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Title: ***Creating Stand-Level Prescriptions that Integrate Ecological and Fuel Management Objectives across the Eastern Cascades – a Workshop***

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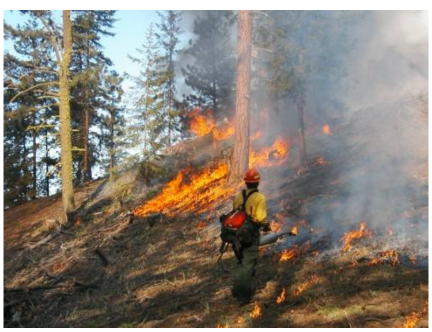

Abstract

The primary goal of this workshop was to develop a range of fuel reduction prescriptions that integrate fuel and ecological objectives specifically related to northern spotted owl (NSO) conservation in dry forests of the Cascade Range in eastern Washington and Oregon and northern California. The workshop was held at the Eagle Crest Resort, Redmond, Oregon, from October 13-15, 2009. Over 200 managers and scientists attended from California, Oregon, and Washington. Most (82%) of the 194 people who formally registered for the workshop worked for federal land management, research, or regulatory agencies. The rest were a mix of university faculty and graduate students (7%), representatives of private non-governmental groups (6%), staff from state resource or wildlife agencies (3%), and staff of tribal governments (2%). Most registrants were from Oregon (63%), followed by California (19%) and Washington (17%). We attracted a mix of managers and scientists. Wildlife biologists made up 40% of the registrants, followed by silviculturists (24%) and fire specialists (14%). Many people professed primary or secondary expertise in botany, ecology, forest health (entomology, pathology), or planning.

The workshop began in the first afternoon with presentations on the scientific basis for dry-forest management and current management and ecological objectives and issues. The second full day was devoted to defining stand management objectives, learning about current management efforts in the region, and two group exercises to define objectives and treatment strategies. The AM of the last day started with 2 hours of discussion of the previous afternoon's break-out discussions. Two talks on landscape planning followed. A final talk discussed options to best implement, test, and improve on the workshop outcomes. An adaptive management template and regional study network were proposed. The PM of the last day was a field trip to Pringle Falls Experimental Forest attended by about 100 people.

A consensus developed that prescriptions most likely to successfully integrate ecological and fuel-management objectives in both mixed-conifer and pine-dominated forests should be based on emulating historic distributions of forest patch and gap sizes. Both scientists and field managers are anxious to participate in a coordinated management study network, recognizing this approach as the most efficient means for gaining reliable information. Key information needs include answers to the questions: (1) How do NSOs respond to different levels of dry forest treatment in both the short and long term?; and, (2) What methods (marking, logging systems, etc.) are most effective at producing the desired pattern of spatial heterogeneity within and among stands? The workshop results and networking will feature strongly in several ongoing research, management, and science delivery efforts across the region.

Background and Purpose

The workshop goal was to initiate a long-term (10-year) program of collaboration between managers and scientists to rapidly accelerate the development of effective and ecologically sound dry forest management in the eastern Cascade Range. In addition to restoration of stable fire regimes and ecological conditions, the program and its results on the ground aimed to promote recovery of the Northern Spotted Owl (NSO), as described in the Northwest Forest Plan (1994) and the NSO Recovery Plan (2008). The workshop and subsequent program are sanctioned by the interagency Eastern Cascades Dry Forest Landscape Working Group formed under the NSO Recovery Plan and lead by the US Fish and Wildlife Service.

This workshop continued efforts begun during workshops in Redmond, OR, (2005), Ashland, OR, (2006), and Wenatchee, WA (2007) that brought together fuel specialists, silviculturists, and wildlife biologists to discuss and develop integrated landscape and stand-level management strategies and practices. The workshop focused specifically on several stand-level needs and recommendations from earlier workshops:

- → Better integrate NSO, prey, silviculture and fire objectives.
- → Provide prescription and implementation guidelines for managers.
- → Develop implementation strategies.
- → Link scientists and managers to understand short- and long-term treatment impacts through monitoring and research.
- → Hold future workshops to continue the dialogue.

