Silvicultural Activities in Pringle Falls Experimental Forest, Central Oregon

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Abstract—*Pringle Falls Experimental Forest has been a center for research in ponderosa pine forests east of the crest of the Cascade Range since 1931. Long-term research facilities, sites, and future research opportunities are currently at risk from stand-replacement wildfire because of changes in stand structure resulting from past fire exclusion. At the same time, many of the special values are increasingly at risk from recreational impacts and nearby urban development. We describe the special values associated with ponderosa pine (*Pinus ponderosa *Dougl. ex Laws.) stands in the Experimental Forest, we present our rationale for a series of treatments, and we discuss implementation of a set of silvicultural prescriptions designed to protect and enhance the special values of Pringle Falls Experimental Forest.*

Introduction

Experimental forests and ranges constitute a national network of outdoor laboratories designated by the U.S. Department of Agriculture, Forest Service for the express purpose of providing sites for research. They have a rich legacy of providing information to guide forest management activities. Experimental forests provide a unique research platform from which to address forest management questions at various scales and offer an important advantage for collaborative research. Pringle Falls Experimental Forest (hereafter Pringle Falls) (lat. 43°42' N, long. 121°37' W), within the Deschutes National Forest in central Oregon and 48 kilometers (30 miles) southwest of Bend, Oregon (figure 1), is a center for silviculture, forest management, and insect and disease research in ponderosa pine (*Pinus ponderosa* Dougl. ex Laws.) forests east of the Oregon Cascade Range. The 4477-hectare (11,055-acre) experimental forest is maintained by the Pacific Northwest Research Station, in cooperation with the Pacific Northwest Region and Deschutes National Forest, for research in ecosystem structure and function and demonstration of management techniques.

Pringle Falls is the oldest experimental forest and the site of some of the earliest forest management and silviculture research in the Pacific Northwest. Thornton T. Munger, first Director of the Pacific Northwest Research Station (then Experiment Station), and colleague and long-time friend of Gifford Pinchot, first Chief of the Forest Service, selected the site in 1914. It was formally established as a unit of the national network of experimental forests on May 20, 1931. Headquarters buildings were constructed between 1932 and 1934. Within Pringle Falls lies a two-unit Research Natural Area, established for non-manipulative research in 1936.

The eastside forests of Oregon are replete with special places ranging from mountain peaks shaped by fire and ice to rivers cutting through lava

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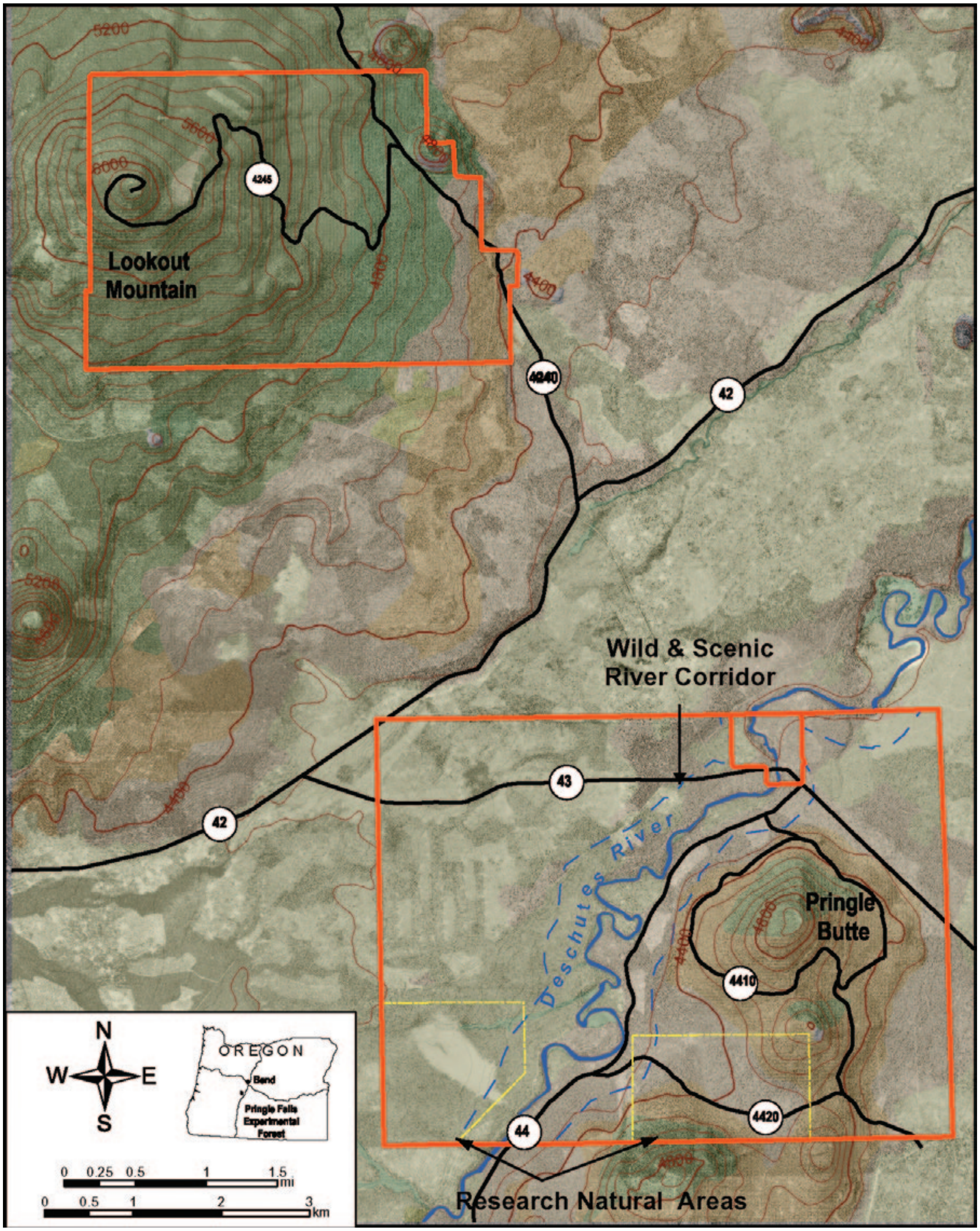

Figure 1—The Lookout Mountain and Pringle Butte Units of Pringle Falls Experimental Forest, located on the Deschutes National Forest southwest of Bend, Oregon. Also indicated are units of the Research Natural Area and a Wild and Scenic River corridor along the Deschutes River.

tubes and basalt beds. The ponderosa pine forests within Pringle Falls Experimental Forest, however, represent special places with unique values: their location within the context of environmental and historical settings, the resource outputs they have provided and the resource values they continue to provide, and the opportunities they afford to address current and future management issues of wildland resource management. In this paper, we (1) describe the special values associated with ponderosa pine stands in Pringle Falls, (2) present our rationale for developing a set of silvicultural prescriptions to protect and enhance these special values, and (3) discuss some unique features involved with implementing the silvicultural prescriptions within the experimental forest.

Special Values of Ponderosa Pine Stands in Pringle Falls Experimental Forest

We base our assignment of special value of ponderosa pine stands within Pringle Falls Experimental Forest on four points. First, ponderosa pine stands in Pringle Falls have special value because they represent a disproportionate amount of remnant eastside old-growth ponderosa pine forests. Second, the administration site has special value because the ponderosa pine stand encompasses historic buildings that provide a link to the establishment and initial functioning of Pringle Falls. Third, ponderosa pine stands on Pringle Butte have special value because they are the sites of many historical and ongoing long-term studies. Finally, ponderosa pine stands surrounding Pringle Butte have special value because they uniquely provide opportunities for new landscape-scale research.

