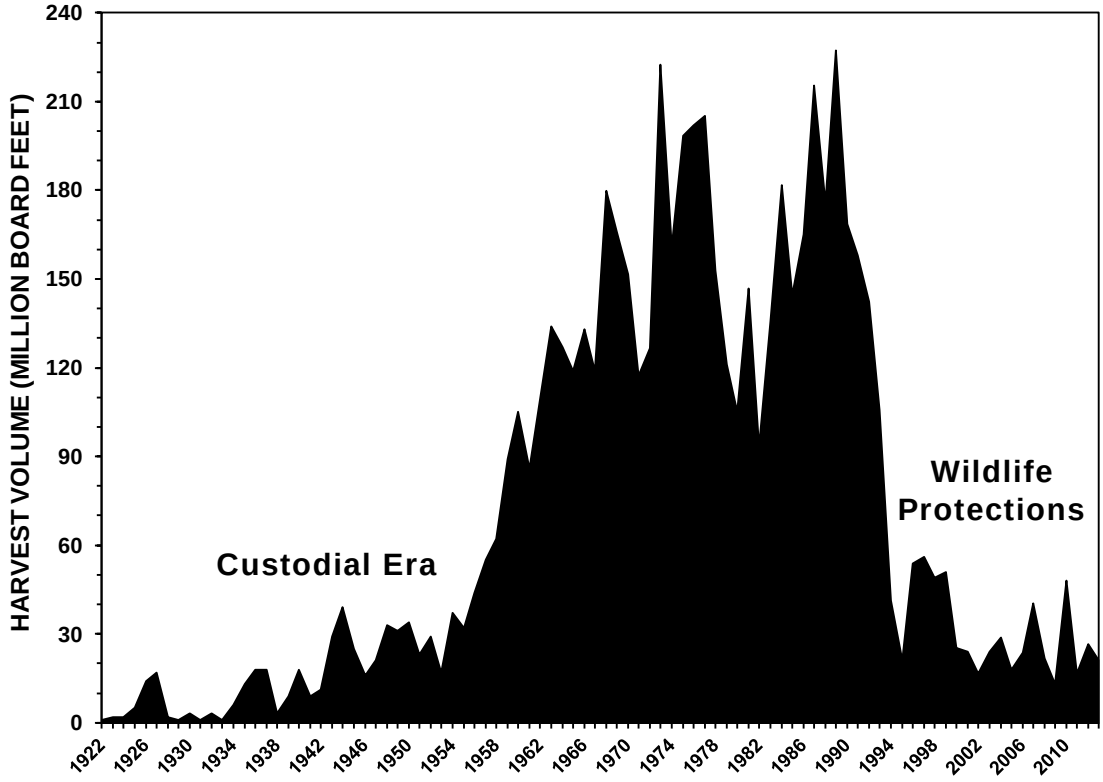
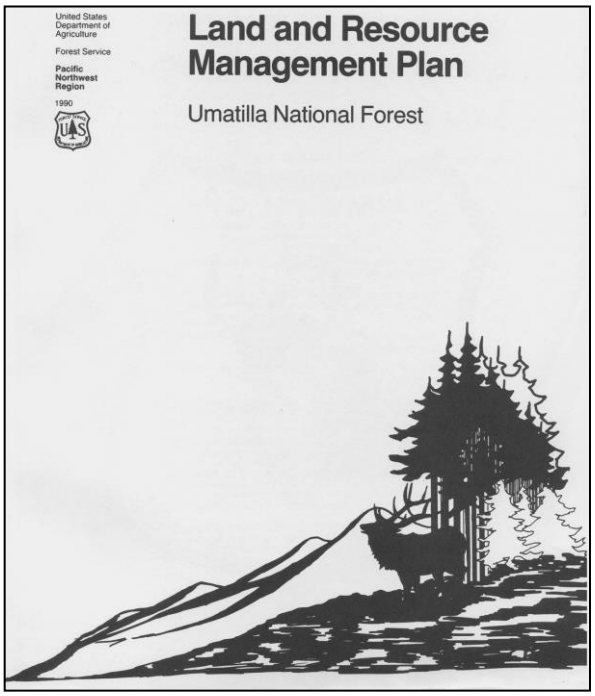


Figure 1 – Timber harvest trend (cut volume, not sold) from 1922 to 2013.

DIAGNOSIS

Once goals and objectives have been identified (referred to as desired future conditions in the Forest Plan), a second step in silvicultural planning can occur – diagnosis of treatment needs and opportunities. A diagnosis identifies options for achieving desired future conditions of an area.

Each year, about 30,000 acres of the Umatilla NF receive a silvicultural diagnosis to evaluate treatment options for meeting desired future conditions.



PRESCRIPTIONS

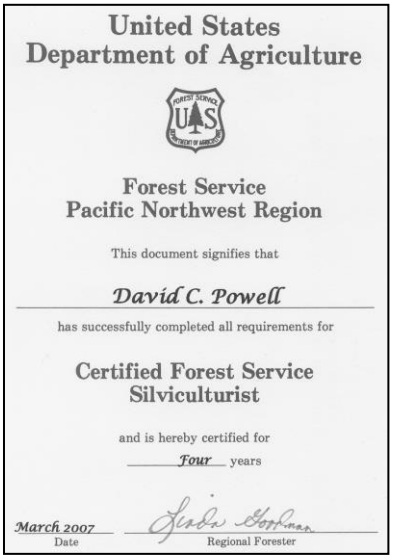
When a planning process is finished, resulting in an approved environmental document, a decision has then been made about which silvicultural activities will be used in a planning area. Specifications and operational considerations for how an activity will occur are contained in a silvicultural prescription.

About 10,000 acres of Umatilla NF are included in a silvicultural prescription each year.

No management activities designed to modify forest vegetation, including fuel treatments affecting live trees, can occur without an approved silvicultural prescription. Prescriptions became mandatory in 1974 in response to public concerns about Forest Service timber management practices on the Monongahela (West Virginia) and Bitterroot (Montana) national forests.

SILVICULTURIST CERTIFICATION

Silvicultural prescriptions are prepared by certified (licensed) silviculturists. Prior to certification, silviculturists complete an intensive program of graduate-level training consisting of 12 weeks of instruction, including 9 weeks in a national program involving 4 universities, and followed by 3 weeks of local (regional) training.


United States
Department of Agriculture

Forest Service
Pacific Northwest Region

This document signifies that

David C. Powell

has successfully completed all requirements for

Certified Forest Service
Silviculturist

and is hereby certified for

Four years

March 2007
Date

Regional Forester

Initial certification is for 4 years. To maintain certification for subsequent 4-year periods, a silviculturist must complete at least 120 hours of continuing education during each 4-year certification period. This coursework is distributed among four subject categories.

As of 2015, Umatilla NF had 4 certified silviculturists. Historically, many more certified silviculturists were needed than now (at least 10 were always employed in the 1990s). Less active management (timber/silviculture) requires fewer silviculturists.

ECOLOGICAL BASIS OF SILVICULTURE[2]

Broadly speaking, nature provides two patterns for silviculturists to follow. The first is called succession – normal growth and development of an existing forest. The second is known as disturbance – partial or complete destruction of an existing forest through natural events. Ecologically, succession and disturbance determine development of a forest stand.

On almost any land, whether tree-covered or not, nature will practice her own silviculture. Managers often become impatient with nature's way, and then silviculture is practiced. Silviculture, however, does not precisely mimic nature because nature's ways are far more random, and sometimes more disruptive, than society finds acceptable.

Succession and disturbance are opposing yet complementary forces. When undergoing succession, a community progresses from rapid early changes to later stages featuring slow, almost imperceptible, change (figure 2). During disturbance, some or all of the vegetation is killed, setting succession back to an earlier stage.

[2] Concepts in this section were adapted from chapter 1 in Baker et al. 1996, by James M. Guldin.

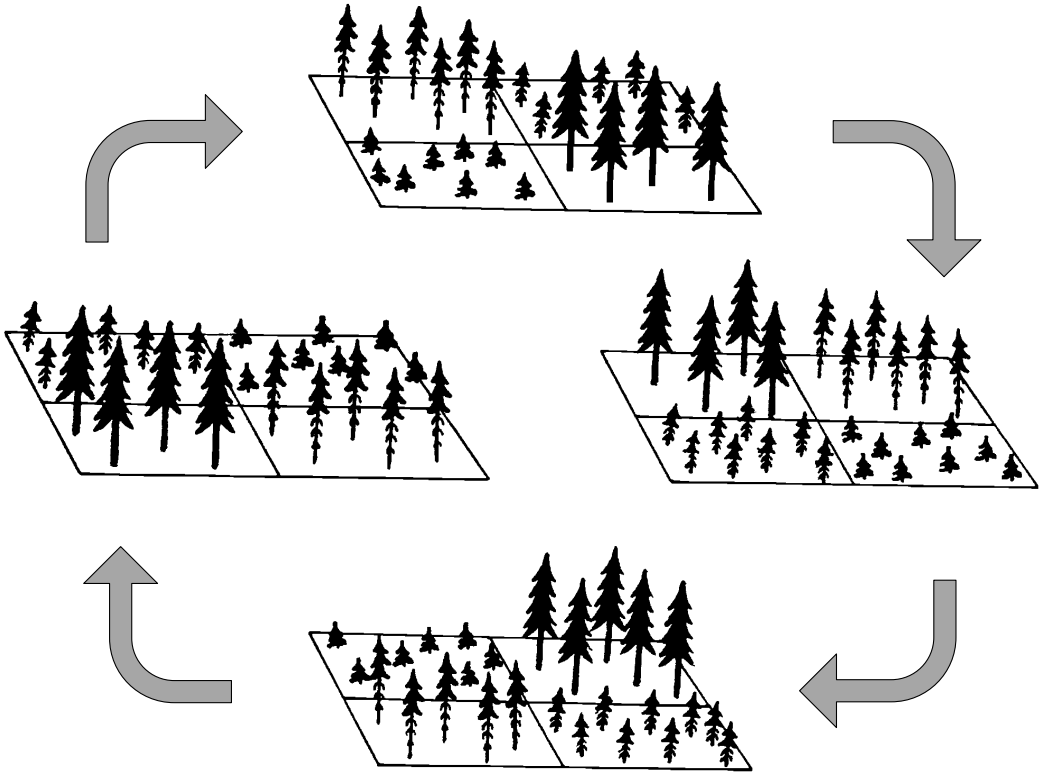


Figure 2–Shifting mosaic concept of forest disturbance (from Powell 2000). This figure shows secondary succession for a small idealized landscape consisting of four rectangular forest stands. Start with the top diagram and follow gray arrows in a clockwise direction – a mature stand (lower right quadrant in top diagram) is eventually affected by a stand-replacing disturbance process, which transforms it to a stand initiation structural stage (these are small trees in lower right quadrant of the next diagram). Small trees grow and eventually reach a "young middle-age" stage called stem exclusion (this is shown in lower right quadrant of the bottom diagram). As growth continues, they reach a "late middle-age" stage called understory reinitiation (shown in left-middle diagram). When trees develop to a point where they are once again mature (old forest), this "circle of forest life" has been completed and we are back to the top diagram again. The structural stages are illustrated and described in more detail in table 1.

