ABSTRACTS

(Listed by author)

Methods for landscape-scale planning of fuel treatments.

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Developing silvicultural practices through large-scale studies

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Over the past two decades numerous large-scale silviculture experiments (LSSEs) have been established to in the Pacific Northwest to evaluate alternative management practices for meeting diverse ecological and social values. These experiments are characterized by their operational scale; experimental units commonly 20 to 100 acres in size and projected study durations typically exceeding 20 years. An advantage of LSSEs is that the experimental units are large enough to assess the responses of multiple taxa and interacting ecological processes operating at different scales; derived inferences can be related directly to management information needs without scaling-up. However, given the long experimental timeframes, a challenge for LSSEs is to maintain relevance and support as management priorities and information needs change. In reviewing more than 30 LSSEs in Oregon, Washington and Alaska it is apparent that these studies have yielded substantial information relevant to early responses to alternative silvicultural practices such as green-tree retention and variable density thinning. However, their collective value can be increased through syntheses, but the opportunities to do so vary with respect to specific management issues or ecological and social values of interest. Furthermore, operational-scale research studies such as these may function as effectiveness monitoring if they incorporate relevant metrics and scope of inference, and are sustained over appropriate timeframes.

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Implications of lower recent fire risk for stand-level restoration

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The 2008 recovery plan for the Northern Spotted Owl (NSO; *Strix occidentalis caurina*) identified high risk of loss to fire as a central reason to eliminate reserves and undertake fuel treatments on up to 65-70% of dry forests in three eastern Cascades and possibly two Klamath provinces. To test whether fire risk is high, we acquired federal data on old forests and fire severity for 1984-2005, extracted high-severity fire

using the RdNBR method, and used these data to estimate fire rotation by province and by length of observation period (5, 10, 20 years). Here we briefly summarize our findings and focus on their implications for stand-level restoration. We found that fire-risk assessment is generally unreliable using short periods of data and small areas, but if short-term data indicate anything it is that recent high-severity fire rotations are generally long in the five provinces (233-4545 years) and old forests are recruiting at high rates relative to high-severity fire. Also, owls may be using these burned areas. Since fire risk to NSO is likely low, abandoning reserves and undertaking extensive fuel treatments are not needed. Instead, small-scale research and adaptive management are first needed to understand NSO response to natural processes and to actions designed to enhance/restore NSO habitat. After this research, natural processes can be managed in ways found to benefit NSO and beneficial restoration actions can be scaled up. In the meantime, we suggest "no regrets" recovery actions that address owl-habitat needs first and foremost, including both active and passive methods.

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California Cascades fuels reduction and wildlife habitat restoration in the Goosenest Ranger District Late Successional Reserves: Overview and lessons learned

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The Goosenest Late Successional Reserve (LSR) Southeast Habitat Restoration Project was designed to address at risk habitat and declining or poor habitat conditions for local wildlife species including the bald eagle (*Haliaeetus leucocephalus*) and the federally listed northern spotted owl (*Strix occidentalis caurina*). The primary objectives of this project were to: 1) promote the development of older forest characteristics in early-to mid successional stands, 2) reduce fuel loads to change predicted fire behavior, and 3) develop and protect sustainable habitat for northern spotted owls and bald eagles while minimizing short-term impacts to these species. Treatments include thinning from below, reduction of ladder fuels and tree density, and promote stand health. Prescribed underburning, mastication, and pile and burn will be used to treat exiting and activity generated fuels. The majority of the sawlog treatments have taken place and current survey efforts indicated that spotted owl territories and the bald eagle winter roost and nest stand are occupied within treated habitat types. The small diameter thinning (4-10"DBH) has not occurred but is planned within the next 2-4 years. During planning the team of specialists tried to meet all objectives in stands proposed for treatment. We realized post decision that this approach creates conflict and some non-anticipated results because each resource failed to reach their objectives 100%.