The workshop addressed long-standing and current issues related to fire and fuel management practices in Late-Successional Reserves and Matrix Forest under the Northwest Forest Plan. The workshop also directly addressed Recovery Actions in the 2008 Recovery Plan for the Northern Spotted Owl. Recovery Action 6 requires the maintenance and restoration of high-quality NSO habitat. Recovery Action 7 describes habitat management outside high-quality owl habitat as: intensive management to protect high-quality habitat, and management to reduce fire risk while maintaining the capacity for rapid development of, and eventual replacement of, high-quality owl habitat. Both recovery actions will require novel silvicultural and fuel treatment approaches to restore, protect, or develop owl habitat, and to manage for overall dry forest integrity. The need for novel prescriptions is all the more urgent considering the uncertain effects of climate change on forest development under passive or active conventional management. Integral to the proposed program will be implementation of Recovery Action 10 (restoration of habitat elements like snags) and Recovery Action 11 (design and conduct experiments). This workshop focused on stand-level management practices as the building blocks for landscape management. Landscape planning issues and methods were discussed briefly for context and will be the topic for a future workshop.

The workshop aimed to promote interagency coordination and collaboration across the Eastern Cascades region. Regional adaptive management studies that include coordination of silvicultural practices, implementation strategies, and monitoring design and implementation will lead to rapid, consistent, and reliable development of effective management practices. In the absence of a coordinated effort, progress toward NSO recovery and ecosystem management of dry forests will be slow, haphazard, and uncertain. The alternative to our organized approach for effective management is a hodge-podge of unconnected efforts that treat many acres, but from which we learn little about the effectiveness or validity of our actions for forest health and species conservation. The series of workshops described above has provided a forum for sharing information and promoting improved interdisciplinary communication, which has been useful, but we expect coordinated adaptive management will more effectively accelerate the pace of learning while doing.

Goal

The goal of the workshop was to initiate long-term (10-year) regional collaboration between managers and scientists to develop and test forest restoration prescriptions that integrate ecological objectives specifically related to NSO conservation in dry forests of the eastern Cascade Range in Washington, Oregon, and northern California. We intended a long-term outcome from the workshop to be the establishment of a network of management study sites that replicate treatment objectives and strategies that we develop in this workshop across the geographic and ecological breadth of the region, similar to the successful Fire and Fire Surrogate[1] and the Birds and Burns[2] studies.

Objectives

- Define restoration, fuel, silvicultural, wildlife, and other ecological objectives for high-quality owl habitat (i.e. Recovery Action 6) and for other dry-forest types (i.e. Recovery Action 7).
- Describe silvicultural options, tools, and procedures to meet those objectives.
- Discuss implementation of prescriptions and the long-term goal to create a management study template, monitoring elements, and a regional management study network of sites to gain reliable data and knowledge about the effectiveness or validity of prescriptions.

Workshop Location and Description

The workshop was held at the Eagle Crest Resort, Redmond, Oregon, from October 13-15, 2009. Over 200 hundred managers and scientists attended from California, Oregon, Washington, and other states. Travel grants totaling $8,000, from the $10,000 JFSP grant, were awarded to 15 participants to allow them to give presentations or participate in working sessions. The remaining $2000 of the grant was used to fund the field trip.

Most (82%) of the 194 people who formally registered for the workshop worked for federal land management, research, or regulatory agencies (Table 1). The rest were a mix of

[1] http://frames.nbii.gov/portal/server.pt?open=512&objID=363&mode=2&in_hi_userid=2&cached=true
[2] http://www.rmrs.nau.edu/wildlife/birdsnburns/

university faculty and graduate students (7%), representatives of private non-governmental groups (6%), staff from state resource or wildlife agencies (3%), and staff of tribal governments (2%). Most registrants were from Oregon (63%), followed by California (19%) and Washington (17%). We even drew in someone from Texas and two from Rocky Mt. states. There were some people who came but did not register, and a few registrants did not attend. Those people are not reflected in the discipline and area summaries of the 194 registrants.

We attracted a mix of managers and scientists (Table 2). Wildlife biologists made up 40% of the registrants, followed by silviculturists (24%) and fire specialists (14%). Registrants professed primary or secondary expertise in botany, ecology, forest health (entomology, pathology), or planning.

The workshop began in the first afternoon with presentations on the scientific basis for dry forest management, and current management and ecological objectives and issues. The idea was to set the stage for work group discussion by attendees (managers, scientists) to flesh out objectives and later treatments from their perspective and experience. Topics ranged from fire ecology, dry forest restoration, vegetation, soils and wildlife. See Appendix I for the final agenda, and Appendix II for the presentation abstracts. The presentations can be viewed at http://www.fws.gov/oregonfwo/ExternalAffairs/Topics/DryForestWorkshop/2009DryForestWorkshop.asp.