Succession – more specifically, secondary forest succession – is what we think of as normal growth and development of a forest stand. It begins after disturbance when new trees start to grow, and it continues through four distinct stages that if unaffected later by another severe disturbance process, extends ultimately to an old-growth forest.

Succession can be explained in terms of an idealized time continuum. Assume a starting point called year zero, immediately after fire, windstorm, or another major disturbance event kills most of the vegetation on a site. Secondary forest succession begins with this deforested condition. From this point on, and assuming no more stand-killing disturbances, a stand will pass through four distinct stages of development. These four stages of stand development are illustrated and described in table 1.

Table 1: Description of forest structural stages (adapted from Oliver and Larson 1996).

	**Stand Initiation (SI)**. Following a stand-replacing disturbance such as wildfire, growing space is occupied rapidly by vegetation that either survives above ground (two tall trees) or initiates new growth from underground organs and seed stored on site. Colonizers disperse seed into disturbed areas, and then new seedlings establish and develop. A single canopy stratum of tree seedlings and saplings is present in this stage.
	**Stem Exclusion (SE)**. In this structural stage, trees initially grow fast and quickly occupy all their growing space, competing strongly for sunlight and moisture. Because trees are tall and reduce light, understory plants (including smaller trees) are shaded and grow slowly. Species needing sunlight usually die; shrubs and herbs may go dormant. In this stage, establishment of new trees is precluded by a lack of sunlight or by a lack of moisture.
	**Understory Reinitiation (UR)**. As a forest develops, a new age class eventually gets established as overstory trees begin to die, or when they no longer fully occupy their growing space after swaying in wind and abrading each other. Regrowth of understory seedlings and non-tree vegetation then occurs, and trees stratify into vertical layers. This stage consists of a low to moderate density overstory with small trees underneath.
	**Old Forest (OF)**. Many age classes and vegetation layers mark this structural stage containing large, old trees. Snags and decayed fallen trees may also be present, leaving a discontinuous overstory canopy. This drawing shows a single-layer stand of ponderosa pine, reflecting influence of frequent surface fire on dry-forest sites. Surface fire is not common on cold or moist sites, so those areas generally have multi-layer stands with large trees in an uppermost stratum.

Disturbance is an ecological counterpoint to succession. Plant communities develop during succession by progressing from immature to mature stages, but disturbance can interrupt succession at any time. Some disturbances are severe enough to set a plant community back to the beginning – a stand initiation stage. Others are so minor that only one or a few trees are affected, and these small changes help advance forest succession when a stand is in the stem exclusion, understory reinitiation, or old forest stages.

When judged by using ecological time scales, the proportion of time that disturbances affect a stand is infinitesimal. But even so, these changes are extremely important

ecologically because they allow new generations of vegetation to get established and develop. Disturbances are of keen interest to ecologists and foresters because they establish environmental conditions under which new plant communities get established and continue to develop.

Disturbances vary in at least three dimensions.

1. **Frequency** is a rate at which disturbances recur over time. Frequent disturbances occur every few years, whereas infrequent disturbances occur once every few centuries.
2. **Predictability** describes regularity of a disturbance, such as timing of flood events on a river or stream (cottonwood and willow regeneration, for example, is tightly synchronized with flood timing, not with flood frequency).
3. **Magnitude** is duration of a disturbance event and it varies from a few seconds or minutes (such as a wildfire) to several years (such as a drought). Magnitude is often expressed using two related concepts called intensity and severity.

For interior Pacific Northwest, a severe disturbance that sets succession back to a stand initiation stage is not uncommon. These large events, such as volcanic eruption of Mt. St. Helens in 1980 or the Tower wildfire in 1996, are spectacular but tend to occur only every century or so. Partial disturbance in which some of a stand is killed but much of its overstory and mid-story survives is also common. Stands resulting from partial disturbance are more variable in structure and species composition than stands created by a complete disturbance.

APPLYING ECOLOGICAL PRINCIPLES TO SILVICULTURE

Foresters use silviculture to impose disturbance and modify successional development. Silvicultural treatments may be used to remove some trees so those remaining can develop better. The degree to which these prescribed actions imitate nature depends on how they are implemented. Reproduction cutting imitates disturbance; thinnings and other intermediate treatments imitate successional processes.

A forester's first option is no treatment. Other alternatives involve removing increasing proportions of forest vegetation. A range of options must be consistent with ecology of species comprising a stand, existing stand conditions, and future conditions desired by a Forest Plan.

Even-aged reproduction cutting imitates disturbance affecting an entire stand; uneven-aged cutting mimics disturbance affecting portions of a stand. Figure 3 shows four silvicultural cutting methods and how they retain varying tree numbers and distributions.

Stages of stand development, along with gradients of disturbance magnitude, provide an ecological basis for silviculture. Early stages of stand development set the stage for even-aged silviculture. By imposing disturbances severe enough to promote regeneration, a forester can encourage development of intolerant and mid-tolerant species distributed uniformly across a stand. In figure 3, these treatments are called stand initiating, and they differ from stand-maintaining treatments designed to mimic later stages of stand development.

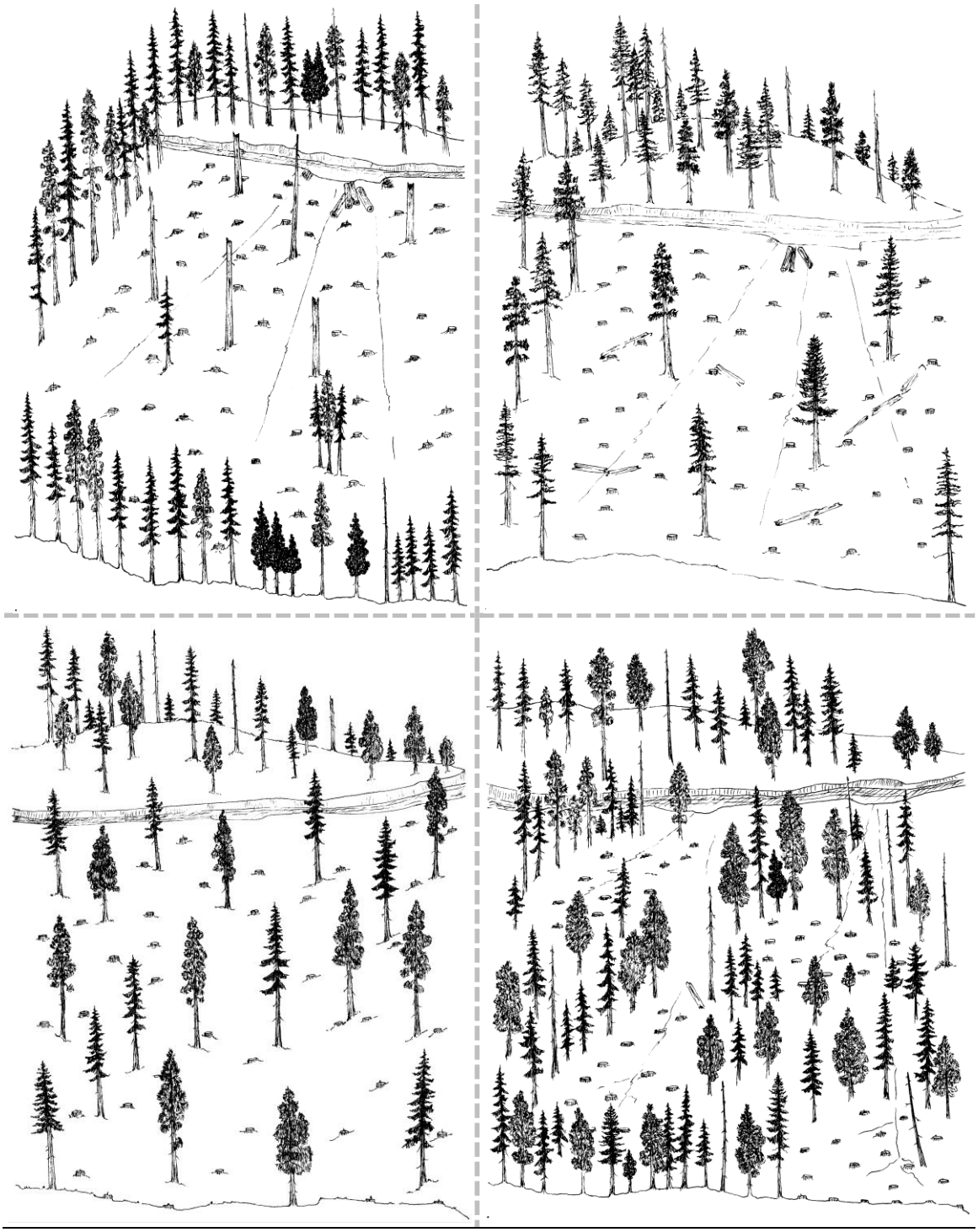


Figure 3–Examples of stand-initiating and stand-maintaining silvicultural treatments. Clearcutting (upper left) and seed-tree cutting (upper right) are examples of stand-initiating silvicultural treatments. Shelterwood cutting (lower left) and group selection (lower right) are examples of stand-maintaining silvicultural treatments. How and why are one of these treatments selected for an area? Silviculturists create and maintain forest compositions, structures, and densities that best provide desired outcomes (e.g., desired future conditions). When reduced to its essence, a silviculturist's task is to integrate knowledge from many disciplines (ecology, pathology, entomology, watershed, wildlife, etc.) when developing prescriptions to create desired future conditions.