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Stand management for ecological objectives in the eastern Washington Cascades

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Environmental analysis of a landscape on the east slope of the central Washington Cascades identified a group of stands for treatment in order to meet fire susceptibility, northern spotted owl, and forest restoration objectives. Specific stand-level objectives included: maintaining suitable (NRF) spotted owl habitat, reducing fire hazard, and ecological restoration. Stand conditions were evaluated in the context of these objectives to develop a silvicultural prescription. The resulting prescription focused on maintaining overstory ponderosa pines, creating canopy gaps, and using prescribed fire to reduce ladder fuels. The prescribed fire treatment will be designed as an adaptive management experiment. Efforts by Washington DNR to develop prescriptions that integrate ecological values with timber production objectives in south-central Washington will be described.

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The Pacific Northwest Consortium for Fire Science Delivery

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We successfully competed for a Joint Fire Science Program grant to build a consortium of natural resource practitioners, scientists, consultation specialists, educators, extension specialists, and others to enhance the delivery and trial adoption of innovations in fire science and related fields of practice. The effort is interdisciplinary and interagency. Key goals of the effort are to improve communication and coordination, enhance learning, and let the field direct science-assistance efforts with a “start to finish” cooperative approach in fire science-related projects. Attendees at this conference can help us greatly with their feedback and assistance in identifying specific projects to test the consortium approach.

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Fire Ecology of the Eastern Cascades: Implications for Dry Forest Restoration

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Fire had profound effect on the establishment and development of pre-settlement forests of the eastern Cascades. In the dry forests of the east Cascades Mountains, fire returned at frequent intervals (11-39 years) in ponderosa pine and in the dry Douglas-fir and dry grand fir forests. These fires were generally non-lethal to the large trees and maintained open stands of fire-resistant species. The moist grand fir forests burned at longer intervals (>39 years) with a more mixed severity and in a patchy mosaic pattern. Post settlement land-use has essentially eliminated historical fire from these systems. As a result, forests of today are far more dense with a concomitant shift in composition to shade-tolerant species, such Douglas-fir and true firs. These forests today contain abundant surface and ladder fuels, which makes them vulnerable to large, intense, stand-replacing fires. The increase in stand density has intensified competition between understory trees and the large, old-growth trees, placing the large trees at increased risk to mortality from bark beetles and climate change. Maintenance of large tree structure is essential for sustaining northern spotted owl habitat. Restoration goals for these forests should be developed by managers at the landscape scale and consider treatments across spatial and temporal scales. Treatment priorities at the stand level should include reducing surface and ladder fuels, decreasing stand density by targeting the removal of removal of true firs, and favor leaving large, fire-resistant trees. Although these treatments may temporarily decrease habitat quality for the northern spotted owl, applying restoration treatments in a mosaic fashion and varying within stand composition and structure will minimize impacts and create a more fire-resistant and sustainable habitat in the long run.

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The scientific basis for dry forest restoration.

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Dry Forest ecosystems have evolved primarily with low- and mixed-severity disturbances, predominantly wildfire. Here, the composition and structure of intact existing old-growth forests *often have been significantly affected by human activities*, resulting in increases in stand density and compositional shifts to tree species that are less fire- and drought-resistant. In ecological restoration, silvicultural treatments, including timber harvest, need to focus on conserving remaining old trees, restoring more sustainable forest conditions (e.g. modifying fuel loadings), and reducing stand densities across the landscape. The specifics of these treatments are a function of plant association and landscape context. Historically, many of these stands had relatively low tree densities that were dominated by 10 to 20 large older trees of fire- and drought-resistant species, such as ponderosa pine and western larch, and displayed much spatial heterogeneity, consisting of fine-scale, low contrast structural patchworks. Denser, even-structured stands also existed with up to 50 dominant trees and Douglas-fir, western larch, and ponderosa pine as common species; such forests dominated some landscapes as a result of more severe fires and insect epidemics. Today most stands and landscapes of both types have been dramatically modified by such activities as grazing by domestic livestock, timber harvest, tree planting, and fire suppression. Both mechanical treatments and prescribed fire can be useful in restoring these forests; detailed prescriptions should be keyed to plant associations and the landscape context. Key elements of a restoration strategy for Dry Forest sites are: (1) Protect and conserve all older trees (>150 years of age), including reducing fire-and competitive risks to these trees; (2) Reduce basal areas in overstocked stands; (3) Increase the mean diameter of stands; (4) Shift composition toward more fire- and drought-tolerant species, such as ponderosa pine and western larch, and away from less fire- and drought-tolerant species, such as white and grand fir; (5) Restore characteristic levels of within-stand spatial heterogeneity; (6) Manage small and intermediate tree populations to restore and maintain characteristic population levels of old and large trees; (7) Restore characteristic levels of ground fuels and understory vegetation, using prescribed fire where possible; (8) Encourage hardwood tree and shrub recovery in riparian habitats; (9) Retain patches of dense forest scattered across the landscape within the area of the NWFP to help conserve the Northern Spotted Owl and its prey species; and (10) Plan and implement restoration activities at larger landscape levels, encompassing the variety of restoration efforts that are needed within a landscape and ensuring that spatial complexity is incorporated at larger spatial scales. Given the high potential for catastrophic loss of resource values in the Dry Forests on federal lands, ecological restoration should be comprehensively implemented across the federal forests over the next 20 years.