Table 1. Number of workshop registrants by agency type, agency, and state.

		State						
Agency type	**Agency**	**CA**	**MT**	**OR**	**TX**	**WA**	**WY**	**Total**
Federal	BIA			1				1
	BLM			16				16
	FS management	30		63		17		110
	FS research	2		9		5		16
	Fish & Wildlife Service	3		10		1		14
	NRCS			1				1
	USGS			2				2
	Subtotal	35		102		23		160
State	Forestry					2		2
	Wildlife			2		1		3
	Subtotal			2		3		5
Private			1	7		4		12
Tribal				3				3
University		1		8	1	3	1	14
	Total	36	1	122	1	33	1	194

Table 2. The number and percentage of registrants with primary and secondary expertise in various management or research fields.

Primary expertise	Secondary expertise	Total	Percentage total
Botany	na	9	5%
Ecology	na	9	5%
Fire	**only**	**15**	
	Botany	4	
	Forest health	1	
	Planning	2	
	Silviculture	5	
	Wildlife	1	
	Fire subtotal	28	14%
Forest health	**na**	**5**	**3%**
Forestry	na	1	<1%
Line Officer	na	3	2%
Planning	**only**	**5**	
	Botany	1	
	Silviculture	3	
	Wildlife	2	
	Planning subtotal	11	6%
Silviculture	**only**	**39**	
	Fire	1	
	Planning	4	
	Wildlife	2	
	Silviculture subtotal	46	24%
Soils	**na**	**1**	**<1%**
Wildlife	**only**	**74**	
	Botany	1	
	Fire	2	
	Forestry	1	
	Wildlife subtotal	78	40%
Unknown		**3**	**2%**
	Total	194	

The second full day was devoted to defining stand management objectives, learning about current management efforts in the region, and developing silvicultural options, tools, and procedures to meet defined objectives. Break-out groups met for an hour and a half in the AM to flesh out stand management objectives from various perspectives – fuel, wildlife, etc. Then there were presentations on current field efforts of federal, state, and private forest managers and scientists. These presentations were intended to inform upcoming group discussions about prescription development by providing case studies of ongoing efforts to integrate ecological and fuel management objectives in dry forests. Then, break-out groups met for 2 hours in the late PM to discuss development of common treatment strategies.

The AM of the last day started with a 2-hour discussion of the previous afternoon's breakout groups. Later, we heard two talks on landscape planning to put our stand management discussion in perspective, and to prime people for a future workshop devoted to that topic. A final talk discussed how we might collectively move forward to best implement, test, and improve on the workshop outcomes. An adaptive management template and regional study network were proposed.

The afternoon of the last day was a field trip to Pringle Falls Experimental Forest attended by about 100 people. Andy Youngblood, La Grande Forestry Sciences Lab, led the group to sites at Lookout Mountain that are planned for treatment under five different experimental prescriptions. The 3,000-acre project area grades from mixed conifer at high elevations to pure ponderosa pine at low elevations. Prescriptions involve various levels of thinning and fuel reduction to create and assess different stand structures and interactions with pine beetle ecology. The study plan has been approved, and the Deschutes NF is currently completing a major EIS.

Key Findings

Prescription objectives

Participants defined objectives for three different kinds of stands:

1) Current high-quality NSO habitat stands, occupied or not, with core preservation areas;
2) "Transitional" stands of NSO habitat stands that may be degraded by treatment in the near term in order to develop long-term habitat potential or protect adjacent high-quality habitat; and,
3) Pine-dominated stands within the larger landscape that are not, or are low-quality, NSO habitat, but have high wildfire risk.