Special Value of Remnant Old-Growth Stands

Pringle Falls Experimental Forest exists as two separate but closely spaced units, each named for the dominant volcanic feature contained within the unit. Pringle Butte, the oldest known geologic formation in the Pringle Butte Unit, is a 5-million-year-old shield volcano rising to 1530 meters (5020 feet). Lookout Mountain, the highest point in the Experimental Forest at 1900 meters (6215 feet) in elevation, is a 300,000-year-old shield volcano. Both these features extend above a generally flat or gently rolling ancient lake basin with average elevation of 1280 meters (4200 feet) that is dotted with small volcanic peaks and cinder cones. Both units are characteristic of low- and mid-elevation portions of the High Cascades physiographic province (Franklin and Dyrness 1973). The Deschutes River, designated a Wild and Scenic River because of outstanding scenic and recreation values, flows northeasterly through the Pringle Butte Unit.

Soils in Pringle Falls are dominated by 0.5 to 2 meters (1.5 to 6 feet) of 6600-year-old aerially deposited pumice and ash from Mt. Mazama (now Crater Lake). More recent deposits are additional ash, pumice, and cinders from surrounding volcanic cones and sand and silt sediments of the La Pine basin, overlain with sands and gravels deposited by glacial outwash from the Cascade Range. Soils derived from Mt. Mazama pumice and ash have only a thin weathered surface layer. Most of the soil profile is undeveloped, with low organic matter content, low nitrogen, sulfur, and phosphorus content, and high porosity. Daytime to nighttime temperature variation within the soil profile can be extreme.

The climate is continental, modified by proximity of the Cascade Range to the west and the Great Basin desert to the east. Most precipitation occurs as snowfall. Annual precipitation averages 600 millimeters (24 inches) on Pringle Butte and over 1000 millimeters (40 inches) on Lookout Mountain. Daytime high temperatures in the summer range between 21 and 32 degrees Celsius (70 and 90 degrees Fahrenheit). Summer nights are cool and frosts can occur throughout the growing season.

Forest communities within Pringle Falls are representative of low- and mid-elevation regional landscapes and contain outstanding examples of undisturbed and managed ponderosa pine, lodgepole pine (*Pinus contorta* Dougl. ex Loud.) and higher elevation mixed conifer forests common throughout central and south-central Oregon. Ecological site differences such as aspect and elevation, and past disturbance events, especially fires, insects, and diseases, and more recent timber harvesting, have created a mosaic of rich biological diversity. Ponderosa pine is the dominant conifer throughout most of Pringle Falls. Shrub layers associated with ponderosa pine include antelope bitterbrush (*Purshia tridentata* (Pursh) DC.), snowbrush ceanothus (*Ceanothus velutinus* Dougl. ex Hook.), greenleaf manzanita (*Arctostaphylos patula* Greene), giant chinquapin (*Chrysolepis chrysophylla* (Dougl. ex Hook.) Hjelmqvist), and pinemat manzanita (*Arctostaphylos nevadensis* Gray).

Ponderosa pine forests east of the crest of the Cascade Range in the Pacific Northwest, including those in Pringle Falls, have undergone dramatic physiognomic changes in the last 100 years. Early settlers and surveyors at the beginning of the 20th century passed through open forests of ponderosa pine with widely spaced trees, few if any down logs, and little litter and woody undergrowth (Bonnickson 2000; Languille and others 1903; Wickman 1992). Witness trees established during the late 1800s in central Oregon were predominantly ponderosa pine with diameters that exceeded 50 centimeters (20 inches) (Perry and others 1995). The stem pattern of these eastside forests was a seemingly uniform parkland of widely spaced medium to large and old trees and continuous herbaceous undergrowth (Agee 1994). Historical fire regimes in these forests consisted of very frequent to frequent, low-intensity fires that burned some or most forest floor plants, consumed litter, and killed primarily small trees (Agee 1993). A fire regime of low-intensity burns, coupled with infrequent large and more intense fires, was common prior to the advent of modern fire suppression efforts. Estimated mean fire return interval was 4 to 11 years within Pringle Falls (Bork 1984; Morrow 1986).

Current amounts of eastside old-growth ponderosa pine forest are estimated to range from 3 to 15 percent of pre-settlement levels (Beardsley and others 1999; Bolsinger and Waddell 1993; Everett and others 1994; Hann and others 1997; Perry and others 1995). Decline in the overall extent of eastside old-growth ponderosa pine forest can be attributed to changes in natural disturbance regimes resulting from active management programs for fire suppression, livestock grazing, selective logging of old fire-resistant trees for timber and insect control, and extensive road building (Bergoffen 1976; Johnson and others 1994; Oliver and others 1994). Pringle Falls is one of the few remaining places where old-growth ponderosa pine forests endure; about 2145 hectares (5300 acres) of old-growth ponderosa pine remain within the experimental forest. Individual dominant ponderosa pine in these stands range from 250 to 620 years in age (data on file, PNW Research Station, LaGrande, Oregon). With effective fire exclusion, understory tree density in these remaining ponderosa pine stands has increased, however, and these stands often contain more fire-intolerant species such as lodgepole pine, Douglas-fir, and grand fir. With the exception of stands recently treated, old-growth ponderosa pine stands are multilayered, contain a variety of size classes, and are greatly overstocked with small-diameter stems. The smaller, younger trees compete for site resources with residual old-growth trees and often lead to mortality of the older and larger diameter trees. Multilayered stands also contain increased number of fuel ladders and greater ground fuels. Consequently, the old-growth stands are at greater risk of stand-replacement wildfire.

Thus, Pringle Falls is a special place because of the disproportionate amount of old-growth ponderosa pine forests it contains.

Special Value of the Administration Site

The administration site at Pringle Falls Experimental Forest consists of 10 hectares (25 acres) on the north bank of the Deschutes River in the Pringle Butte Unit. Original headquarters buildings consist of a three-story administration building and a single-story cottage constructed between 1932 and 1934 by Works Progress Administration (WPA) craftsman. These buildings are excellent examples of the period architecture and rustic rock, log, and frame construction. Later, an additional two-story dormitory, a garage/shop complex, and various outbuildings were added. This infrastructure provides seasonal living and working conditions for about 20 people.

The ponderosa pine stand surrounding the buildings at the administration site has been continuously protected from fire since the early 1930s and, like other ponderosa pine stands that have had fire exclusion, has undergone dramatic changes in structure and composition. Near the turn of the 20th century, 40 to 70 large pines per hectare (16 to 28 per acre) comprised the overstory, with only a few stems in the understory. With fire exclusion, the number of small diameter ponderosa and lodgepole pine saplings increased to a stand density of over 2000 trees per hectare (810 trees per acre). Contiguous fuels represented by decadent antelope bitterbrush, ponderosa pine needle drape, and abundant ladder fuels also increased dramatically. These conditions represent a high risk for stand replacing wildfire, with the first fire likely a high intensity crown fire that would be difficult to control and would likely endanger crews living and working in the headquarters buildings.