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Fuel management objectives

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Most restoration projects within the dry forests are designed with reduction of fuels as the primary objective. Fuel reduction aims to create fire resilient stands by reducing surface fuels, reducing ladder fuels, and reducing crown density. This three-part objective is focused on limiting torching and active crown fire so that stands largely survive wildfire much like historical dry forests that were maintained by frequent, low severity fire. Fuel treatments range from using prescribed fire alone, to combinations of commercial or non-commercial thinning treatments followed by prescribed fire. Although these treatments focus on stands, it important to consider scale when restoring fire resistant forests. Small and scattered fuel treatments will be ineffective at mitigating large, crown fire growth across the landscape and stand level treatments can be overwhelmed by intense fire in non-treated stands. Not all landscapes will receive treatment over the entire area, so it is important to strategically locate treatments to be most effective at reducing large fire growth.

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Homogeneous or heterogeneous stands: prescriptions for restoring mixed conifer forests

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Large and severe wildfires have become a common feature of many western US mixed conifer forests where once a more variable assortment of fire event sizes and severities occurred. In response, managers are prescribing controlled burns often combined with thinning to improve landscape tolerance to wildfires. Prescriptions generally increase the average diameter, simplify structure, and favor fire tolerant species composition of the residual stand. Questions abound, though, about how variably to apply this restorative management. Here, I briefly review Agee's stand-level *FireSafe* principles for improving the fire resistance of fire-prone stands. I discuss the main effects of stand-level burning and thinning treatments that are based on these principles, and the advantages and disadvantages of the treatments. I introduce two new principles that apply within-stands and to landscapes that, when considered alongside of the stand-level principles, incorporate important fine- to coarse-scale habitat complexity considerations and a broader range of options for native species and processes. While it is sensible to reduce surface fuels, increase the height to live crowns, decrease crown density, and favor fire tolerant tree species and trees, the patterns and variability of the mosaics that result from treatments matter to native species, their food webs, and the processes that must adapt to the changes. The trick will be to create spatial mosaics within stands, among stands, and across variably patterned landscapes that enable them to persist, considering the scale of their respective domains.

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Risk assessment and silvicultural treatments in spotted owl sites in mixed conifer forests

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Adaptive management may promote silvicultural prescriptions to create or enhance habitat for the northern spotted owl. In 1998 we initiated an adaptive management project with two primary components: (1) a retrospective examination of nocturnal responses of radio-tagged spotted owls to variation in abiotic and vegetative features of small patches (circa 2 ha), from which we estimated a discrete-choice resource selection function (RSF); and (2) case-study evaluations of spotted owl responses to silvicultural treatments. Here, we report initial results from 4 study areas in mixed coniferous forests, involving 138 northern and California spotted owls. Results indicate that spatial scale, details of the physical environment, and forest vegetation structure and composition matter greatly to spotted owls. Probability of patch use declined with distance from streams or riparian zones. The relations with total basal area and basal area of large trees (> 66 cm dbh) were unimodal, suggesting that there may be an optimal total basal area and an optimal basal area of large trees. The probability of selection of patches with such large trees diminished with distance from nest sites. Probability of selection of a patch decreased with increasing basal area of ponderosa pine. RSF covariates with positive coefficients included understory shrubs, hardwoods, large snags and down logs. The probabilistic nature of the RSF promotes linkages with forest-growth and fire-risk models for conducting relative risk assessments that

predict consequences of various land management alternatives over the short- to long-term. Radio-tagged spotted owls used recently thinned stands and those treated with preparatory-stage shelterwood harvests. Use of treated stands was greater than or equal to that before treatments, and use appeared to increase along edges of treated stands. Home range sizes did not appear to change as a result of the treatments.