A summary of the participant responses regarding prescription objectives is listed below:

High-quality NSO habitat stands

Vegetation objectives

- Preserve both occupied and unoccupied core areas with high-quality habitat stands.
- Maintain landscapes in a mosaic of varying stand sizes, densities, structures, gap sizes, etc. Consider spatial complementarity and landscape-scale tradeoffs to protect core areas from wildfire.
- Maintain/encourage gaps at multiple scales by taking advantage of natural disturbances such as root disease, windthrow, and bark beetle induced mortality.
- Use silvicultural and fuels treatments outside of core areas to set up desired patterns within and among stands – but don't "over-engineer".
- Develop prescriptions with all disturbance processes in mind because different disturbance mechanisms yield different patterns of variation.
- Maintain large tree structures and provide for large tree structure over time.
- Maintain plant species diversity, including fire intolerant spp overstory and understory species, and hardwoods.
- Maintain snags and large logs in abundance appropriate for NSO prey and other species.
- Consider likely influences of climate change on stands and landscapes.

Wildlife objectives

- Protect existing core; treat by feathering out from core
- Maintain multi-storied canopy for owl foraging.
- Maintain >50-60% canopy closure in patterns and with a range of variation consistent with desired patterns of spatial heterogeneity.
- Consider managing some stands for nesting-roosting habitat only, and other stands for foraging habitat.
- Distinguish between mature forest that can become nesting, roosting, and foraging habitat (NRF) and mature forests that cannot (related both to site capability and sustainability).
- Maintain or promote "defective" or deformed "character" trees with pathologies conducive to cavity excavation.

Fire & fuel objectives

- Estimate the average percentage of various landscapes and forest types impacted by wildfire severity in each fire severity category with each seral stage over time and space.
- Identify and treat areas that will reduce fire intensity and resultant severity, and moderate ecological impacts, within and among the identified stands.
- Identify active suppression goals within a larger fire management plan that maintains mixed-severity fire effects while protecting high-quality habitat from high-severity fire.

"Transitional" stands

Vegetation objectives

- Manage more actively and with higher impact than high-quality habitat stands to provide for broad ecosystem restoration in addition to fire resistance and resilience that includes high spatial and temporal heterogeneity.
- Promote fire resistant and resilient overstory and understory tree species while maintaining overall species diversity and including fire intolerant tree and understory species.
- Move stands to have a higher component of pine and Douglas- fir.
- Reduce total stand density and the risk of losing big trees to drought, insects, pathogens and fire.
- Maintain and promote development of future large-tree components, primarily ponderosa pine and Douglas-fir. Be aware of tree size/density tradeoffs, and maintain large tree structure in both post-disturbance and green stands.
- Retain legacy structures, i.e., large logs and snags, and recruit future large snags and logs.
- Maintain/encourage gaps that are larger and more numerous than in high-quality habitat by taking advantage of natural disturbances such as root disease, wind throw, and bark beetle mortality.
- Evaluate and treat stands to reduce tree competition and stress, particularly considering the likely influences of climate change on stands and landscapes.

Wildlife objectives

- Develop potential nesting, roosting and foraging conditions within stands as replacement habitat potentially needed within 50 years.
- Create and maintain small dense pockets of fire-intolerant tree species and structures to recruit snags and coarse downed wood.
- Manage to develop and retain mortality and defect (e.g., mistletoe brooms and other tree deformities) to create/promote development of nesting structures.
- Create gaps, clumps, patchiness, (skips) in a mosaic to encourage development of replacement nest trees and increase fire resilience.

Fire & fuel objectives

- Make significant surface fuel reductions applied in diverse, but generally more open, stand structural conditions. Treatment effects need to persist for decades.
- Thin for variable-density stands within areas that can provide NSO habitat, including reintroducing low- to mixed-severity under-burning.
- Re-introduce fire at low intensity within landscape mosaics.

Pine-dominated stands

Vegetation objectives

- Focus management of the restoration of fire resistant and resilient stand structure and composition.
- Develop and maintain ecologically-appropriate medium and large tree densities.
- Maintain fire and drought tolerant overstory and understory species.
- Create and maintain stand and landscape patterns of clumps and openings.
- Consider likely influences of climate change on stands.
- Use site-specific information as much as possible to define historic conditions, but don't forget social and climate change.

Wildlife objectives

- Consider habitat needs of wildlife species other than NSO and prey.
- Manage lodgepole pine stands interspersed among patches of NRF as dispersal habitat.
- Make fuel reduction treatments consistent with ecology of NSO prey species where appropriate.

Fuels objectives

- Develop spatial heterogeneity within and among stands as fuel discontinuities.
- Emulate historic patterns of patchiness for fire resistance and resilience.
- Manage surface fuels over time and space to regulate fire line intensity and rate of spread within natural ranges.
- Reintroduce fire where necessary or manage suppression activities appropriately.