Thus, the administration site has special value because the ponderosa pine stand encompasses historical buildings that provide a link to the establishment and initial functioning of Pringle Falls and represent fine craftsmanship from the WPA era.

Special Value of Research Sites on Pringle Butte

Pringle Falls Experimental Forest has a rich history of serving as a diverse natural laboratory used by university and federal scientists for field research. Descriptions of past work from establishment through the early 1990s have been chronicled in an annotated bibliography (Youngblood 1995). Some of the earliest forestry research in central and eastern Oregon occurred within Pringle Falls. A large number of these early studies were located on or immediately adjacent to Pringle Butte (figure 2). The earliest known published work was a rating system for determining the susceptibility of ponderosa pine trees to western pine beetle attack by F. Paul Keen (1936). Keen later documented the age-class distribution in several stands on Pringle Butte, including stands with stems having establishment dates of 1330 A.D. (Keen 1940). One of the earliest silvicultural studies was a test of cutting methods with different intensities of selection, initiated in 1937 along the northeast slope of Pringle Butte (Kolbe and McKay 1939). Later, Edwin L. Mowat described the stand structure and analyzed periodic growth measurements for suppressed ponderosa pine seedlings that were released from a lodgepole pine canopy (Mowat 1950). And at the same time, James Sowder conducted one of the earliest studies combining the objective of sanitation and salvage of ponderosa pine, judged to be highly susceptible to insect attack, with the objective of fuel and fire hazard reduction (Sowder 1951). Contributions such as these added greatly to management of ponderosa pine forests throughout eastside forests

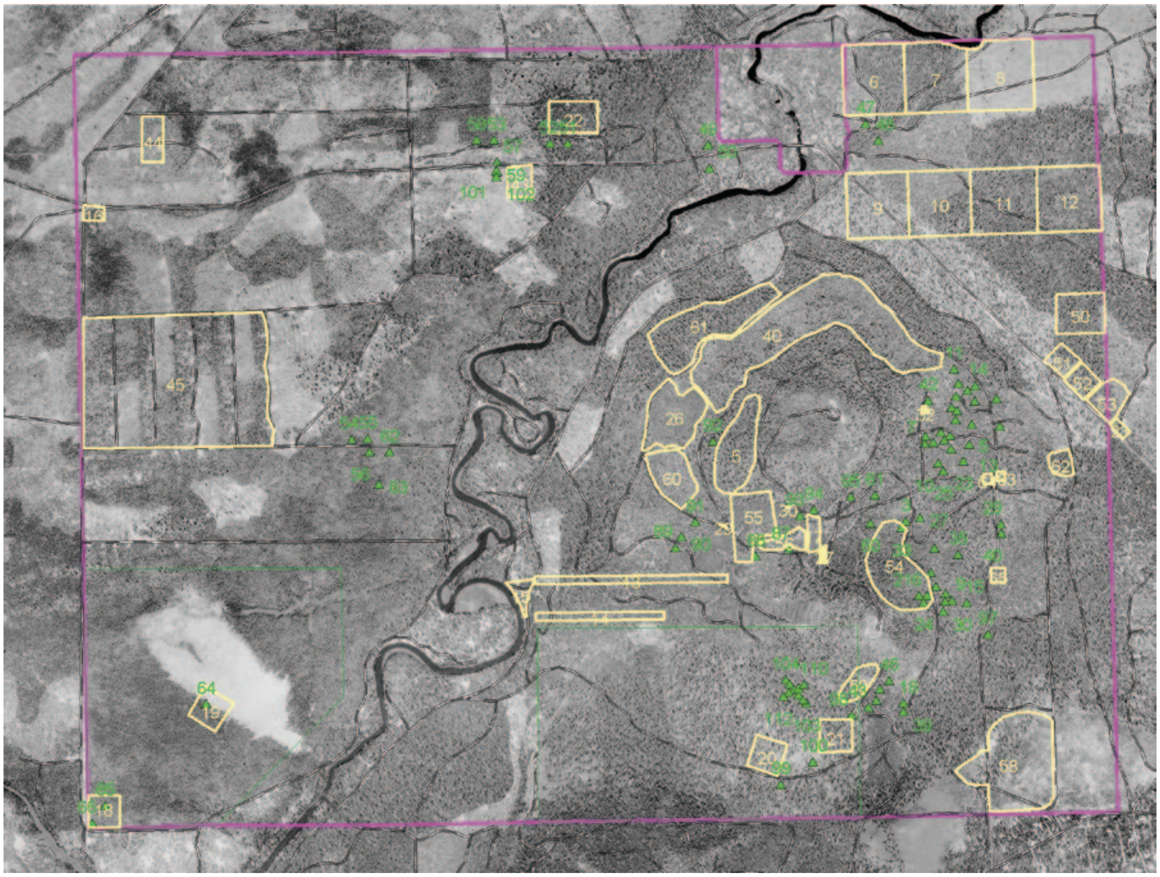

Figure 2—Historical and ongoing research sites, either mapped portions of stands (shown in yellow) or mapped points (shown in green) in the Pringle Butte Unit, Pringle Falls Experimental Forest.

of Oregon and Washington at a time when vast segments of these forests were being harvested to meet society's increasing demands for lumber products.

During the next several decades, studies that were established on Pringle Butte concentrated on determining the competitive effect of shrubs growing with ponderosa pine (Barrett 1965; Dahms 1961); the soil thermal properties, surface temperatures, and seed bed characteristics required for lodgepole and ponderosa pine regeneration from natural seedfall (Barrett 1966; Dahms and Barrett 1975); the biology of dwarf mistletoe in ponderosa pine, its spread, and subsequent damage in understory pine (Roth 1953, 1971; Roth and Barrett 1985); and the effect of underburning on dwarf mistletoe in ponderosa pine (Koonce and Roth 1980). During this time, logging methods that ensured survival of existing seedlings and saplings were developed, thus reducing future reforestation efforts and costs (Barrett 1960). Long-term or permanent research plots were established to study the response of ponderosa pine to fertilization (Cochran 1977), and the release and subsequent growth of ponderosa pine at various tree densities (Barrett 1982; Dahms 1960; Oren and others 1987). Periodic evaluation of these stands added to our understanding of structural changes occurring in natural and managed stands. Also, the frequency, intensity, and spatial patterns of wildfire in old-growth ponderosa pine stands near the top of Pringle Butte were examined (Bork 1984; Mazany and Thompson 1983; Morrow 1986).

Work extending through the 1990s emphasized the relationship between ponderosa pine vigor and mountain pine beetle attacks (Larsson and others 1983); the effect of fire on root decay in ponderosa pine and the occurrence of fungal microflora on burned and unburned sites (Reaves and others

1990); and the cyclic population dynamics of Pandora moth (*Coloradia pandora* Blake), an important defoliator of ponderosa pine (Speer and others 2001). Although much of the long-term research in applied forestry has continued over the years, such as identification of optimal growing regimes for planted pine (Cochran and others 1991), other topics have increased in importance. Current research on Pringle Butte is designed to increase our understanding of the processes that regulate or influence the structure, composition, and pattern of forests and that are critical for the maintenance of diverse, healthy, productive, and sustainable forest ecosystems.

Thus, the Pringle Butte portion of Pringle Falls has special value because of the concentration and legacy of historical and ongoing research sites.