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Overstory and understory vegetation objectives

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Historical data, photographs, and written observations indicate forest stands that developed in association with frequent low to moderate intensity fire were generally highly heterogeneous. This heterogeneity not only broke up surface and crown fuel continuity, limiting large-scale crown fires, but likely also promoted forest biodiversity. Several silvicultural experiments in California (one in process, and two implemented) were designed to recreate structural elements thought to exist historically and evaluate their importance to a suite of ecological variables. The "Variable Density Thinning" study on the Stanislaus-Tuolumne Experimental Forest will quantify wildlife, natural tree regeneration, and understory diversity among high variability thin, low variability thin, and untreated control units in second growth mixed-conifer stands. The high variability prescription was developed based on data from unlogged historical stands mapped in 1929. These data showed that stands generally consisted of a series of groups, relatively even aged within groups, but of diverse ages and densities among groups. Groups and gaps averaged slightly less than a quarter acre in size, gaps were common (10-15% of the stand), and basal area within groups ranged from 32-707 ft^2/ac. The Blacks Mountain ecological study (Lassen NF) was set up to evaluate the effect of high and low structural diversity in east-side ponderosa pine on multiple variables including wildlife. The high-diversity thinning prescription created abundant vertical and spatial heterogeneity utilizing the different size classes existing on site. The objective of the Goosenest study (Klamath NF) was to, through thinning, accelerate development of the large tree component in dense mixed pine/fir stands that arose after railroad logging, and evaluate the effects on wildlife and other ecological variables. Lessons learned, including challenges with implementing non-standard prescriptions, will be presented.

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Wildlife objectives for mixed-conifer and ponderosa pine forest

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The best flying squirrel habitat in the eastern Washington Cascades is estimated to be mixed conifer forest with >55% canopy cover, lots of large woody debris for truffle food production, diverse understories of mast producing food plants, a high biomass of arboreal lichen winter food in patches of old trees, and snags or mistletoe brooms for den sites. Flyers also were fairly abundant in ponderosa pine forest; but, pine stands were small and close to prime mixed-conifer habitat where squirrels likely foraged. Flying squirrels might well persist with fuel reduction treatments if treatments are patchy and retain required habitat features. Bushy-tailed wood rats are most abundant in either mixed-conifer or pine stands with essential cover habitats of large snags, large down wood, and mistletoe brooms. If these habitat elements are provided, both mixed-conifer and pine stands could support wood rats. Deer mice and yellow-pine chipmunks are the numerically dominant small mammals, and they generally respond positively to fuel reduction treatments, as do some other early-successional species. Small mammals associated with closed-canopy forests are present, but uncommon, in dry forests, and could be maintained by patchy implementation of treatments. There are wildlife habitat objectives for species that aren't prey for spotted owls. The group of species using ponderosa pine dominated, old, single-storied, open forests includes white-headed woodpeckers, pygmy nuthatch, white-breasted nuthatch, and flammulated owl. Habitat for these species has declined strongly from historical conditions. In some areas trade-offs will need to be made to meet habitat objectives for these species and spotted owl prey species.

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Moving forward: How can we best implement, test, and improve these ideas? Implementation in a management study template and a regional study network

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A hoped for long-term outcome from the workshop is the establishment of a network of management study sites that apply the treatment objectives and strategies that we developed in this workshop across the geographic and ecological breadth of the region. Regional coordination of silvicultural practices, and monitoring design and implementation as management studies, will lead to rapid, consistent, and reliable development of effective management practices. Such a network of study sites with common objectives, prescriptions, and monitoring protocols would be a powerful learning tool for managers and scientists to rapidly improve science-based management strategies and practices, and for convincing critics that land managers are serious about effective conservation management. The challenge of this task will be creating a sufficiently specific and powerful, yet flexible, framework or template that allows for regional variation in forest vegetation, environment, and societal needs. This does not mean that every project needs to be a study; regional coordination will be necessary to decide on the allocation of resources for management studies and monitoring. The proposed Pacific Northwest Consortium for Fire Science Delivery (see DeMeo talk) and the Dry Forest Landscape Working Group formed to support the NSO Recovery Plan may provide essential regional coordination and resources to assist the grassroots efforts of field managers and scientists.