Common themes for silvicultural prescriptions

Silvicultural prescriptions, at their core, describe a series of treatments (if any) that are needed to shift existing stand conditions (within a landscape context) to different conditions that better fulfill the array of management objectives for that stand and landscape. At the heart of dry-forest management within NSO habitat areas is a desire to shift stand structure/composition (and associated fuel loadings) to be more resistant and resilient to wildland fire while maintaining suitable habitat. It was acknowledged that within small areas these two objectives are mutually exclusive by their very nature; however, sound silviculture within larger stands and among stands that form a landscape can balance these objectives – and specifically, the objectives outlined in the above section.

Across the three stand designations (high-quality, transitional, and non-habitat pine stands), there is a logical range of willingness to reduce fuel loadings and tree densities. The above section demonstrates that range of willingness and provides the foundation for what silvicultural activities can be incorporated into prescriptions across various stand types and habitat conditions. Six general silvicultural themes that factor into specific prescriptions for specific stands across the region emerged from the workshop:

1) **High-quality habitat, no or light treatment**: In existing high-quality habitat, with or without a current nesting pair, the core nesting area is to be preserved unmanaged with tapered treatment intensity moving away from that core area. The lightest treatments include cutting/pruning smaller diameter trees to reduce ladder and crown fuels, with hand-piling and burning of new or accumulated surface fuels. These activities may be followed with a prescribed fire or resource benefit fire to better reduce surface fuel loading, but only under exacting conditions given the risk of habitat loss. Treatment impacts persist for only 5-15 years, requiring regular light retreatment.

2) **High-quality habitat, moderate treatment**: In existing high-quality habitat, with or without a current nesting pair, moderate treatment intensity away from the core nesting area may be justified in high hazard/high risk situations. These moderate treatments include a range of partial harvests (free thinning) that treat crown fuels more intensively and comprehensively in time and space, removing 10-25% of canopy cover in suppressed, intermediate and some co-dominant trees in a heterogeneous pattern responding to existing conditions and the expressed objectives above. These activities can be more easily followed with a prescribed fire or resource benefit fire to further reduce surface fuel loading, but only under exacting conditions given the risk of habitat loss. Retreatment is likely within one-two decades depending on burning.

3) **Transitional habitat, light treatment**: Light treatments in transitional habitat walk the fine balance between future habitat needs, as expansion or replacement habitat, with current and future wildland fire risk. They mix relatively unmanaged, multi-storied clumps ("skips") with moderately impacted small group openings ("gaps") with 50-90% of canopy cover removed, with all variations between skips and gaps. Some machine work (e.g., feller/buncher) is likely required to handle log sizes and total biomass volume. These treatments are likely followed by prescribed fire to enhance this heterogeneity and meet other objectives (e.g., for snags and rare vegetation types). Resource benefit fire is more probable in these situations, though it is recognized that a significant hazard is still present in these stands under extreme fire weather conditions. Retreatment is likely within one-two decades depending on burning.

4) **Transitional habitat, moderate and heavy treatment**: Moderate and heavy treatment intensities in transitional habitat areas acknowledge a greater concern over current and future wildland fire risk, and its implications for habitat loss, than lack of current, surrounding habitat. These heavier treatments minimize the dense

relatively unmanaged, multi-storied clumps (“skips”) within a more broadly-treated multi-aged management strategy that includes moderate to large openings (“gaps”) removing 50-90% of canopy cover. Operations would certainly involve machines in the forest. These treatments are also likely followed by prescribed and/or resource benefit fire to enhance this heterogeneity and meet other objectives. There is a significant and persistent reduction in fuel hazard, however, which reduces fire risk for the stand and neighboring stands (which may be high-quality habitat) under extreme fire weather conditions. Treatments are likely to persist for two decades or longer depending on burning.

5) **Pine-dominated non-habitat, light-to-moderate treatment**: Light and moderate treatments intensities in dry pine-dominated stands acknowledge that limiting factors (e.g., urban interface, political or market conditions) may preclude heavier restoration treatments, and that heavier treatments are not urgently required to protect neighboring NSO habitat. These treatments represent a range of light thinning-from-below (10-25% canopy removal) to more intensive free-thinning approaches that reduce canopy cover by 25-75%, treating suppressed, intermediate and up to co-dominant size classes of trees, often with a diameter limit. All fuel classes (surface, ladder and crown) need to be addressed to some degree with mechanical and fire treatments to be effective over time and space. Specific prescription elements (e.g., the protection of large trees, character trees, special features, snags and coarse wood) are moderately easy to address at this treatment intensity. Some natural regeneration in the openings over time is likely to sustain these stands, and the resilience of these stands to drought and other climate effects are enhanced. Treatments are likely to persist for two decades or longer depending on burning.