Later stages of succession, primarily understory reinitiation and old forest stages, provide an ecological basis for uneven-aged silviculture. A silvicultural prescription that imitates scattered natural mortality in upper crown classes can promote development of reproduction continuously over time.

A goal of uneven-aged silviculture is to stabilize stand structure and biomass over long periods, thus emulating an old forest phase. But other desirable features of an old forest stage (such as snags and down wood) can also be provided relatively easily by uneven-aged silviculture.

Intense, small-scale disturbances do not affect an entire stand, but are used to create openings within a stand. Natural examples include a localized insect infestation such as western pine beetle, a small area of windthrow, or an area of torching within a larger surface fire. Such a disturbance creates a gap in the canopy of a stand; reproduction becomes established and develops within this opening. Ecological conditions within a gap are affected by bordering trees, depending on opening size and shape. Foresters often use group selection cutting to mimic these conditions.

Benign, small-scale disturbances often take the form of a single tree falling, or dying while standing, in the woods. Causes of such individual tree mortality include root rot or other disease, insects, lightning, windthrow, or some combination of these factors. If a dying tree had a large crown, shade-tolerant reproduction will become established in a newly created gap after it dies. In the smallest gaps, an opening may close before tree reproduction can grow into the main canopy, in which case small trees may persist without further growth (stagnate), or they could become suppressed and die. Foresters often use individual-tree selection cutting to mimic these conditions.

The remainder of this white paper describes how three common silvicultural activities are used on Umatilla NF: tree planting, natural regeneration, and thinning.

TREE PLANTING

Reforestation is a critical component of forest management on Umatilla NF. Reforestation is renewal of a forest after a disturbance. Renewal can occur through natural processes (natural regeneration) or because of forest management (tree planting). [There is often confusion between two closely related terms: deforestation and reforestation. Deforestation refers to situations where forest cover is removed permanently, such as removing forest to create an asphalt parking lot; reforestation refers to temporary removal of forest cover by timber harvest or another disturbance.]

All public lands that are harvested (regenerated) must be successfully reforested in five years or less. National Forest Management Act of 1976 (NFMA) established this requirement. NFMA's 5-year regeneration requirement also applies to salvage timber sales where trees killed by wildfire or insect attack are harvested; if no salvage harvest occurs, NFMA's 5-year regeneration requirement does not apply to stands killed by fire, insects, or other natural processes.

Each year, more than a million seedlings are planted on Umatilla NF to replace trees that were harvested, killed by fire, or damaged by insects and diseases. Tree planting

began on Umatilla NF in 1910, when red oak, shagbark hickory, pignut hickory, and black walnut were planted experimentally.[3] Tens of millions of trees have been planted since then, but exotic species like walnut or hickory have not been used for at least 75 years.

Since mid-1990s, much of the Forest's planting program has been designed to help restore sites affected by wildfires or insect attack. Long-term trend data for common disturbance processes clearly shows that at a broad scale, *forest insects are influencing conditions on Umatilla NF more than either timber harvest or wildfire* (fig. 4, below).

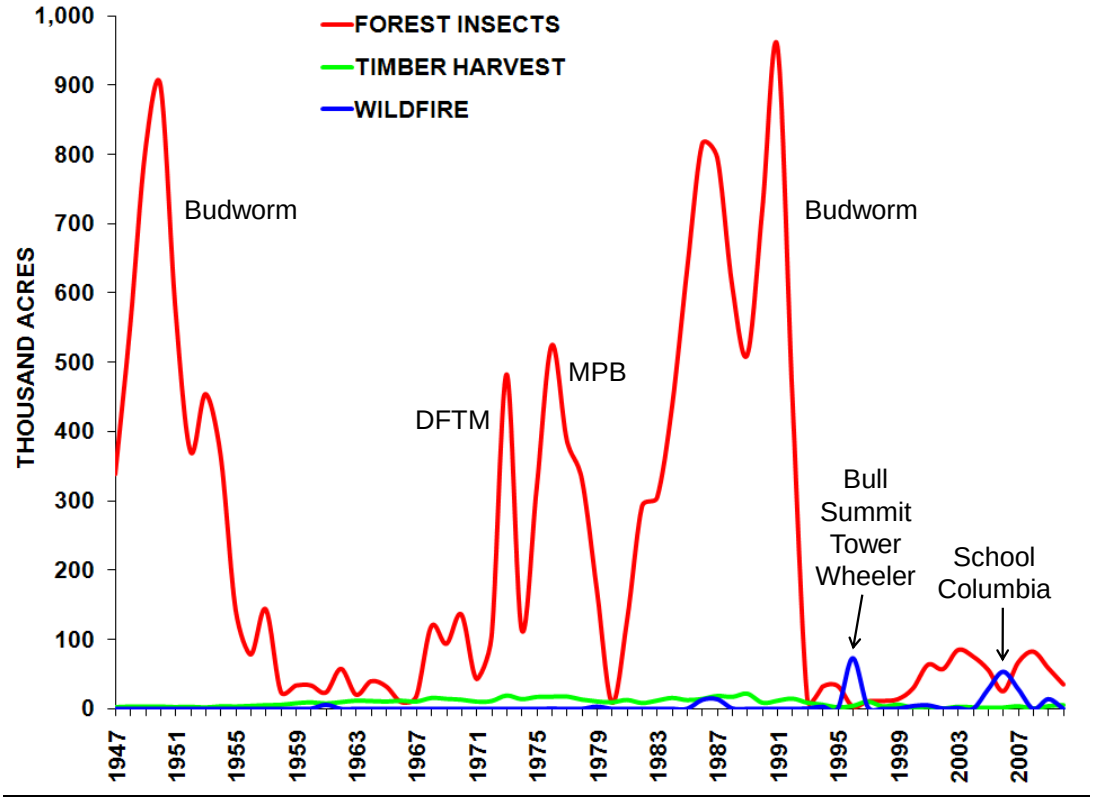


Figure 4–Disturbance process trends from 1947 to 2010. Although fire hazard has recently received the most attention and funding, this *disturbance history for Umatilla NF suggests that conditions are influenced more by forest insects than by wildfire or timber harvest*. This chart shows two major outbreaks of western spruce budworm (1944-1958 and 1980-1992), and outbreaks of mountain pine beetle (MPB) and Douglas-fir tussock moth (DFTM) in the early to mid-1970s. Six of the Forest's largest recent fires are also shown (Bull, Summit, Tower, Wheeler Point, School, and Columbia Complex).

The Umatilla NF's silviculture program is driven largely by disturbance – either by supporting timber salvage operations to remove dead or dying trees (in fig. 1, high harvest levels in the mid-1970s reflect salvage of timber killed by Douglas-fir tussock-moth), or by replanting areas after trees were killed by insects or fire (or by other disturbance agents).

[3] Exotic tree planting references are from reports about early plantation work on Wenaha NF; note that records of exotic tree plantings for Heppner Forest Reserve and Wenaha Forest Reserve are available in Umatilla NF Supervisor's Office historical archives.

Six tree species are commonly planted on Umatilla NF, and two or three different species are generally used on the same site. Most common species planted are:

Western larch	Western white pine
Lodgepole pine	Ponderosa pine
Engelmann spruce	Douglas-fir

First-year seedling survival rate averages about 86%. Third-year survival (survival of seedlings planted three years ago) averages about 72% (figure 5).

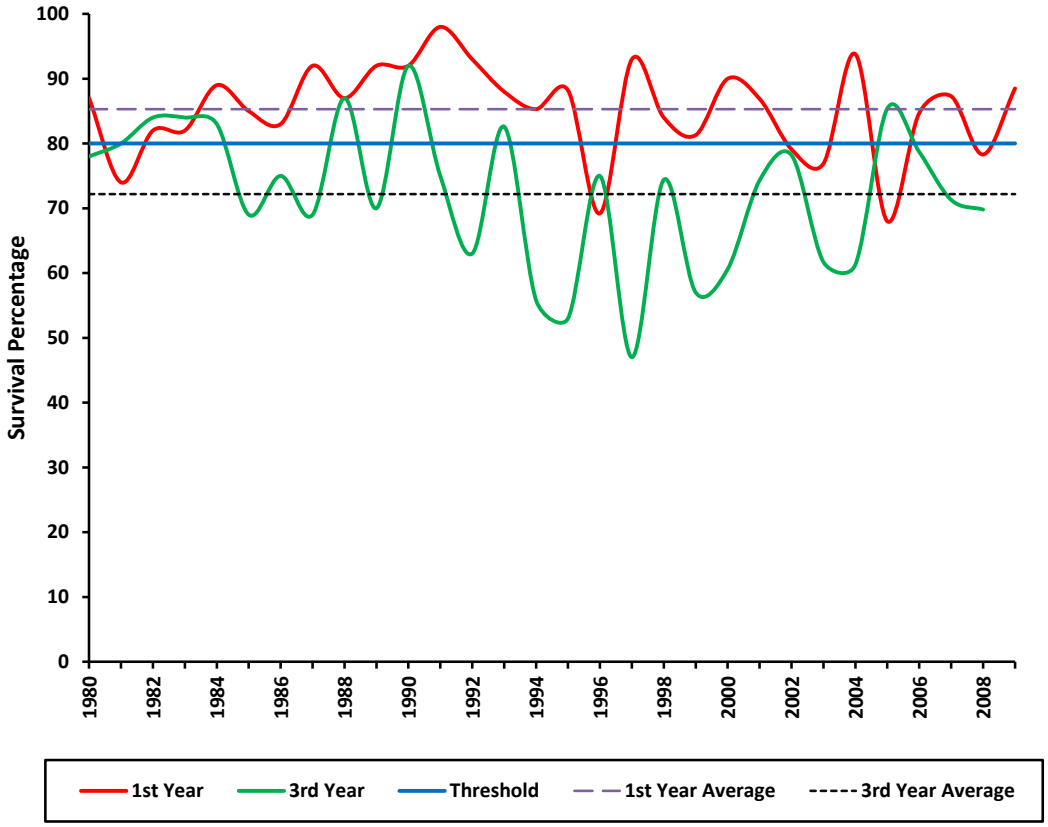


Figure 5–Historical tree seedling survival rates for the Umatilla NF, 1980-2009. Fig. 4 describes many disturbance processes after which reforestation operations are completed (this information was compiled by Don Justice, analyst, Umatilla NF, Supervisor's Office).