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Key recommendations and products from a series of dry-forest workshops in Oregon and Washington

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An integrated effort in building a knowledge- and support-base from which to manage dry-forest ecosystems has occurred in the form of multiple, federally-sponsored workshops over the past decade. Workshops in Redmond, and Ashland, Oregon focused on managing northern spotted owl habitat in the dry-forest environments of the eastern Cascades and Klamath Provinces. Two other workshops in Wenatchee, Washington presented a more comprehensive overview of dry forests, covering the myriad ecological functions that play out in dry-forest ecosystems. Key messages from these workshops relevant to this current workshop include: 1) be proactive; 2) be strategic in actions aimed at restoring dry-forest ecosystems; 3) fill key knowledge gaps; 4) incorporate multiple scales; 5) integrate management across the landscape; and 6) learn from our management. Several products came out of the Ashland workshop, which focused on silvicultural treatment concepts and tactics that could be used in managing for northern spotted owl habitat in dry-forest ecosystems. Most of the products were specific to the Klamath Province, but they can be modified and their principles applied elsewhere in the dry-forest provinces. Key among these products include: 1) a summary of province-specific spotted owl habitat parameters; 2) analysis tools for predicting spotted owl occupancy and prioritizing risk-reduction treatments; and 3) a glossary and a description of forest stand components as viewed from the perspective of different disciplines, in an effort to improve communication among resource specialists. Reports from the Redmond and Ashland workshops can be found under the Dry Forest Ecosystem link at, http://www.fws.gov/oregonfwo/ExternalAffairs/Topics/default.asp#DryForest

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Interagency initiatives: the Tapash Sustainable Forests Collaborative of south-central WA

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Linking the latest advances in dry forest ecology to a functional interagency management framework is regarded as the best means for achieving landscape level restoration by agency, tribal and non-profit managers and scientists in south Central Washington. The Tapash Sustainable Forests Collaborative, founded by regional land managers as a model for interagency cooperation on forest management, is in the process of using a strategy development tool to develop treatments across ownerships on a 300,000 acre multi-basin landscape. The Conservation Action Planning (CAP) tool, developed by the Nature Conservancy and used broadly by state and federal agencies, is being used to array multiple objectives, from legacy retention to NSO population trend improvements and habitat hazard reduction across a shared landscape. The inputs to the CAP tool include both fine-filter and coarse-filter attributes, allowing for the use of stand-level/species level to landscape level indicators. Latest decision support tools enhance the utility of the CAP process, and are integrating into the planning product. Implementing the CAP objectives at this landscape will provide important case study results for managing at multiple scales for seemingly conflicting objectives.

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Strategic landscape and stand management for northern spotted owl habitat on the Deschutes National Forest

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Northern spotted owl (*Strix occidentalis caurina*) habitat management within stands on the Deschutes National Forest (NF) requires an understanding of dynamic ecological processes occurring across the landscape. This presentation will focus on habitat management on the Crescent Ranger District (RD) of the Deschutes NF, where owls occupy late seral dry mixed conifer forests on buttes surrounded by vast acres of lodgepole pine (*Pinus contorta*). Insect and disease related mortality within stands currently inhabited by owls indicate that these stands will not support owls in the future. Therefore, for nearly 15 years, the Crescent RD has been implementing stand level prescriptions in suitable habitat for spotted owls to provide future forests for the owl. The emphasis on stand retention focuses on retaining large trees and developing habitat components for the owl. District Wildlife Biologist, Joan Kittrell, will explain various level of silvicultural treatment within stands to provide spatial and temporal habitat for owls.

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Silvicultural experiments exploring linkages between stand structural diversity and ecological variables in California

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The dark side of the forest: belowground ecosystem response to wildfire severity and fuel reduction treatments.