6) **Pine-dominated non-habitat, heavy restorative treatment**: Full restoration of pine structure, composition and dynamics (burning) not only protect neighboring habitat from fire risk but acknowledge broader interest in restoration of ecosystems in these landscapes. These multi-aged free-thinning treatments reduce canopy cover by 75-90% (depending on site productivity and past treatment history) over most of the stand. Most suppressed, intermediate and co-dominant trees are removed without a diameter limit. All fuel classes (surface, ladder, and crown) need to be addressed with mechanical and fire tools to be effective over time and space, and to complete and maintain the restoration. Specific prescription elements (e.g., the protection of large trees, character trees, special features, snags and coarse wood) are easily addressed and natural regeneration will be prolific in most decades. These stands will be most resilient to climatic fluctuations. Treatments are likely to persist for more than two decades given regular fire events.

Management Implications

- A consensus is developing among scientists and managers that the prescriptions most likely to successfully integrate ecological and fuel-management objectives are those based on emulating historically appropriate ranges of tree diameters, densities and distributions of forest patch sizes and gap sizes. Although the shape of these distributions may be similar across the region, there may be appreciable geographic variation in their scale. Traditional and innovative approaches to stand reconstruction will provide the best guidance for developing locally appropriate management prescriptions. These prescriptions will emphasize managing for heterogeneity, i.e., a wide variance rather than a mean condition.
- Both scientists and field managers are anxious to participate in a coordinated management study network, recognizing this approach as the most efficient means for gaining reliable information (i.e., "adaptive management" as originally intended). Funding and upper-management support are the most substantive obstacles to be addressed.
- Key information needs include answers to the questions: (1) How do NSOs respond to different levels of dry forest treatment in both the short and long term?; and (2), What methods (marking, logging systems, etc.) are most effective at producing the desired pattern of spatial heterogeneity within and among stands? These questions can be readily addressed within the scope of coordinated adaptive management studies.
- There was discussion about how great a risk wildfires are in the dry forests in general, and to spotted owls, and how spotted owls respond to fires of different severity and extent. The USFWS Dry Forest Landscape Working Group is starting to address the issues by compiling relevant information in an effort to identify specific points of agreement, disagreement, and future research needs.

Relationship to Other Recent Findings and Ongoing Work on this Topic

The workshop and its scientist and manager organizers have active ties to several other efforts to create, deliver, or field test science on dry forest restoration. The workshop was designed to inform the Dry Forest Landscape Working Group, which was created in 2009 by the US Fish and Wildlife Service under the Northern Spotted Owl Recovery Plan to guide and integrate implementation of dry forest management and spotted owl conservation. Sue Livingston is the manager of the Group, and all the workshop organizers are members. The Group will continue this work over the next few years.

A top-down effort at integrating scientists and managers (vs. our bottom-up workshop) that we anticipate in the near future to be a critical component of science delivery is the interagency PNW Consortium for Fire-Science Delivery, which we hope will be funded by

JFSP in 2010. The consortium will solidify top-down regional-office support for bottom-up management efforts, and broaden the scope and effectiveness of science delivery. Lehmkuhl is a member of the Consortium development team.

Results of the workshop on prescription strategies will be integrated with the Vegetation-Fire-Owls Project funded by JFSP for work during 2009-2011 (Rebecca Kennedy, PI; John Lehmkuhl, co-PI, among others). Stand level prescriptions or strategies from the workshop will be the building blocks to model alternative landscape management strategies (e.g., NW Forest Plan reserves *vs*. whole-landscape management, and their variations) and their implications for the viability of northern spotted owls in eastern Washington (Okanogan-Wenatchee NF) and Oregon (Deschutes NF).

Future Work Needed

Participants were asked to fill out an evaluation form to help us plan future science and science delivery. We received evaluation forms from 66 participants, representing roughly one-third of attendees. In general, respondents found the workshop effective and relevant, and they supported participating in a management study network. Responses to each question on the evaluation form are summarized in Appendix III.