When natural regeneration might not be adequate to adequately renew forest cover for a disturbed area, then tree seedlings will be planted to accomplish at least three objectives: (1) establish an ecologically appropriate forest cover – defined as a proper mix of early- and mid-seral tree species in a plant succession context; (2) ensure that minimum stocking objectives from Umatilla NF Forest Plan, by Forest Plan Working Group, are achieved; and (3) ensure that minimum stocking standards are met within 5 years of salvage harvest, as required by National Forest Management Act, whenever dead trees are harvested to provide wood products.

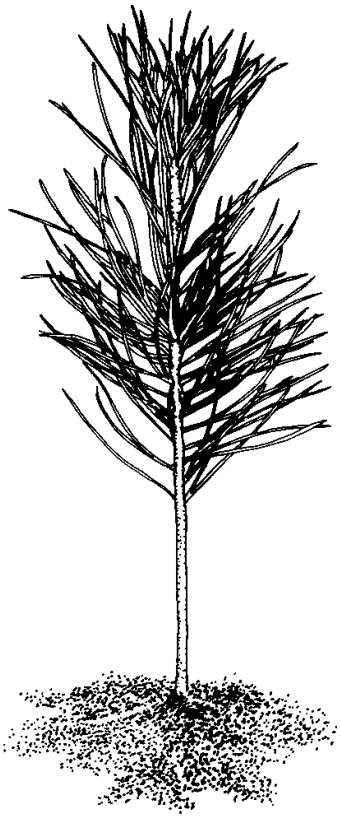
After a decision is made to plant an area, it usually takes 2 or 3 years to grow seedlings adapted to specific site conditions (as reflected by elevation bands within designated seed zones), prepare silvicultural prescriptions detailing reforestation specifications, and arrange to get seedlings planted by using either contract or force-account (Forest Service) crews.

All tree seedlings planted on Umatilla NF originated from seeds collected in wild, native stands. Seeds collected for planting stock come from numerous parent trees growing in the same general ecological setting as a planting site.

Use of designated seed zones and 500-foot elevation bands (with narrower bands for some species like Douglas-fir) ensures that seedlings produced from a seed lot will be used in the same area where seed was collected.

It is important that planted seedlings are well suited to their new home – tree seedlings needing well-drained soils cannot survive in a marsh, for example. Umatilla NF uses an ecological site classification system (Powell et al. 2007) to match tree species to biophysical environments where they will survive and prosper.

Before using timber harvest or any activity that removes trees, a silvicultural prescription is prepared to describe how reforestation will occur, the species to be used in a planting mix (if tree planting is prescribed instead of natural regeneration), and how new trees will be cared for in the future.



NATURAL REGENERATION

On sites where only one or two tree species are planted, natural seeding from other trees in and around a reforested area often serves to enhance diversity. On Umatilla NF, disturbed areas regain their plant diversity rapidly because trees and other native vegetation usually reestablish quickly.

Dead trees can be replaced by planting a new tree or by natural regeneration, where seeds from cones in surrounding trees fall to the ground, take root, and begin a new forest. Planning for natural regeneration must also match tree species to their favored environments – ponderosa pine seeds require bare soil for germination, and no amount of coaxing will get them to establish on a thick layer of fir needles.

Natural regeneration is used for more than 75% of areas being reforested, but it generally takes up to three years longer for a natural seedling to become established than if it was planted. On average, more than 4,000 acres of Umatilla NF receive a natural regeneration treatment annually.

THINNING

To grow well, a tree needs a place in the sun and some soil to call its own. When trees in a stand are crowded and stand too close together, they lack enough sun or water to flourish. Thinning reallocates growing space by opening a stand, so more sunlight, water, and nutrients are available for remaining trees.

Since thinning improves tree resistance to insects and diseases (but not all of them), and because it reduces stand susceptibility to a destructive type of wildfire called crown fire, thinning is often used to improve forest health or address wildfire hazard.

To guide thinning and other activities where reducing tree density is an important objective, the Umatilla NF developed a stocking-level guide (Powell 1999). It provides stocking levels for up to seven tree species growing on 44 plant associations.

When thinning occurs in stands with larger trees, trees being removed can provide lumber or other wood products. These treatments are called commercial thinnings. On average, Umatilla NF completes about 1,000 acres of commercial thinning each year.

Noncommercial thinning removes trees too small to be used for wood products, although small trees are sometimes removed for Christmas trees. On average, more than 1,000 acres of Umatilla NF receives a noncommercial thinning each year (fig. 6).

Of three main groups of silvicultural activities (timber harvest, noncommercial thinning, and tree planting/natural regeneration), noncommercial thinning receives the least emphasis (see figure 6 below, and figure 7 on next page), due mostly to a lack of funding support for this activity. Poor funding support for noncommercial thinning is widespread in Pacific Northwest Region of the USFS, as described in Powell et al. (2001).

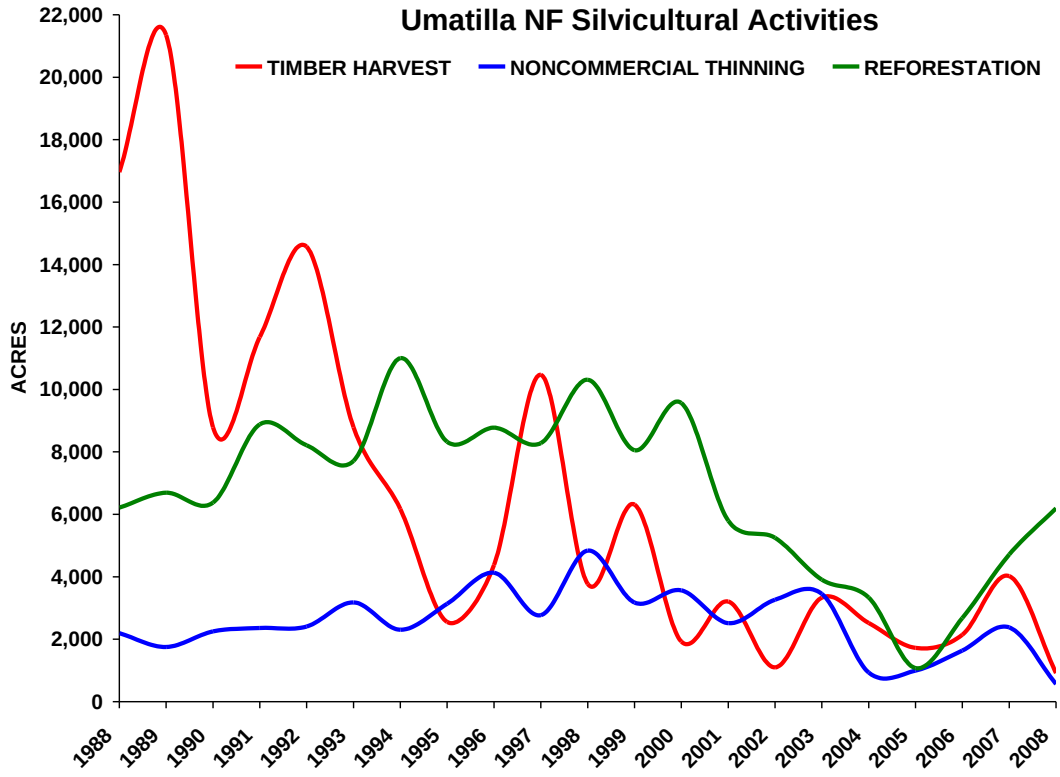


Figure 6–Silvicultural activity trend from 1988 to 2008. This chart shows that timber harvest was important in the early 1990s but recently declined to low levels. Noncommercial thinning remained at relatively low and constant levels across the 21-year period.

Reforestation varied through time – it was high in the mid-1990s to help reforest harvested areas from the late 1980s and early 1990s, and it was high in the late 1990s to help reforest more than 70,000 acres of wildfire occurring in 1996 (Bull, Summit, Tower, and Wheeler Point wildfires).

An upswing in reforestation in the late 2000s is also fire-related – it is tied to School, Columbia Complex, Monument, Sharps Ridge, and other fires from the early- to mid-2000s.