Special Value of New Research Opportunities

Pringle Falls Experimental Forest was established and continues to be managed *a priori* for research and demonstration. One example of research and demonstration identified within the Pacific Northwest Research Station's strategic research planning process is the need to evaluate practices and strategies to better manage risks within the wildland/urban interface. A critical component in establishing a mutually acceptable active management strategy in the area where residential development and wildlands share boundaries is the ability to assess risk of wildland fire moving from the surrounding forest into urban areas in combination with the ability to assess risk of fire originating from the urban setting moving out into the adjacent wildlands. Additional components include the needs to develop and test operational practices and techniques and to evaluate strategies for reducing fuels to manage risks within the wildland/urban interface. Research is needed to assess how silvicultural treatments affect fire risk, stand structure, wildlife habitat, and the risk of other disturbances such as insect outbreaks and invasion by nonnative plants, as well as how treatments influence the social values held by forest users and conditions of local communities. Evaluating management choices at the wildland/urban interface is limited by both inadequate technical knowledge of the effects of treatments, such as prescribed fire or surrogates such as thinning, mowing, or crushing, and also by public resistance to these treatments or to perceived resulting conditions. There also are economic tradeoffs associated with short- and long-term solutions to fire risk reduction activities on both public and private lands, which include initial costs of treatment, employment opportunities, and their attendant impacts on economic well-being, as well as the potential repeated treatment needs and property value considerations. There is a need to identify factors that influence acceptability of wildland fuel reduction strategies and underlying decision-making processes. This includes improved understanding of public knowledge, preferences, and understanding of tradeoffs and opportunities for mutual gains, and also understanding of effectiveness of alternative approaches to enhance public understanding and knowledge of wildland management.

Pringle Falls represents a unique place to conduct such research because of its proximity to the wildland/urban interface and the high number of forest visitors passing through, especially those using the paved highway to the higher Cascade lakes or boating on the Deschutes River. Pringle Falls could play a pivotal role in focusing attention from various research disciplines and resource managers on a set of operational methods for fuels reduction in the ponderosa pine stands surrounding Pringle Butte, on the role various partnerships may play across multiple ownerships including the wildland/urban interface, and on the environmental and social consequences of the various methods. Thus, the ponderosa pine stands surrounding Pringle Butte at Pringle Falls have special value because they uniquely provide opportunities for new landscape-scale research.

Silvicultural Prescriptions for Special Places: The Dilman Project

Discussions among Research Station scientists and personnel on the Bend/Fort Rock District of the Deschutes National Forest resulted in agreement on the special values of ponderosa pine stands in Pringle Falls Experimental Forest, a set of risks associated with each special value, and the need to develop and apply silvicultural prescriptions to maintain and protect the values. These values and their needs include the following:

- Pringle Falls has special value because of the disproportionate amount of old-growth ponderosa pine forest it contains. Silvicultural prescriptions are needed to restore the frequency of low-intensity disturbances and thus the resulting periods of stability in these stands. Prescriptions are needed to protect these remnant old-growth stands and individual trees from stand-replacement disturbances.
- The administration site at Pringle Falls has special value because the ponderosa pine stand encompasses historical buildings that provide a link to the establishment and initial functioning of the experimental forest and represent fine craftsmanship from the WPA era. Because the site continues to be used in support of ongoing research, there is a need to provide a safe working environment for occupants. Silvicultural prescriptions are needed to reduce the fuels and reduce the risk of stand-replacement fire within the administration site in order to protect the historical buildings and protect the lives of those using the buildings.
- Pringle Butte in Pringle Falls has special value because of the concentration and legacy of historical and ongoing research sites. This portion of the experimental forest is bordered on three sides by urban development or dense recreation sites. Recently, fires started in the wildland/urban interface or within recreation sites along the Deschutes River threatened ponderosa pine stands and research sites contained within them on Pringle Butte. Silvicultural prescriptions are needed to reduce the risk of stand replacement fires entering this area from surrounding areas in order to protect historical and ongoing research sites.
- Ponderosa pine stands surrounding Pringle Butte have special value because they uniquely provide opportunities for new landscape-scale research. One fundamental constraint to new research addressing fire risk within the wildland/urban interface, however, is that the once relatively homogeneous landscape surrounding Pringle Butte is fragmented into small stands as a result of past research and management actions. The current landscape provides little opportunity for large-scale operational studies with sufficient treatment replication. Silvicultural prescriptions are needed to modify existing stand structures and consolidate fragmented stands into larger blocks with similar structures such that large-scale operational fuels reduction practices and strategies to better manage risks within the wildland/urban interface may be evaluated.

Prescription Development

Consideration and analysis of silvicultural prescriptions for special places within Pringle Falls occurred within the context of the Dilman Environmental Assessment (EA) and the resulting Dilman project. Under National Environmental Policy Act guidelines, scoping for the Dilman Environmental Assessment began in July 1999. In addition to vegetation management, the environmental assessment addressed road closures and recreation management activities within Pringle Falls. It was completed in December 2001.The environmental assessment is tiered to several layers of management direction that guided the development of project alternatives and prescription development. Existing management direction was provided by:

- Deschutes Land and Resource Management Plan (DLRMP), 1990, and the Regional Forester's Forest Plan Amendment #2, 1995. Within the DLRMP, Pringle Falls is identified as a single management area with specific standards and guidelines for managing resource values. The Regional Forester's Plan Amendment, known as "Eastside Screens," established a policy restricting harvest of trees greater than 53 centimeters (21 inches) in diameter at breast height (DBH). The DLRMP also provided direction for visual concerns along major paved travel-ways.
- Inland Native Fish, 1995. Interim Riparian Habitat Conservation Area applied to the Deschutes River. This policy established a buffer on either side of the river extending outward from the edge of the active stream channel 91 meters (300 feet), within which timber harvesting, including fuelwood cutting, is prohibited except where silvicultural practices are needed to attain desired vegetation characteristics to meet riparian management objectives. Under the Dilman Environmental Assessment, silvicultural practices were carefully considered to avoid adverse effects on inland native fish and included the use of horses for skidding and locating treatment boundaries away from the slope break to prevent sediment from entering the river.
- The Upper Deschutes Wild and Scenic River Final Environmental Impact Statement, 1996. Superimposed on Pringle Falls is a 1.6-kilometer-wide (1-mile) corridor, centered on the Deschutes River, within which management direction emphasizes protection of the outstanding scenic and recreation values.

The Dilman Project focused on the following four objectives:

- Implement the Upper Deschutes Wild and Scenic River Environmental Impact Statement for segment 2 of the river to meet stated goals for protection and enhancement of outstanding scenic and recreation values, and thus protect the special values of old-growth ponderosa pine stands and individual trees (special value 1).
- Provide defensible space along wildland/urban interfaces, especially the administration site, private in-holdings on the north side of the Pringle Butte unit, and the urban interface immediately to the east of Pringle Falls (special value 2).
- Provide defensible space along major travel corridors that access National Forest land, especially roads on either side of the Deschutes River that serve as key access corridors through Pringle Falls, thus protecting the special values of historical and long-term research sites concentrated on Pringle Butte (special value 3).
- Enhance the special values of existing old-growth ponderosa pine stands and create options for future research within Pringle Falls by concentrating

treatments around the base of Pringle Butte to restore old-growth conditions and processes (special value 4).