In general, the workshop fully met the expectations of 56% of respondents, and 32% were partly satisfied. The workshop was considered effective by most respondents in science delivery and facilitating interdisciplinary networking informally and in the formal discussion sessions. Respondents thought the workshop could have had more time for questions after presentations, better guidance and sideboards to "tighten-up" group discussions, more case studies, more specific quantitative guidance for prescriptions, and more attendance by line officers, planners, and entomologists.

The most important idea or concept gained from the workshop was to manage for landscape heterogeneity, including gaps, clumps, and “messiness” at fine and coarse scales. Beyond this common theme, there was remarkable diversity in responses to this question. Some of the dominant ideas were:

- A management study network is a desirable approach for learning more about how to manage dry forests, but we need more resources for adaptive management.
- Leave overstory trees and develop focused or standard treatments for replacement of nesting, roosting, and foraging spotted owl habitat.
- We all want to do ecosystem management, but we're not sure how.
- Consensus is building about how to manage dry forests based on improving science/management integration.
- Monitoring is critical.
- Doing nothing isn't an option.
- Leave suitable NSO habitat alone.
- We need more precise definitions and use of language.

- Historic stand reconstructions and an understanding of stand dynamics are essential to guiding management.
- Lots of different ideas exist about how to deal with spotted owl habitat.

Most respondents (64%) felt that the prescription strategies and the adaptive management network we discussed were applicable to their areas; but, treatment strategies needed more specificity and need to be nested within a landscape context to be most applicable. Most respondents who answered "yes" to applicability in their area also supported participation in a management study network. Barriers to participation were listed as:

- Money (25 respondents)
- Management support (9)
- Personnel/expertise (7)
- Clear objectives (6)
- Specific prescriptions (5)
- Study design and monitoring support (4)
- NEPA support (4)
- USFWS support (3)
- Public support (2)
- Enough spotted owls to allow experimentation (2)
- A broad-scale landscape plan into which this study fits (1)
- Multidisciplinary consensus (1)
- Credibility of a systematic, science-based approach (1)
- An invitation (1)

Recommendations for future topics were:

- Spotted owl use of burned areas of various severity and size(4)
- Implementation case studies (4)
- Project design tools, including decision-tree protocols for treatment, and monitoring design (4)
- Local, site-specific, workshops (3)
- Barred owl responses to treatments and fire (3)
- Economics of small-diameter wood (2)
- More frequent workshops (2)
- Sessions for marking teams
- Disturbance agents other than fire and interactions with fire.
- Marten and fisher
- NSO prey species requirements and responses to disturbance.
- Checkerboard landscape management
- Sessions for full IDTs

- Making heterogeneity happen

The workshop organizers are actively following up on the workshop with plans to develop a landscape management workshop, efforts to develop treatment strategies (see Deliverables), and development of management studies (i.e., adaptive management) to test their treatment effectiveness, validate their scientific basis, and evaluate their operational feasibility. As a result of the workshop, plans are being developed for a management study of ponderosa pine prescriptions on the Fremont-Winema NF, and to inform the "Westside Project" on that same Forest with a review of the scientific basis for fuel treatments in spotted owl habitat, which also is being called an "uncertainty analysis".

Deliverables

The deliverables table in our proposal is shown below (Table 3), and a note for each item is listed below the table. The delivery dates in most cases are off by about 4 months because we had to postpone the workshop from June, as proposed, until October because of scheduling issues with the National Silviculture Workshop and field season.

Table 3. Deliverables listed in our original proposal to JFSP, with the proposed and actual delivery dates resulting from a 4-month postponement of the workshop.

Deliverable	Description	Proposal Delivery Date	Actual Delivery Date
Workshop	List of participants and contact information	July 2009	December 2009
Non-refereed publication	Conference proceedings (synthesis actually) submitted for publication	December 2009 (submitted for publication)	May 2010 (submitted)
Website	Website posting of abstracts, PowerPoint presentations.	August 2009	December 2009
Website	Website posting of workshop report or synthesis paper	December 2009	December 2009
Refereed publication (possibly)	Silviculture to meet fuel, vegetation, wildlife, and other ecological objectives in dry forests of the Cascade Range (conditional on workshop outcome)	May 2010 (submitted)	December 2010 (submitted)

1. Workshop: list of participants and contact information. This was downloaded to the JFSP website in December 2009.

2. Non-refereed publication. We posted the workshop final report during December 2009, but posting the synthesis paper will be delayed until May 2010 because the workshop was postponed 4 months as stated earlier.