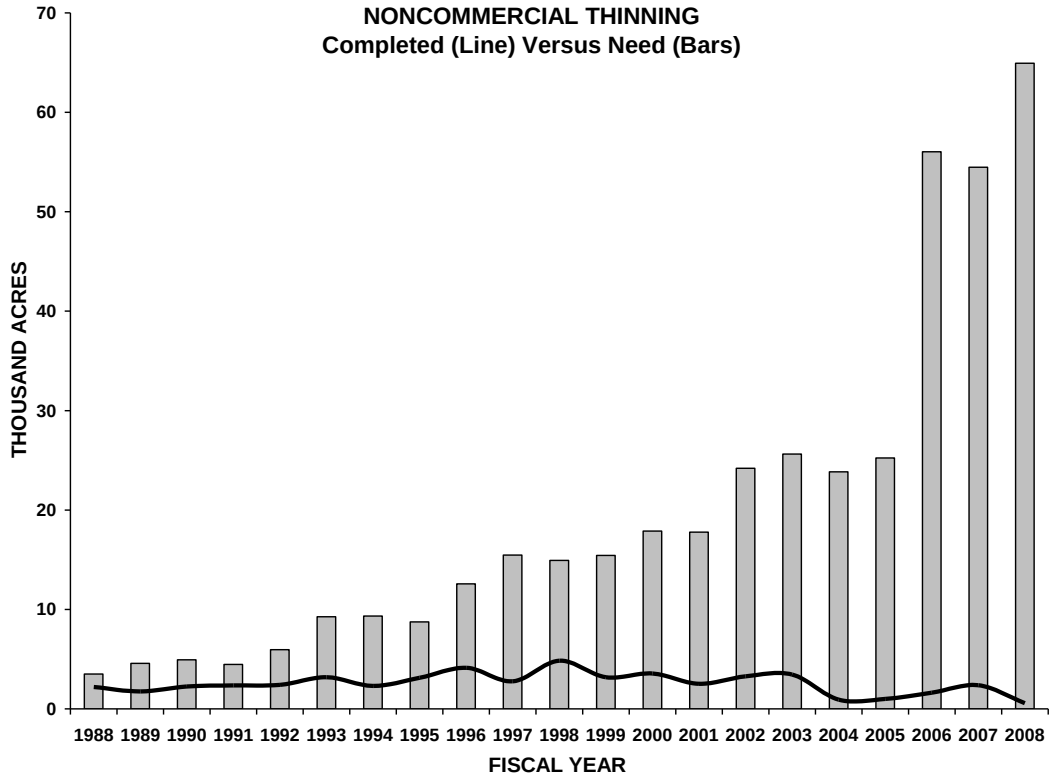


Figure 7–Noncommercial thinning trend from 1988 to 2008. This chart shows that noncommercial thinning accomplishment (completed thinning shown as a line) has been unable to keep pace with how fast the need for noncommercial thinning is being added (the gray bars). A net result of these trends is a rapidly growing backlog of noncommercial thinning need.

Note that noncommercial thinning not only improves tree growth and timber volume production, but it also contributes to improved forest resistance to insect or disease attack (Powell 1999), and it reduces susceptibility to destructive crown fire.

Why is funding support low for silvicultural activities such as noncommercial thinning? It may seem surprising, but the main reason is not that the Forest Service's overall budget declined significantly (although reductions in total budget have occurred).

The primary reason for a 'de-emphasis' of noncommercial thinning and other silvicultural activities is that a much higher percentage of the Forest Service's budget is now being allocated to wildfire functions (fig. 8).

In 1995, a reasonably 'good' year for noncommercial thinning in figure 6, fire funding made up 16 percent of the Forest Service's annual appropriated budget. By fiscal year 2015, for the first time, *more than 50 percent of the Forest Service's annual budget was utilized for wildfire spending* (preparedness, suppression, FLAME, and other fire functions) (USDA Forest Service 2015).

Continual budget shifts to fire spending have been accompanied by corresponding shifts in staffing. As described earlier in this white paper, there are many fewer certified silviculturists and other silviculture employees now than there were in the 1990s. Silviculture staffing reductions are correlated with long-term budget trends presented in figure 8.

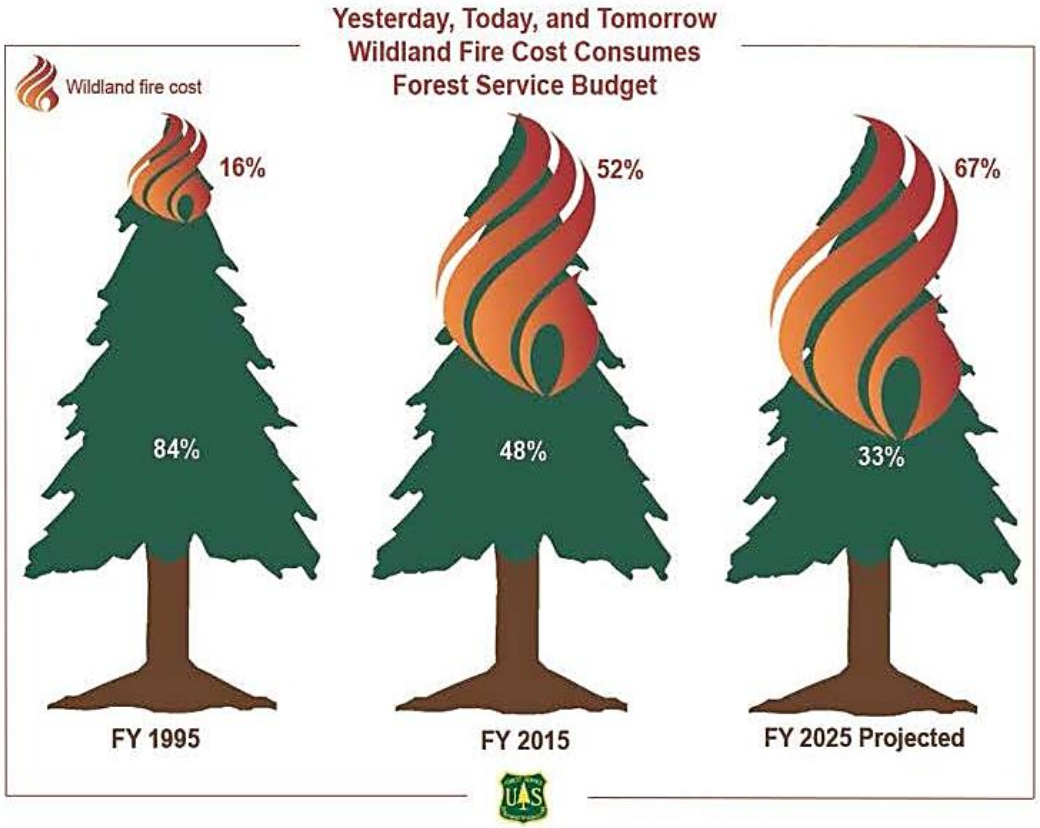


Figure 8–Budget summaries for fiscal years 1995 and 2015, and budget projections for fiscal year (FY) 2025 (source: USDA Forest Service 2015). For FY 1995, app. 16% of the total Forest Service budget was utilized for fire-related functions (suppression, preparedness, etc.). By FY 2015, fire spending comprised more than 50% (52%) of the Forest Service's total budget. If current trends continue unchanged, it is estimated that fire-related spending for FY 2025 will reach two-thirds (67%) of the total budget.

As described in this white paper, these budget trends have been accompanied by silviculture staffing reductions. A reduced silviculture budget, and fewer silviculture employees to prepare and accomplish silvicultural activities on the ground, has resulted in substantial declines in activity attainment (figs. 6, 7).

A potentially beneficial side-effect of this budget trend has been closer coordination between the silviculture and fuels staff areas. Now, most active management vegetation treatments, regardless of whether they are funded as a silviculture or fuels activity, are designed to accomplish multiple objectives relating to both silviculture and fuels.

Fire is an ecological catalyst that takes its character from whatever surrounds it. Forests with qualities (character) that are viewed as atypical or unnatural, a condition sometimes termed as being 'out of whack,' will almost always yield wildfires, insect outbreaks, or disease epidemics that are also out-of-whack.

This means that if we want to successfully reinstate fire as an ecological process, especially for dry-forest ecosystems, we first need to craft suitable habitat for desirable fire regimes. Crafting suitable habitat involves weeding (thinning) the woods to address fire risk and crown-fire susceptibility, but for dry-forest sites, it's not just the trees that matter – we must provide fine fuels (grass), a fire 'carrier,' by managing livestock grazing.

SILVICULTURE AND FIRE-SAFE FOREST CONDITIONS

Much of the West is meant to burn, and many of our native trees are adapted to fire as part of their life cycle. On dry sites, for example, historical fires moved swiftly across the forest floor, killing few large trees while consuming needles, twigs, down logs, and small seedlings.

But now, after years of overprotection from fire, dry forests are often choked with debris and a flammable understory of small trees. When these forests burn, as they inevitably will, they burn hotter, faster, and more completely than before we began suppressing natural fires.

What can be done to reduce fire impacts on human life and property? Perhaps our best hope lies with thinning; it can be used to mimic one effect of fire by cutting small trees that nonlethal fire would have killed historically. For this reason, low-severity fire was often referred to as nature's thinning agent.

We can't prevent summer thunderstorms and fires spawned by their lightning. But we can thin our forests (fig. 9) so that when a fire starts, it doesn't rage out of control, leaving sterilized soil and burned homes in its wake.

[White paper F14-SO-WP-Silv-37, *Tree density thresholds as related to crown-fire susceptibility*, and a journal paper, *Estimating crown fire susceptibility for project planning* (Powell 2010), describe how foresters determine if a forest is at high risk for destructive crown-fire activity, and how foresters design thinning treatments to reduce crown-fire vulnerability.]

Recent experience with 'megafires' across the West is clear – the choice is ours to make (as a society), and let's choose to thin for fire-safe forests! (And we should also consider that providing fire-safe forests results in circumstances more like historical, 'park-like' forests, and open park-like conditions are better adapted to drier temperature and moisture regimes associated with ongoing climate changes.)

Fire-safe forest conditions are not the only reason to thin. Forests are dynamic as they develop (fig. 1 describes common stages a forest passes through as it develops). Foresters manage dynamic forests to create 'desired conditions' (desired future conditions in Umatilla NF Forest Plan), and they may manage an individual forest tract again and again, over decades or even centuries.

When managing forests, foresters must consider that everything is constantly changing, with some phases exhibiting rapid change and others experiencing slow change. Much of the enjoyment that people receive from being in a healthy forest comes from what they see and how it makes them feel. Foresters need a wide range of management 'tools' at their disposal to provide a healthy forest while simultaneously mimicking what can seem like the discordant harmonies of nature (Botkin 1992).

[White paper F14-SO-WP-Silv-34, *Silvicultural activities: description and terminology*, provides quite a bit of additional information about how foresters use silvicultural practices to mimic natural processes such as disturbance. Appendix 2 describes silviculture white papers, and it provides a weblink for accessing and downloading them.]