A mix of vegetative treatments was developed that addressed these objectives. Because many of the stands were multistructured, contained a variety of size classes, and differed greatly in composition, density, and past history, various treatments with multiple entries were determined necessary to achieve desired conditions. Although the Dilman Project specifically addresses about 746 hectares (1844 acres) within Pringle Falls, it also addresses stands with similar needs and treatments in proximity to the experimental forest. Within Pringle Falls, about 471 hectares (1164 acres) will receive commercial thinning, about 85 hectares (185 acres) will receive noncommercial thinning, and about 200 hectares (495 acres) will have fuel reduction from prescribed broadcast burning, hand piling and burning, mowing, mechanical mastication, or some combination of fuel treatments. In the old-growth ponderosa pine stands surrounding Pringle Butte, commercial thinning of 13- to 53-centimeter (5- to 21-inch) DBH ponderosa pine, at roughly 6- by 6-meter (20- by 20-foot) spacing with retention of natural clumping, will reduce stand density, disaggregate fuel continuity, and decrease fuel ladders. No ponderosa pines over 53 centimeters (21 inches) DBH will be removed. All large lodgepole pines, however, will be removed, further reducing stand density and fuel loadings. Along the river corridor, all lodgepole pines greater than 8 centimeters (3 inches) DBH will be commercially thinned, with a subsequent noncommercial thin at 3.3-meter (11-foot) spacing to follow. To begin developing open stand structures along highly visible paved travel ways, ponderosa pines in the 13- to 53-centimeter (5- to 21-inch) DBH class will be commercially thinned, again retaining all existing natural clumping, and all lodgepole pines will be removed through a series of commercial and noncommercial thinnings. Noncommercial thinning of ponderosa and lodgepole pines will occur in areas of previous harvest activity such as old clearcuts and fire and beetle-kill salvage areas to reduce fuels and accelerate residual tree growth. Finally, fuel reduction in areas of previous harvest, in areas of commercial or noncommercial thinning, or as an activity by itself, may include slashing, hand piling, mowing, mechanical mastication, or prescribed burning either singly or in combination with other fuel reduction methods. When fully applied, the silvicultural prescriptions collectively represent a significant amount of vegetation management treatments within Pringle Falls (figure 3) while addressing the four identified special values.

Prescription Projection

We used the southeast Oregon variant of Forest Vegetation Simulator (FVS), coupled with the Stand Visualization System (SVS) to model and project the effects of our prescriptions into the future. For each of the stands modeled, the following assumptions applied:

- Marking prescriptions are fully met 90 percent of the time.
- The shrub layer is treated concurrently with activity fuel reduction treatments.
- Natural regeneration of ponderosa and lodgepole pines occurs on a frequent but nonuniform basis; only ponderosa pine establishment and growth was modeled.
- A single noncommercial thinning after commercial thinning is more realistic than frequent noncommercial thinnings given budget constraints;

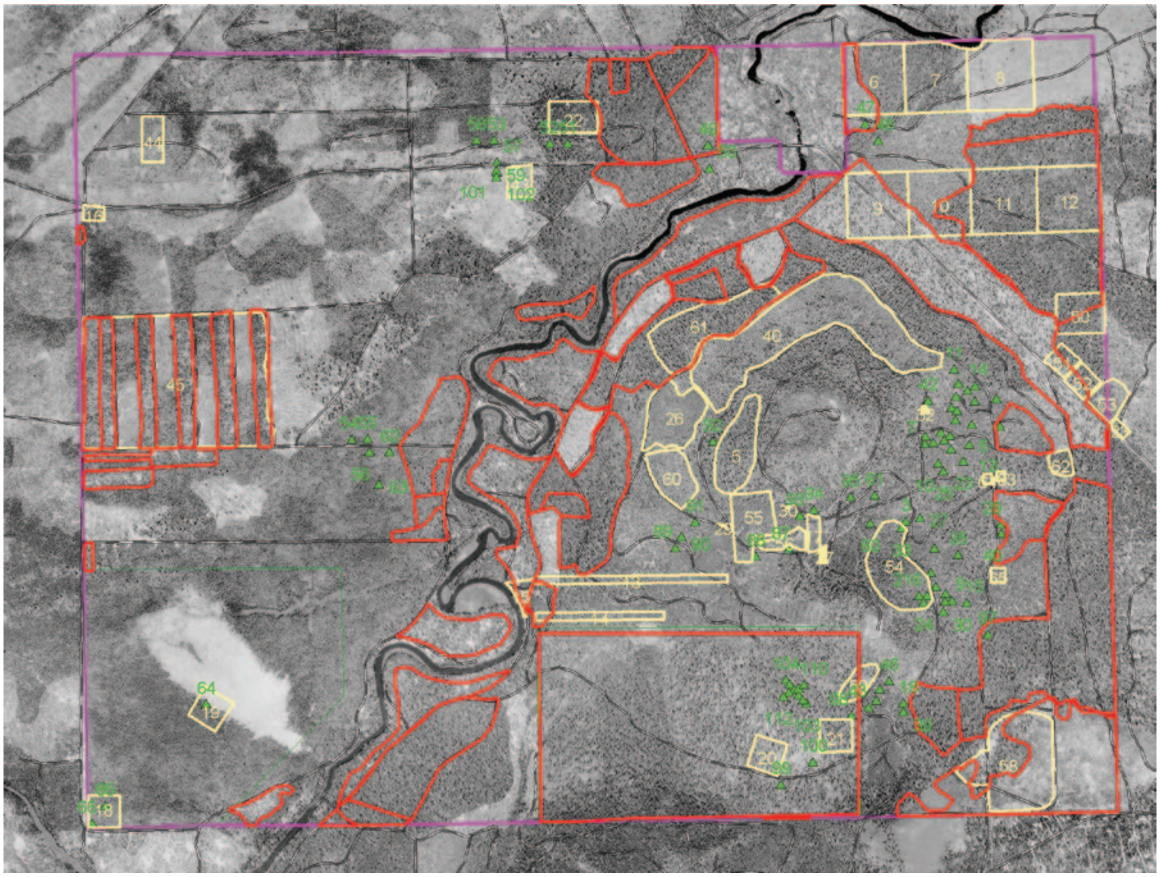

Figure 3—Commercial thinning, noncommercial thinning, and fuel reduction units of the Dilman project (shown in red), overlapped with historical and ongoing research sites (shown in yellow or green) in the Pringle Butte Unit, Pringle Falls Experimental Forest.

this suggests that prescribed fire in subsequent years may serve as a surrogate for additional noncommercial thinning.

- Prescribed fire will be applied after each initial commercial thinning treatment, 15 years after the initial treatment and then conservatively, at 20-year intervals through the remaining 100-year timeframe.

Model outputs were initially configured for 5-year cycles to more accurately account for initial prescribed fire and initiation of natural regeneration of ponderosa pine.