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Decades of fire suppression have resulted in high fuel levels in dry forests in eastern and central Oregon. To alleviate the impending risk of stand replacing wildfire, forest managers are applying fuel reducing restoration treatments. The impacts of thinning and burning treatments on soil microbial communities and biogeochemical responses are not well understood. It is, however, well established that soil is susceptible to natural and man-made disturbance and that ecosystem function and recovery is dependent on functioning soil communities. Selecting management practices that avoid soil degradation is critical to forest ecosystem sustainability. To provide greater understanding of soil as an important resource, we explore the vast diversity and describe the critical functions of various groups of soil organisms. Results from a series of studies on changes in soil quality in response to wildfire and to various timings and combinations of thinning and burning will be presented. Fire that significantly reduced the depth of the forest floor had a negative impact on the abundance and species richness of fungi and bacteria. In comparison, soil quality was generally unaffected following thinning or less severe burning. Management implications and considerations of the findings in the context of soil type and impending wildfire risk will be addressed. Understanding how soil microbial communities respond to thinning and burning will assist forest managers in selecting fuel-reducing restoration treatments that maintain critical soil processes.

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Northern Spotted Owl habitat objectives.

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A primary objective of this workshop is to discuss and develop stand-level prescriptions for dry forest restoration and advance conservation of the northern spotted owl (*Strix occidentalis caurina*) in the eastern Cascades of Washington, Oregon and California. Development and implementation of prescriptions requires: 1) an understanding of *what* is spotted owl habitat and 2) based on these habitat relationships, *what* should be the stand-level management objectives. My presentation will provide an overview on what is known about stand-level habitat associations of spotted owls in the eastern Cascades. From this overview, I will provide some ideas on what stand level objectives should be of primary consideration for spotted owl habitat management. This information, coupled with information provided

by other speakers on northern spotted owl prey relationships and the effects of silviculture on spotted owls, should hasten the development of prescriptions for spotted owl habitat conservation, an anticipated outcome of this workshop.

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Landscape planning for fire and fuel issues on National Forests in California.

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In 2004, the National Forests in the Sierra Nevada range in California amended their forest plans to adopt a strategic landscape fuels management strategy. The strategy involves implementing a spatial pattern of treatments over a relatively short period of time while balancing fire risk, wildlife occurrences and important habitats, and treatment opportunities and effectiveness. The intent was to implement fuels reduction treatments over 20 to 30 percent of the landscape in 20 years to reduce the extent and severity of wildfires. An implementation method termed Stewardship and Fireshed Assessment was developed to facilitate collaborative strategic planning to address the often conflicting objectives and define a spatial and temporal plan for treatment. However, despite the availability of tools to facilitate landscape planning, insufficient treatments are occurring to materially affect the risk of large wildfires with less than 3 percent of the landscape treated to date. The apparent conflict between protecting wildlife habitat from adverse wildfire effects and protecting wildlife habitat from treatment effects appears to be the primary factor for inaction. The consequences of inaction; however, are often overlooked or downplayed yet recent examples of wildfires in the Sierra Nevada demonstrate that they have long-lasting effects on wildlife. I suggest that planning for fire and fuels issues must realistically assess the consequences of wildfire and must assess landscape strategies rather than individual projects to ensure landscape level benefits are being achieved.

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Silvicultural experiments on Pringle Falls Experimental Forest

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Pringle Falls Experimental Forest (Pringle Falls), southwest of Bend, Oregon, is the oldest experimental forest in the Pacific Northwest and is the site of some of the earliest forest management and silviculture research in this region. Research at this site began in 1914, and it was formally established as part of the national network of experimental forests in 1931 as a center for silviculture, forest management, and insect and disease research in ponderosa pine forests east of the Oregon Cascade Range. Long-term studies that span multiple decades have focused on three different yet interconnected themes: (1) management of existing old-growth ponderosa pine; (2) management of young or immature ponderosa pine; and (3) management of young ponderosa pine mixed with true firs. Examples will illustrate how work at Pringle Falls has both pursued and influenced societal demands for forest management strategies, and how this trajectory has cycled back to the themes under which the experimental forest was first established. Finally, these themes are integrated as drivers for new landscape-scale long-term research at Pringle Falls, designed to evaluate the effects of thinning and fuel reduction treatments on multiple, interacting forest stresses of fire, insects, wind, and climate change.