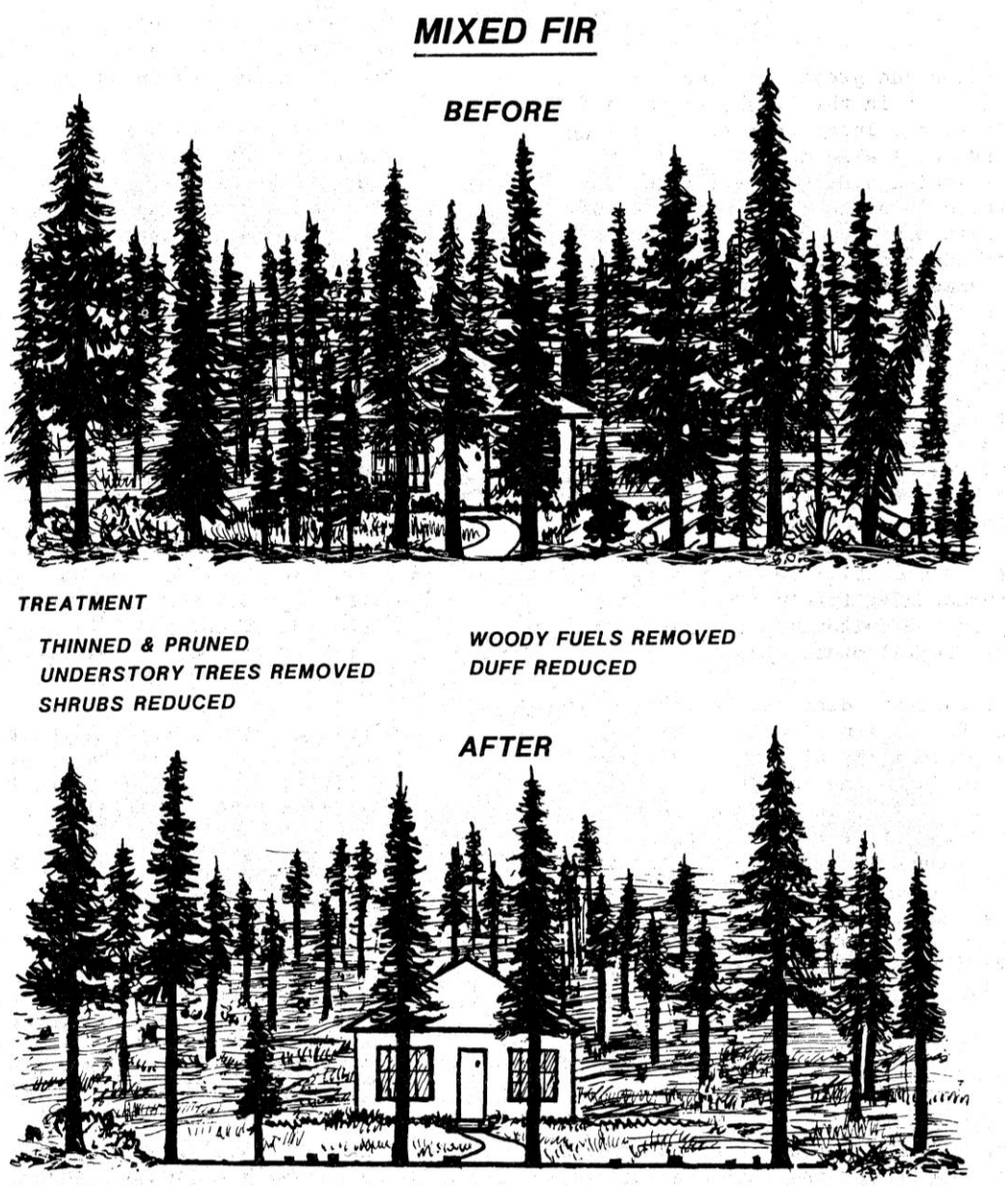


Figure 9–Using silvicultural and fuel-treatment activities to create fire-safe conditions (drawing taken from Schmidt and Wakimoto 1988). Mixed fir communities feature a mix of tree species. Primary objectives of mixed-fir treatments are: (1) thin overstory trees to disrupt canopy fuel continuity, reduce canopy bulk density, and lessen crown-fire risk; and (2) remove many understory trees to address ladder-fuel objectives. Trees near homes in a wildland-urban interface may be pruned to address ladder-fuel concerns. In a fire-safe zone near structures, most understory trees will be removed, and shrubs may also be substantially reduced, along with removal of woody fuels and application of some measure (treatment) to reduce surface fuels and perhaps litter and duff.

Fire-safe conditioning works in both directions – not only does a homeowner want to prevent a wildfire from destroying their home or other structures, but they also don't want a structure fire to spread from their home and burn their forest of trees. Both objectives can be met by applying fire-safe practices to a forest zone adjacent to their home and structures, along with structure modifications (metal roofing, fire-resistant siding, etc.).

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APPENDIX 1: WHY WE DO IT

Over the last few decades, how much silviculture has been practiced on the Umatilla National Forest? This white paper summarizes historical accomplishment trends for many silvicultural activities:

- stand examinations and other surveys
- diagnosis of treatment needs
- silvicultural prescriptions
- certification of silviculturists
- tree planting
- reforestation success (plantation survival and growth)
- timber harvest
- noncommercial thinning

It would not have been possible to provide the trend data presented in this document if Forest Service employees were not diligent about reporting their silvicultural accomplishments at the conclusion of each fiscal year.

Year-end reporting, however, can be viewed as a 'hassle,' and some employees wonder if the effort is worth it:

Does anyone use the accomplishment information?

Does anyone really care how many acres were planted?

Who cares if 3rd-year plantation survival rates for ponderosa pine average 78 percent?

Does Congress really require that reforestation success be reported to them?

In response to employee concerns about the time and effort required for annual accomplishment reporting, the Washington Office of USDA Forest Service prepared a short brochure with a short, succinct title – "Why We Do It." This appendix provides the text of the "Why We Do It" brochure. I believe the brochure provides valuable context for why, and how, the historical accomplishment data in this white paper was collected across many decades.

WHY WE DO IT

Understanding the importance of accomplishment reporting in the USDA Forest Service

Prepared by: **Performance Management Branch of SPBA, Washington Office**

The Where and How of Accomplishment Data

"So Mike, you look a little tired this morning. Did you party it up last night?" Steve asked.

"Hardly. I was here until eight-thirty entering field data into the system. You know, all that stuff we did up on Grand Mesa, "replied Mike.

He went on, "So last night, while I was making coffee, I began wondering. Just where does all this stuff go? The stuff we enter I mean. I always hear it is very important, but to who? "

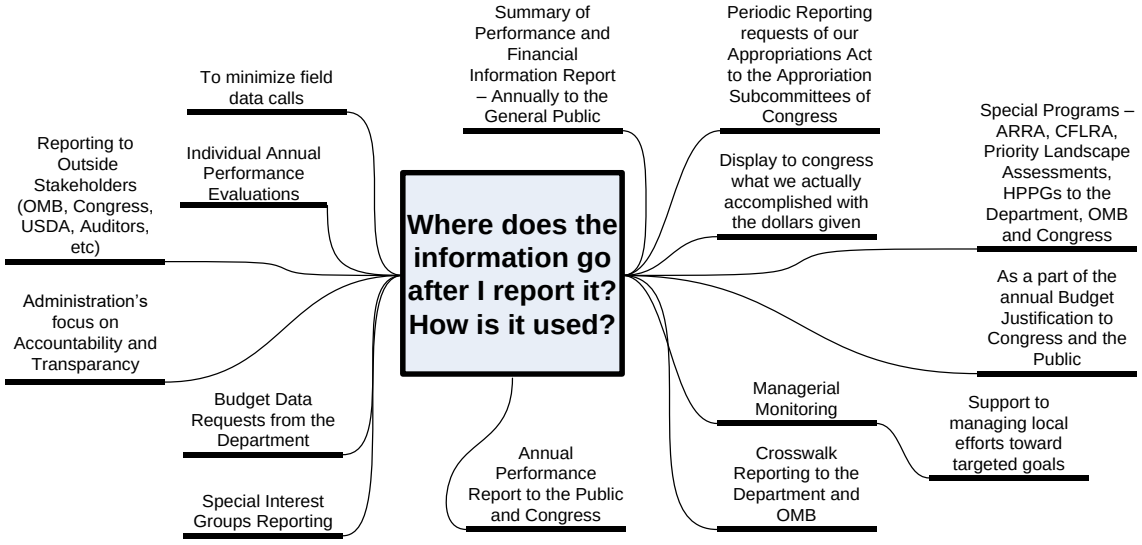
"That's a good question," reflected Steve. "Doesn't it go to Congress or something?"

"I can't believe Congressmen sit around reading this stuff. Can't be that. Maybe it is just for posterity. Trend information for the future somehow," said Mike.

The two sat there thinking about it.

Finally Steve said, "The weirdest thing is the fact that we don't know. We both spend a bunch of time each year entering all this stuff and neither one of us knows where it goes from here. Don't you think that is a little strange?

An all too common question is, "What happens to all this information we put into a system." So where does it go and how is it used? The data is distributed and used widely and therefore a short answer is not possible. In various summary forms it is used by the Senate and House Appropriation Committees, and by the office of Natural Resources and the Environment, (an Under Secretary of the Department of Agriculture). It is also used by the Office of Management and Budget (one of the administrative offices of the President). The information is published on various sites and in documents for the General Public. In addition to all of this, it is provided to leadership at all levels of the organization as vital management information, and is also used in personal performance reviews throughout the agency. The reporting and distribution of accomplishment data benefits the field by often enabling a "pull", rather than a "request" for data in response to intermittent data requests from outside parties.



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Accomplishment Data for Accountability

"Mr. Curtis, welcome to Johnson Heights Bank and Trust. We hope you will use us for all your banking needs. My name is Al Harris," Al said smiling.

"Thanks Al. Looks like you have a nice facility here. So if I deposit my money into your bank, do you have a way of keeping me informed with what happens with it?" asked Mr. Curtis.

"What do you mean sir? We are a bank. What do you think happens with it?" Mr. Harris laughed.

"Well, I would like to know what you do with the money I put into your trust. I know my deposits are covered by FDIC insurance, but I don't want that hassle in the event of a bank default. If I know your operation is safe, solvent and well managed, I am more likely to continue putting my money here. So, specifically, do you have some kind of quarterly report of your investment history, with figures indicating your profit and so on?" said Mr. Curtis. There was no smile on his face.