As one example of prescription application and projection, we present graphical representations of structural changes in stand 904. In 2000, this stand consisted of about 2000 ponderosa pine trees per hectare (806 per acre) and 900 lodgepole pines per hectare (363 per acre) (figure 4). Although most of the basal area was in large-diameter ponderosa pine, most of the density was in small-diameter ponderosa and lodgepole pine. Less than 15 ponderosa pines per hectare (6 per acre) were greater than 53 centimeters (21 inches) DBH. Total basal area was about 24 square meters per hectare (106 square feet per acre). Commercial thinning is projected to reduce the density to about 1790 ponderosa pine trees per hectare (726 per acre) and eliminate most of the standing lodgepole pine (table 1). The first prescribed fire is scheduled as a broadcast underburn in 2005; this treatment is projected to eliminate all lodgepole pines that escaped the initial

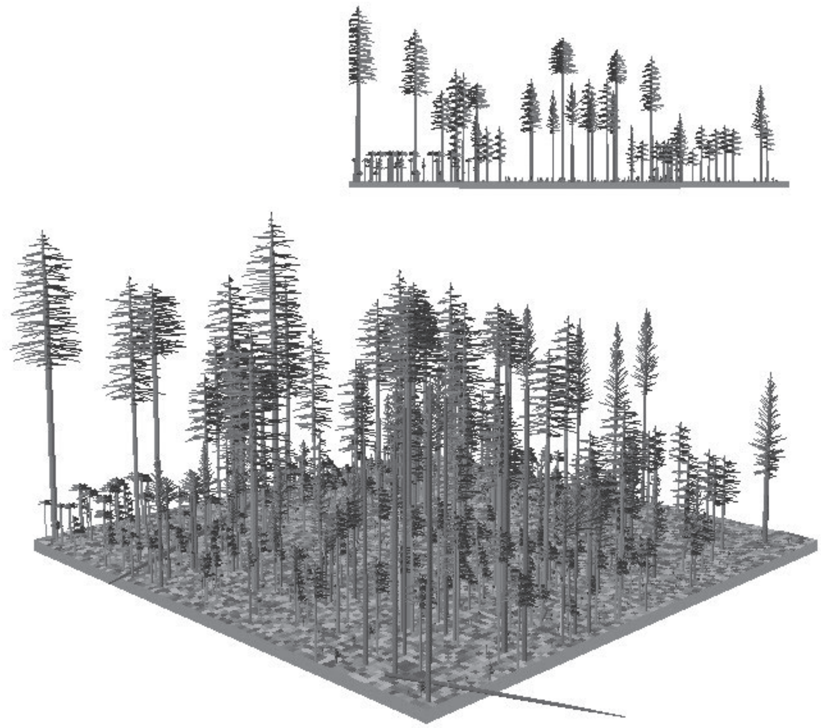

Figure 4—Graphical representation of initial structural conditions in stand 904, designated for commercial thinning and broadcast burning as part of the Dilman project in Pringle Falls Experimental Forest.

Table 1—Change in structural features for stand 904 projected with FVS/SVS.

Year	Density	Percent of maximum stand density index	Quadratic mean diameter	Basal area	Treatment and target
	Trees/hectare (trees/acre)		Centimeters (inches)	Square meters (square feet)	Trees/ha (trees/acre)
2000	2877 (1165)	30	11.7 (4.6)	30.9 (134.4)	Thin,1793 (726)
2005	1793 (726)	23	11.7 (4.6)	19.2 (83.8)	Burn, 321 (130)
2020	442 (179)	24	23.9 (9.4)	19.0 (82.6)	Burn, 193 (78)
2040	230 (93)	25	33.8 (13.3)	20.6 (89.7)	Burn, 131 (53)
2060	175 (71)	26	39.9 (15.7)	21.9 (95.4)	Burn, 106 (43)
2080	151 (61)	28	43.9 (17.3)	22.9 (99.6)	Burn, 94 (38)

thinning and to reduce the stand density to about 321 ponderosa pines per hectare (131 per acre) (figure 5). Subsequent underburnings are scheduled at 20-year intervals to control establishment of lodgepole pine, to gradually reduce density, and to restrain down woody fuels and live shrubs. After five underburns, overall density is projected to be about 94 trees per hectare (38 trees per acre), consisting almost entirely of large-diameter, widely spaced old-growth ponderosa pine (figure 6).

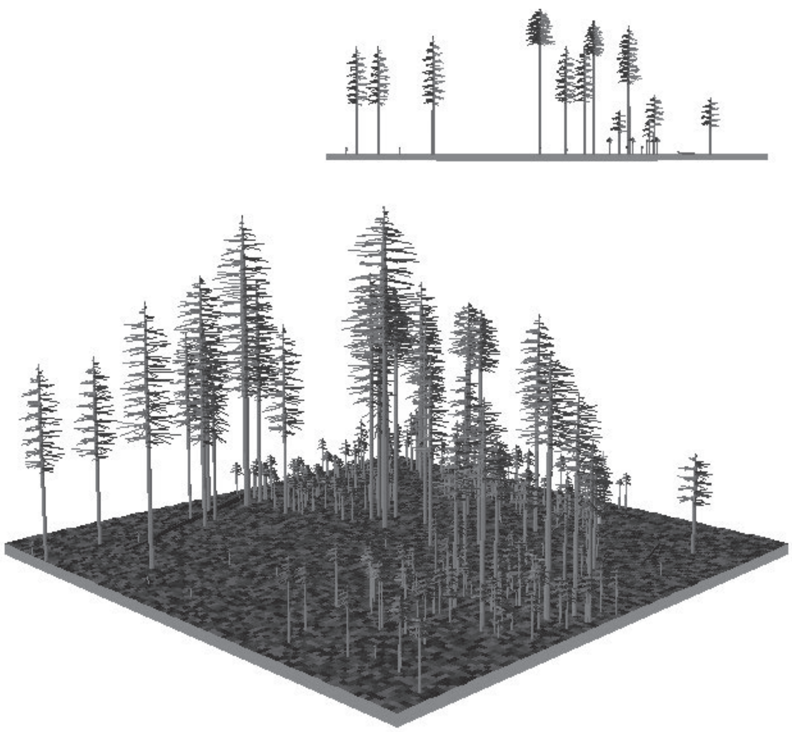

Figure 5—Graphical representation of structural conditions in stand 904 projected for the year 2005, after commercial thinning and initial broadcast burning as part of the Dilman project in Pringle Falls Experimental Forest.

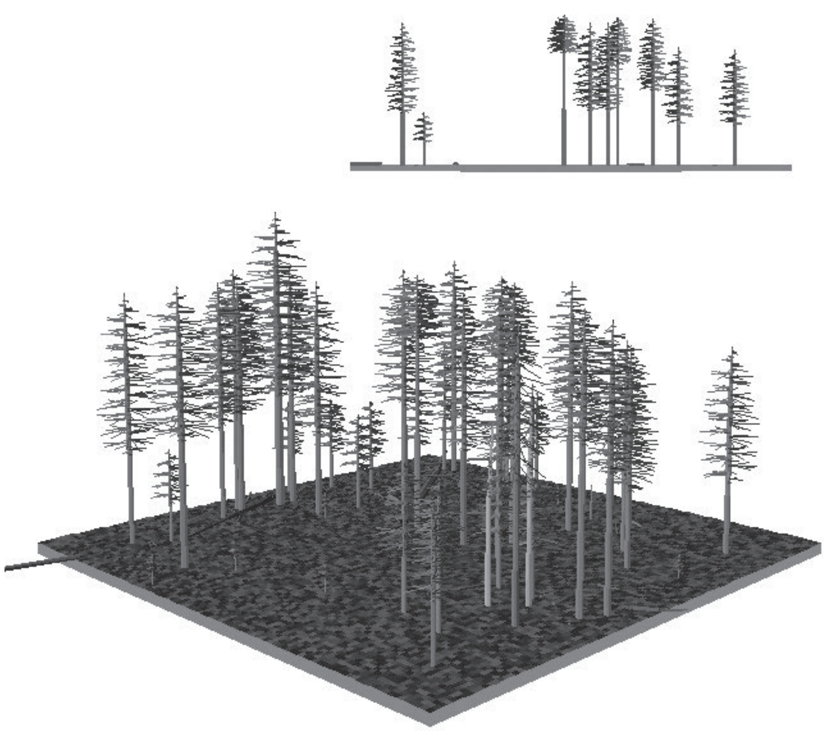

Figure 6—Graphical representation of structural conditions in stand 904 projected for the year 2080, after the initial commercial thinning and broadcast burning followed by four broadcast burnings, as part of the Dilman project in Pringle Falls Experimental Forest.

Implementation of Prescriptions for Special Places

Treatment implementation in Pringle Falls began with the administration site. While initially considered within the Dilman Environmental Assessment, a categorical exclusion was written to assess treatment on the 10 hectares (25 acres) of the administration site separately from the rest of the Dilman project in order to take advantage of PNW Station facilities maintenance funds. The categorical exclusion was based on Forest Service Policy and Procedure Handbook 1909.15 that provides for routine operation and maintenance of administration sites and was signed in February of 2000. Treatment of the administration site consisted of a single commercial timber sale of 30,000 board feet, hand thinning of trees around the buildings, pruning of dwarf mistletoe-infested limbs, hazard tree removal, hand-piling and burning of slash, and broadcast burning of the shrub layer. Work in the administration site began in March 2000 and was completed in October 2001. This stand now contains about 25 large pines per hectare (10 per acre) with DBH greater than 53.3 centimeters (21 inches). Total stand density is about 247 trees per hectare (100 per acre), basal area is 22.1 square meters per hectare (96.4 square feet per acre), and stand density index is 40 percent of maximum (figure 7).

Outside of the administration site, four separate types of timber sale contracts (2400-1, 2400-3, 2400-4, 2400-6), service contracts, purchase

Figure 7—Pringle Falls Experimental Forest administration area after thinning and underburning for fuels reduction.

orders, and force account crews are being used to implement the silvicultural prescriptions within the Dilman project. Work began in the spring of 2002. All activities associated with the first entry are planned for completion by spring 2009. High fuels areas within the wildland/urban interface, administrative sites, campgrounds, and major access roads represent the highest priorities and will be completed first.

Operational Considerations

To address concerns for fisheries during the treatments along the Deschutes River within Pringle Falls, thinning within 91 meters (300 feet) of the bank involves a combination of hand crews, including those from local Youth Conservation Corps, Oregon State Department of Correction, Deschutes County Corrections, force account crews from the Deschutes National Forest, and troubled youth programs, in addition to service contracts and a contract for horse logging.

Selection of horse logging as a means for skidding of logs within the designated buffer along the Deschutes River was based, in part, on a desire to prevent opening or creating additional areas for nondesignated, dispersed recreational camping. Conventional ground-based skidding operations require a network of designated skid roads. On the flat benches adjacent to the Deschutes River, these designated skid roads are slow to revegetate with trees and shrubs and quickly become permanent access roads to desirable dispersed recreation campsites along the river. In addition, horse logging has been used over the last decade in campgrounds and other recreational sites on the Deschutes National Forest to remove hazard trees and has been well received by the public and public interest groups as an environmentally sensitive means of treatment. We anticipated greater public support for this part of the Dilman project if horse logging was featured. Material removed during horse logging consisted of lodgepole pine greater than 15 centimeters (6 inches) in diameter under a 2400-3 contract. This diameter limit was set in part because of the potential for the combination of products removed to generate positive net revenue for the operator, and the feasibility of hand piling the residual stems. Local experience has shown that the upper limit in piece size for most hand crews is about 23 centimeters (9 inches) DBH. Production rates for horse logging on the gentle terrain average about 2,000 to 4,000 board feet per day depending on factors such as skidding distance, average volume per log, volume per acre, and stand density. Brush disposal deposits collected from the purchaser are used to fund piling of slash by hand crews.

One large sale designed to remove about 1.04 million cubic feet (about 5.4 million board feet) from Pringle Falls was sold under a 2400-6T contract (tree measurement contract) with minimum specifications for merchantable trees of 8 centimeters (3 inches) DBH for lodgepole and ponderosa pine. Again, harvesting is restricted to trees less than 53 centimeters (21 inches) DBH. Final bid price was $35.75 per hundred cubic feet for lodgepole pine and $118.58 per hundred cubic feet for ponderosa pine. To minimize damage on residual vegetation and soils, the contract requires a boom-mounted saw/shear with a reach of at least 5 meters (17 feet) from the equipment center point. Other requirements include the use of designated skid roads at 30.5- meter (100-foot) average spacing and moving logging equipment over snow and frozen ground. Brush disposal deposits and whole-tree yarding ensure adequate treatment of slash. Minimal residual stand damage associated with whole-tree yarding is anticipated because of the flat topography across harvest units, which minimizes the need for sharp turns during skidding, and the relatively short tree lengths being harvested.

Post-sale service contracts for noncommercial thinning and removal of damaged and unsuitable trees are scheduled in all commercial timber sale units. Service contracts will use a variety of funding sources including hazardous fuels, Knutsen-Vandenberg Act (KV), and appropriated timber stand improvement thinning. Service contracts and purchase orders also will be used to conduct noncommercial thinning in stands that have little or no commercial size material.

Force account crews will be used to conduct prescribed burns, prune, dispose of brush, establish road closures, and rehabilitate dispersed recreation sites and designated campsites within Pringle Falls.

Summary

Pringle Falls Experimental Forest has been a center for research in ponderosa pine forests east of the crest of the Cascade Range since 1931. Long-term research facilities, sites, and future research opportunities are currently at risk from stand-replacement wildfire because of changes in stand structure resulting from past fire exclusion, especially the dramatic changes in tree density and establishment of lodgepole pine under ponderosa pine. We identified four conditions or locations within Pringle Falls that represent special values that are increasingly at risk from fire because of the structural changes either within the stands themselves or in adjacent stands that receive recreational impacts or urban development. Our set of silvicultural prescriptions is designed to protect and enhance these four special values. Implementation of the silvicultural prescriptions involves innovative use of existing contracting and workforces. To date, results have been well received by the visiting public.

References

Agee, James K. 1993. Fire ecology of Pacific Northwest forests. Washington, DC: Island Press. 493 p.

Agee, James K. 1994. Fire and weather disturbances in terrestrial ecosystems of the eastern Cascades. Gen. Tech. Rep. PNW-GTR-320. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 52 p.

Barrett, James W. 1960. Intensive control in logging ponderosa pine. Iowa State Journal of Science. 34: 603-608.

Barrett, James W. 1965. Spacing and understory vegetation affect growth of ponderosa pine saplings. Res. Note PNW-27. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 8 p.

Barrett, James W. 1966. A record of ponderosa pine seed flight. Res. Note PNW-38. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 5 p.

Barrett, James W. 1982. Twenty-year growth of ponderosa pine seedlings thinned to five spacings in central Oregon. Res. Pap. 301. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 18 p.

Beardsley, Debby; Bolsinger, Charles; Warbington, Ralph. 1999. Old-growth forests in the Sierra Nevada: by type in 1945 and 1993 and ownership in 1993.