"Why Mr. Curtis, we are a very large and busy bank, with thousands of customers. It would be expensive and very time consuming if we prepared special reports each quarter for all of the folks that have money here. I believe there is some form of stockholder's report that comes out annually, but you would have to be a stock holder to get one. We are a bank. Working to produce quarterly updates for everyone just doesn't fit into our priorities. You can understand sir," said the bank manager.

"Not even a web site where I can find information about your operation?" asked Mr. Curtis.

"Sorry," Al said. "But believe me, we are a very well run bank. And, we provide a great service to the community. Please Mr. Curtis, sit down and I will get the forms for opening your first account with us.

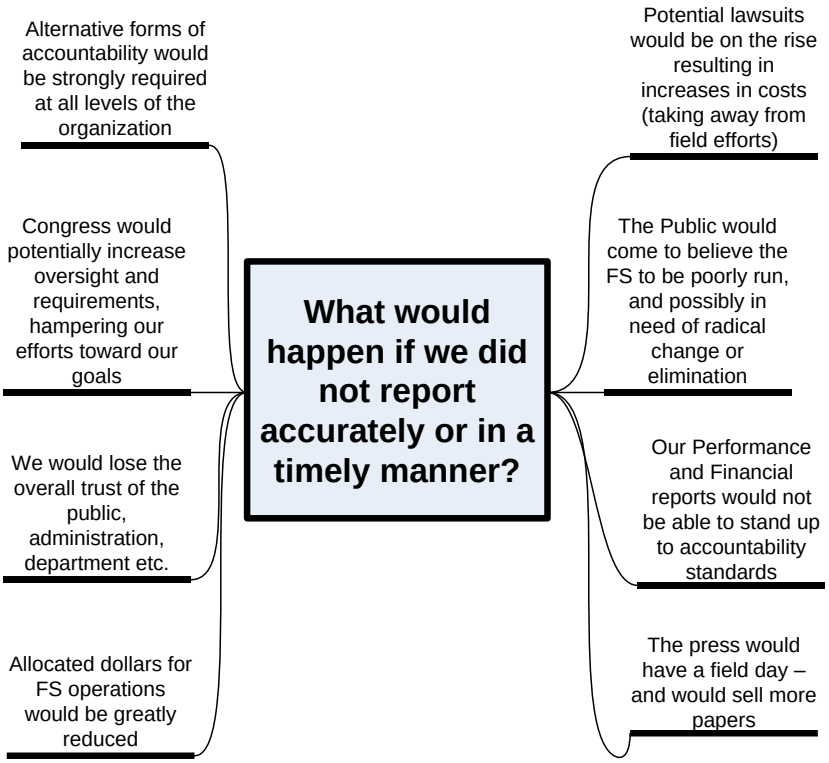
As Mr. Curtis walked quickly away from the bank manager, he looked over his shoulder and said, "Don't bother."

The US Forest Service is an agency made up of over 30,000 excellent employees. These dedicated folks work hard each day to further the mission of the agency. They like to make a difference and see the results of their efforts. Each year the American Public, through Congress, provides over $5 billion to fund our operations – a substantial commitment to the work we do. Without this funding, or with a significant reduction in funding, our operations would be very different, if they existed at all. Those things we know to be important - caring for the land and serving people – would be very possibly out of reach.

Like the bank customer in the analogy above, Congress and the American public demand accountability. A business and its customers share a special relationship. It is a give/deliver relationship. The customer gives, and the business delivers a product and is accountable for the quality of that product. Without this relationship, the two parties ultimately break apart. Sometimes businesses forget who butters the bread. The bank manager in the analogy feels the bank is doing a great job, and it may well be, but he is missing the importance of accountability in maintaining the necessary relationship

with the customer. He sees the reporting on his organization's status somehow separate from the "real work" of the bank. Regardless of how well the bank is currently performing, the future looks dim for the bank if they begin to see their customer base move to the competition.

Because all Americans are our "customers", the Forest Service must collect enough information to show the American people, and their representatives in Congress, that we are spending their money wisely and accomplishing work that matters.



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Accomplishment Data for Decisions

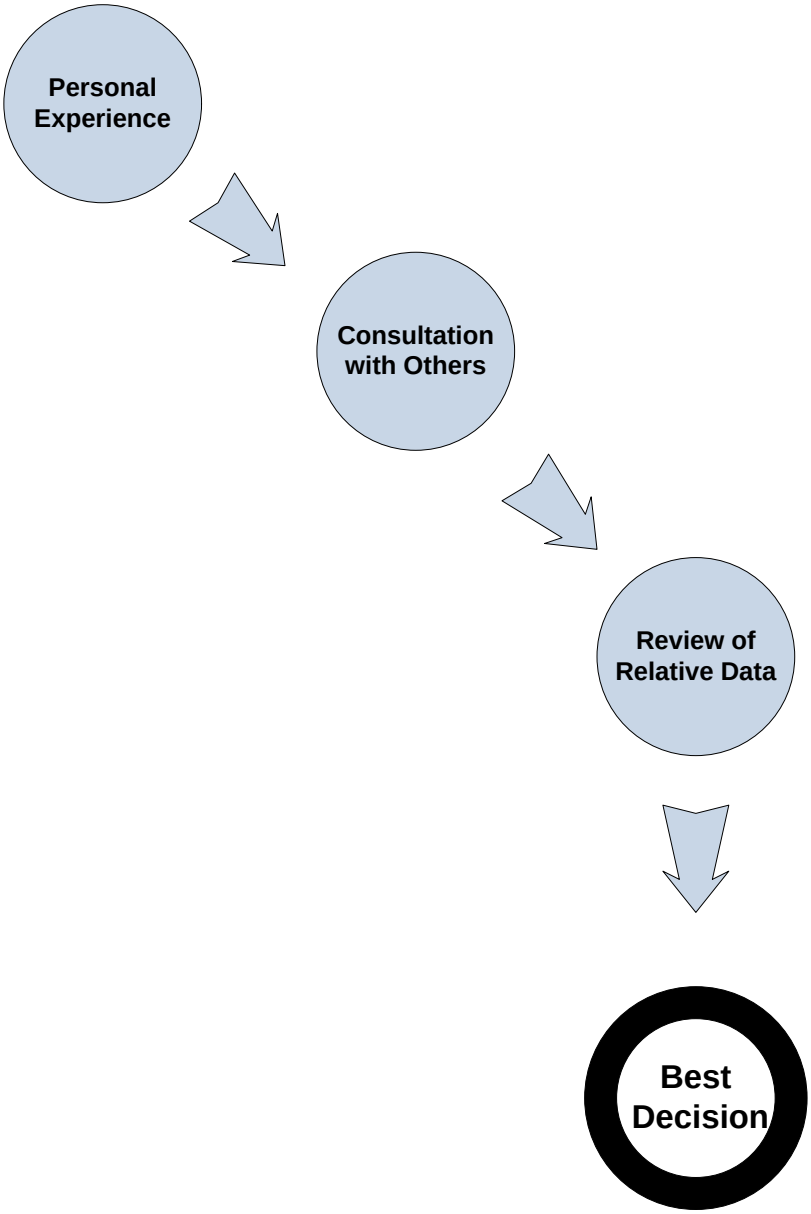
A forest supervisor speaking to her staff on the second day of a three day leadership retreat said, "We have some critical decisions to make as we move into the coming year, and the years after. I am blessed with an experienced staff, each with many years with the agency. However, times are changing and we need to work toward being smarter, more precise and quicker with our response to the challenges we face. I have to tell you, I am not sure we are using all the tools we have at our disposal. Today, it takes more than experience to make the best decision. It takes a well rounded approach."

The room got quiet. The forest supervisor went on. "I am about to state one of the most often used phrases of our time. We live in an information age. We've all heard it, and we all are bombarded with all kinds of information on a daily basis. I know you know what I mean. Before all this began a few years back, maybe more years than we want to think about, experience was all we had. When I made a decision, I based that decision on my personal education, experiences and what I had learned through trial and error throughout my working career. I am sure you all did the same. But now we have more tools available. Today, when I make a decision, I try to employ at least three different resources. One - my personal experience, which continues to be a valuable thing. Two - I consult with folks of various backgrounds to get new perspectives, thoughts and ideas. I tap their experience as well. And three - I consult available data. I try to find any data related to the decision I am pondering to help round out the process. Here, I am tapping into the information age a bit."

"This brings me to the point I want to make," she said. "How often do we use a well rounded approach to decision making, personally or as a group? Yesterday, we made several leadership decisions in this room, and through discussion, we employed the first two of the three resources I spoke of before, experience and consulting. What seemed to be missing is that we never looked at any data related to those decisions. One of those decisions was to continue to fund the NEPA effort for the Cumberland timber sale project. We all agreed that although this process seemed a little stalled, that since we had already worked a year on this, it seemed logical to continue funding in support of the investment. Last night I worked with a few data savvy folks to pull data on all NEPA efforts last year across the forest related to timber sales. Looking at this data, it appears that a neighboring district last year was able to work through four NEPA efforts, equally as complicated and difficult, for less money as we continued to stall with the Cumberland. If we had this data yesterday, I believe our discussions may have been different on the funding question."

The supervisor smiled and said, "Look folks, even with the data we might well have funded Cumberland anyway, but had we made the decision with the support of data, I can't help but feel our decision would have been more solid and grounded. There is no doubt that quality data in today's world is a necessary part of decision making."

The Forest Service is big and diverse. The challenges are many at all levels of the organization. The quality of decisions made by our leaders has a direct relationship with our chances for success. We all want those decisions to be as well informed as possible, solid and grounded. Availability of quality, timely data to support their decisions is crucial. The entire data process, including input, systems collection, reporting, data display and quality control supports our organization in this critical way.


Personal Experience
Consultation with Others
Review of Relative Data
Best Decision

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Accomplishment Data for Monitoring

Two colleagues were having lunch at Big Bill's Burger Barn just outside of town. In the middle of the meal, Rick said to Allen, "So I had my performance review yesterday with the boss." Rick rolled his eyes.

"And," asked Allen.