Res. Pap. PNW-RP-516. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 46 p.

Bergoffen, W. W. 1976. 100 years of Federal forestry. Info. Bull. 402. Washington, DC: U.S. Department of Agriculture, Forest Service. 200 p.

Bolsinger, Charles L.; Waddell, Karen L. 1993. Area of old-growth forests in California, Oregon, and Washington. Resource Bull. PNW-RB-107. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 26 p.

Bonnicksen, Thomas M. 2000. America's ancient forests–from the ice age to the age of discovery. New York: John Wiley and Sons, Inc. 594 p.

Bork, Joyce L. 1984. Fire history in three vegetation types on the eastern side of the Oregon Cascades. Ph.D. thesis. Corvallis, OR: Oregon State University. 94 p.

Cochran, P. H. 1977. Response of ponderosa pine 8 years after fertilization. Res. Note PNW-301. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 7 p.

Cochran, P. H.; Newman, R. P.; Barrett, James W. 1991. Fertilization and spacing effects on growth of planted ponderosa pine. Res. Note PNW-RN-500. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 13 p.

Dahms, Walter G. 1960. Long-suppressed ponderosa pine seedlings respond to release. Res. Note 190. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 5 p.

Dahms, Walter G. 1961. Chemical control of brush in ponderosa pine forests of central Oregon. Res. Pap. 39. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 17 p.

Dahms, Walter G.; Barrett, James W. 1975. Seed production of central Oregon ponderosa and lodgepole pines. Res. Pap. PNW-191. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 13 p.

Everett, Richard; Hessburg, Paul; Lehmkuhl, John; Jensen, Mark; Bourgeron, P. 1994. Old forests in dynamic landscapes. Journal of Forestry. 92: 22-25.

Franklin, Jerry F.; Dyrness, C. T. 1973. Natural vegetation of Oregon and Washington. Gen. Tech Rep. PNW-8. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 417 p.

Hann, Wendel. J.; Jones, Jeffrey L.; Karl, Michael G.; Hessburg, Paul F.; Keane, Robert E.; Long, Donald G.; Menakis, James P.; McNicoll, Cecilia H.; Leonard, Stephen G.; Gravenmier, Rebecca A.; Smith, Brad G. 1997. Landscape dynamics of the basin. In: Quigley, Thomas M.; Arbelbide, Sylvia J., tech. eds. An assessment of ecosystem components in the interior Columbia basin and portions of the Klamath and Great Basins. Gen. Tech. Rep. PNW-GTR-405. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 337-1055.

Johnson, Charles G., Jr.; Clausitzer, R. R., Mehringer, P. J.; Oliver, Chadwick D. 1994. Biotic and abiotic processes of eastside ecosystems: the effects of management on plant and community ecology, and on stand and landscape vegetation dynamics. Gen. Tech. Rep. PNW-GTR-322. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 66 p.

Keen, F. P. 1936. Relative susceptibility of ponderosa pine to bark-beetle attack. Journal of Forestry. 34: 919-927.

Keen, F. P. 1940. Longevity of ponderosa pine. Journal of Forestry. 38: 597-598.

Kolbe, Ernst L.; KcKay, Donald. F. 1939. Seven methods of cutting tested at Pringle Falls. Res. Note 27. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest Experiment Station. 1 p.

Koonce, Andrea L.; Roth, Lewis F. 1980. The effects of prescribed burning on dwarf mistletoe in ponderosa pine. In: Martin, Robert E.; Edmonds, Robert L.; Fulkner, Donald A. [and others]. 6th conference on fire and forest meteorology.

Proceedings of a symposium; 1980 April 22-24; Seattle, WA. Bethesda, MD: Society of American Foresters. 197-203.

Languille, H. D.; Plummer, F. G.; Dobwell, A.; [and others]. 1903. Forest conditions in the Cascade Range forest reserve—Oregon. Professional Paper 9, Series H, Forestry 6. Washington, DC: U.S. Department of the Interior, Geological Survey. 298 p.

Larsson, S.; Oren, R.; Waring, R. H.; Barrett, J. W. 1983. Attacks of mountain pine beetle as related to tree vigor of ponderosa pine. Forest Science. 29: 395-402.

Mazany, Terry; Thompson, Marna Ares. 1983. Fire scar dates from the Pringle Falls area of central Oregon. Tucson, AZ: University of Arizona, Laboratory of Tree-Ring Research. 14 p.

Morrow, Robert J. 1986. Age structure and spatial pattern of old-growth ponderosa pine in Pringle Falls Experimental Forest, central Oregon. Corvallis, OR: Oregon State University. 80 p. M.S. Thesis.

Mowat, Edwin L. 1950. Cutting lodgepole pine overstory releases ponderosa pine reproduction. Journal of Forestry. 48: 679-680.

Oliver, Chadwick D.; Irwin, Larry L.; Knapp, Walter H. 1994. Eastside forest management practices: historical overview, extent of their applications, and their effects on sustainability of ecosystems. Gen. Tech. Rep. PNW-GTR-324. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 73 p.

Oren, R.; Waring, R. H.; Stafford, S. G.; Barrett, J. W. 1987. Twenty-four years of ponderosa pine growth in relation to canopy leaf area and understory competition. Forest Science. 33: 538-547.

Perry, D. A.; Henjum, M. G.; Karr, J. R.; Bottom, D. L.; Bednarz, J. C.; Wright, S. G.; Beckwitt, S. A.; Beckwitt, E. 1995. Interim protection for late-successional forests, fisheries, and watersheds: a summary of the report of the eastside forests scientific society panel. In: Everett, Richard L.; Baumgartner, David M., comps. Ecosystem management in western interior forests. Proceedings of a symposium; 1984 May 3-5; Spokane, WA. Pullman, WA: Washington State University, Department of Natural Resource Sciences. 103-114.

Reaves, Jimmy L.; Shaw, Charles G., III; Mayfield, John E. 1990. The effects of *Trichoderma* spp. isolated from burned and non-burned forest soils on the growth and development of *Armillaria ostoyae* in culture. Northwest Science. 64. 39-44.

Roth, L. F. 1953. Pine dwarf mistletoe on the Pringle Falls Experimental Forest. Res. Note 91. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 3 p.

Roth, L. F. 1971. Dwarf mistletoe damage to small ponderosa pines. Forest Science. 17: 373-380.

Roth, Lewis F.; Barrett, James W. 1985. Response of dwarf mistletoe-infested ponderosa pine to thinning: 2. Dwarf mistletoe propagation. Res. Pap. PNW-331. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 20 p.

Sowder, James E. 1951. A sanitation-salvage cutting in ponderosa pine at the Pringle Falls Experimental Forest. Res. Pap. 2. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 24 p.

Speer, James H.; Swetnam, Thomas W.; Wickman, Boyd E.; Youngblood, Andrew. 2001. Changes in Pandora moth outbreak dynamics during the past 622 years. Ecology. 82: 679-697.

Wickman, Boyd E. 1992. Forest health in the Blue Mountains: the influence of insects and disease. Gen. Tech. Rep. PNW-GTR-295. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 15 p.

Youngblood, Andrew. 1995. Research publications of the Pringle Falls Experimental Forest, central Oregon Cascade Range, 1930 to 1993. Gen. Tech. Rep. PNW-GTR-347. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 45 p.