"Well it went pretty well except one part. He was pointing out how I missed three of my annual targets. I told him that those totals snuck up on me, and that I didn't expect to fall so short. I explained to him I hadn't seen the outcomes until about a week ago when the year was over, so how was I going to do anything about it then. I thought he'd understand. Boy was I wrong," Rick said.

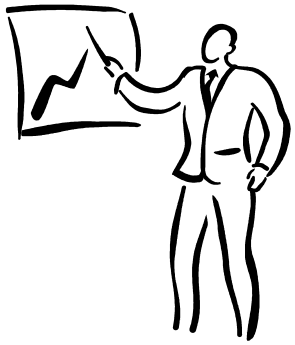
"What did he say?" asked Allen.

"The usual," said Rick. He stopped to gulp another bite of burger. Then he continued, "Oh, he said I should have known earlier in the year. That it was my responsibility to monitor progress toward our targets, and to make adjustments throughout the year. That not knowing was unacceptable, and stuff like that. I still got a satisfactory rating. You know, I was thinking, I have been heading up this staff area for a lot of years now, so missing a target here or there won't hurt me with my background. I can live with it."

"I guess," said Allen.

Two and a half months later, Allen was reading the organization's newsletter, and his eyebrows rose when he read that a new person was joining the ranks, and would be assuming a staff officer position under a new reorganization plan. The new person came from an organization which recently was awarded for excellent results. By the description, Allen knew it was Rick's old position. "Wow," thought Allen.

Understanding where we are in respect to our accomplishment expectations is a key responsibility for leadership at all levels of the organization. Having accurate, timely and complete data is crucial. Organizations use accomplishment information throughout the year to highlight needed adjustments toward annual success at meeting targets. Without it, our agency is less likely to be successful in meeting its accomplishment expectations.



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In Summary

Our agency is blessed with excellent employees at all levels. We work hard each day to further an honorable mission that is good for the people and for the land. Our working character shows in our attention to detail, and our desire to do a complete and quality job at all levels. We understand that what we do matters. This understanding is key to our effort. If we understand what is needed, and see that it matters, we will work tirelessly toward accomplishing what lies before us.

Accomplishment reporting is very much a part of our efforts. It establishes Accountability, provides for quality decisions, allows for progress monitoring and adjustments along the way, and provides a reporting to outside stakeholders and the Public. Accomplishment reporting should not be seen as a separate or additional requirement, but rather as a part of the effort itself. It is like tying shoes is part of putting them on.

So, what can you do to support performance reporting in the Forest Service?

If you are in leadership, you can place emphasis on the effort during your meetings and field visits. If you are a supervisor, you can help demystify the process, discuss the uses of accomplishment information, as well as encourage your folks. If you are a data provider, you can work to provide timely, accurate and complete data. Everyone can rest assured that the effort of reporting performance is vital to our organization.

APPENDIX 2: SILVICULTURE WHITE PAPERS

White papers are internal reports, and they are produced with a consistent formatting and numbering scheme – all papers dealing with Silviculture, for example, are placed in a silviculture series (Silv) and numbered sequentially. Generally, white papers receive only limited review and, in some instances pertaining to highly technical or narrowly focused topics, the papers may receive no technical peer review at all. For papers that receive no review, the viewpoints and perspectives expressed in the paper are those of the author only, and do not necessarily represent agency positions of the Umatilla National Forest or the USDA Forest Service.

Large or important papers, such as two papers discussing active management considerations for dry and moist forests (white papers Silv-4 and Silv-7, respectively), receive extensive review comparable to what would occur for a research station general technical report (but they don't receive blind peer review, a process often used for journal articles).

White papers are designed to address a variety of objectives:

(1) They guide how a methodology, model, or procedure is used by practitioners on the Umatilla National Forest (to ensure consistency from one unit, or project, to another).
(2) Papers are often prepared to address ongoing and recurring needs; some papers have existed for more than 20 years and still receive high use, indicating that the need (or issue) has long standing – an example is white paper #1 describing the Forest's big-tree program, which has operated continuously for 25 years.
(3) Papers are sometimes prepared to address emerging or controversial issues, such as management of moist forests, elk thermal cover, or aspen forest in the Blue Mountains. These papers help establish a foundation of relevant literature, concepts, and principles that continuously evolve as an issue matures, and hence they may experience many iterations through time. [But also note that some papers have not changed since their initial development, in which case they reflect historical concepts or procedures.]
(4) Papers synthesize science viewed as particularly relevant to geographical and management contexts for the Umatilla National Forest. This is considered to be the Forest's self-selected 'best available science' (BAS), realizing that non-agency commenters would generally have a different conception of what constitutes BAS – like beauty, BAS is in the eye of the beholder.
(5) The objective of some papers is to locate and summarize the science germane to a particular topic or issue, including obscure sources such as master's theses or Ph.D. dissertations. In other instances, a paper may be designed to wade through an overwhelming amount of published science (dry-forest management), and then synthesize sources viewed as being most relevant to a local context.
(6) White papers function as a citable literature source for methodologies, models, and procedures used during environmental analysis – by citing a white paper, specialist reports can include less verbiage describing analytical databases, techniques, and so forth, some of which change little (if at all) from one planning effort to another.
(7) White papers are often used to describe how a map, database, or other product was developed. In this situation, the white paper functions as a 'user's guide' for the new

product. Examples include papers dealing with historical products: (a) historical fire extents for the Tucannon watershed (WP Silv-21); (b) an 1880s map developed from General Land Office survey notes (WP Silv-41); and (c) a description of historical mapping sources (24 separate items) available from the Forest's history website (WP Silv-23).

These papers are available from the Forest's website: Silviculture White Papers

Paper #	Title
1	Big tree program
2	Description of composite vegetation database
3	Range of variation recommendations for dry, moist, and cold forests
4	Active management of Blue Mountains dry forests: Silvicultural considerations
5	Site productivity estimates for upland forest plant associations of Blue and Ochoco Mountains
6	Blue Mountains fire regimes
7	Active management of Blue Mountains moist forests: Silvicultural considerations
8	Keys for identifying forest series and plant associations of Blue and Ochoco Mountains
9	Is elk thermal cover ecologically sustainable?
10	A stage is a stage is a stage…or is it? Successional stages, structural stages, seral stages
11	Blue Mountains vegetation chronology
12	Calculated values of basal area and board-foot timber volume for existing (known) values of canopy cover
13	Created opening, minimum stocking level, and reforestation standards from Umatilla National Forest Land and Resource Management Plan
14	Description of EVG-PI database
15	Determining green-tree replacements for snags: A process paper
16	Douglas-fir tussock moth: A briefing paper
17	Fact sheet: Forest Service trust funds
18	Fire regime condition class queries
19	Forest health notes for an Interior Columbia Basin Ecosystem Management Project field trip on July 30, 1998 (handout)
20	Height-diameter equations for tree species of Blue and Wallowa Mountains
21	Historical fires in headwaters portion of Tucannon River watershed
22	Range of variation recommendations for insect and disease susceptibility
23	Historical vegetation mapping
24	How to measure a big tree
25	Important Blue Mountains insects and diseases
26	Is this stand overstocked? An environmental education activity
27	Mechanized timber harvest: Some ecosystem management considerations
28	Common plants of south-central Blue Mountains (Malheur National Forest)
29	Potential natural vegetation of Umatilla National Forest
30	Potential vegetation mapping chronology

Paper #	Title
31	Probability of tree mortality as related to fire-caused crown scorch
32	Review of “Integrated scientific assessment for ecosystem management in the interior Columbia basin, and portions of the Klamath and Great basins” – Forest vegetation
33	Silviculture facts
34	Silvicultural activities: Description and terminology
35	Site potential tree height estimates for Pomeroy and Walla Walla Ranger Districts
36	Stand density protocol for mid-scale assessments
37	Stand density thresholds as related to crown-fire susceptibility
38	Umatilla National Forest Land and Resource Management Plan: Forestry direction
39	Updates of maximum stand density index and site index for Blue Mountains variant of Forest Vegetation Simulator
40	Competing vegetation analysis for southern portion of Tower Fire area
41	Using General Land Office survey notes to characterize historical vegetation conditions for Umatilla National Forest
42	Life history traits for common Blue Mountains conifer trees
43	Timber volume reductions associated with green-tree snag replacements
44	Density management field exercise
45	Climate change and carbon sequestration: Vegetation management considerations
46	Knutson-Vandenberg (K-V) program
47	Active management of quaking aspen plant communities in northern Blue Mountains: Regeneration ecology and silvicultural considerations
48	Tower Fire…then and now. Using camera points to monitor postfire recovery
49	How to prepare a silvicultural prescription for uneven-aged management
50	Stand density conditions for Umatilla National Forest: A range of variation analysis
51	Restoration opportunities for upland forest environments of Umatilla National Forest
52	New perspectives in riparian management: Why might we want to consider active management for certain portions of riparian habitat conservation areas?
53	Eastside Screens chronology
54	Using mathematics in forestry: An environmental education activity
55	Silviculture certification: Tips, tools, and trip-ups
56	Vegetation polygon mapping and classification standards: Malheur, Umatilla, and Wallowa-Whitman National Forests
57	State of vegetation databases on Malheur, Umatilla, and Wallowa-Whitman National Forests
58	Seral status for tree species of Blue and Ochoco Mountains

REVISION HISTORY

June 2010: Since its inception in May of 2001, this white paper was revised at least half a dozen times, but no specific revision history was maintained because a 'revision history' convention was not instituted until the Umatilla NF developed a new white-paper protocol. Many white papers are designed for internal (Forest Service) use, but this white paper was designed specifically to be used with publics (stakeholders), some of whom do not understand what silviculture is, what duties are performed by a silviculturist, and why silvicultural practices are implemented as they are.

It was also designed to show trends for major silvicultural activities, such as acres of reforestation, stand examination, noncommercial thinning, and other practices accomplished each year. This is one reason for its frequent updates – every few years, it was revised to include the most recent silvicultural accomplishments.

February 2017: For this revision, editing changes were made to the text (only one chart was revised), the white-paper header (first page) was added, and the white-paper appendix and revision history sections were added. Note that none of the silvicultural activity trend charts were updated during this revision because the author is retired and no longer has access to the accomplishment information.