3. Website: post abstracts and presentations. These were posted during December 2009 at http://www.fws.gov/oregonfwo/ExternalAffairs/Topics/DryForestWorkshop/2009DryForestWorkshop.asp.

4. Website: post workshop report or synthesis paper. The workshop report was posted in December 2009 on the US Fish and Wildlife Service website listed above. See #2 above for the status of the synthesis paper. It will be posted when completed.

5. Refereed publication: We are working on this and will download to the JFSP website and post on the USFWS website when in press.

APPENDIX I – Workshop Program

Creating Stand-Level Prescriptions to Integrate Ecological & Fuel Management Objectives for Dry Forests of the Eastern Cascade Range

A Workshop, October 13-15, 2009, Eagle Crest Resort Redmond, Oregon

Tuesday, PM

Objective: Describe the scientific basis for dry forest management, and current management and ecological objectives and issues.

1300-1310 *Welcome, introduction, goals & objectives of workshop.* Sue Livingston, US Fish and Wildlife Service.

1310-1340 *Fire ecology of the eastern Cascades and implications for dry forest management.* Stephen Fitzgerald, OSU Extension Service, Redmond.

1340-1400 *The scientific basis for dry forest restoration.* Jerry Franklin, University of Washington.

1400-1420 *Fuel management objectives.* Richy Harrod, Okanogan-Wenatchee NF.

1420-1440 *Overstory and understory vegetation objectives*. Eric Knapp, Becky Estes, and Carl Skinner, PSW Research Station, Redding.

1440-1500 *Homogeneous or heterogeneous stands: prescriptions for restoring mixed conifer forests.* Paul Hessburg, PNW Research Station, Wenatchee.

1500-1530 Break

1530-1550 *Implications of lower recent fire risk for stand-level restoration.* William Baker, University of Wyoming, Chad Hanson, University of California, Davis, Dennis Odion, University of California, Santa Barbara, & Dominick DellaSala, National Center for Conservation Science and Policy, Ashland.

1550-1610 *The dark side of the forest: below-ground ecosystem response to wildfire severity and fuel reduction treatments.* Jane Smith and Doni McKay, PNW Research Station, Corvallis, and Cassie Hebel and Tara Jennings, Oregon State University.

1610-1630 *Northern Spotted Owl habitat objectives.* Jim Thrailkill, US Fish and Wildlife Service, Portland.

1630-1655 *Wildlife objectives for mixed conifer and pine forest.* John Lehmkuhl, PNW Research Station, Wenatchee, & Kim Mellen-McLean, US Forest Service, Portland

1655-1700 Wrap-up. Sue Livingston.

1700-1900 No-host social at the Eagle Crest Resort.

Wednesday

Objectives: Define stand management objectives, learn about current efforts in the region, and develop silvicultural options, tools, and procedures to meet defined objectives.

800-900	*Break-out groups.* Moderator: John Lehmkuhl Objective: Define measurable objectives, or desired future conditions and dynamics (e.g., for forest structure, fuel levels, vegetation diversity, and wildlife habitat) for potential silvicultural treatments.
900-930	*Group reports & discussion*.
930-950	*Key recommendations and products from a series of dry-forest workshops in Oregon and Washington.* Sue Livingston, US Fish & Wildlife Service, Portland.
950-1010	**Break**
1010-1030	*Stand management for ecological objectives in the Washington Cascades.* Matt Dahlgreen, Okanogan-Wenatchee NF, and Scott McLeod, Washington Department of Natural Resources
1030-1050	*Strategic landscape and stand management for NSO habitat on the Deschutes National Forest.* Jennifer O'Reilly, US Fish and Wildlife Service, Bend, and Joan Kittrell, Deschutes NF.
1050-1110	*California Cascades fuels reduction and wildlife habitat restoration in the Goosenest Ranger District Late Successional Reserves: Overview and lessons learned.* Christy Cheyne, Klamath NF, and Dan Blessing, Klamath NF.
1110-1130	*Interagency initiatives: the Tapash Sustainable Forests Collaborative of south-central WA.* Reese Lolley and Betsy Bloomfield, The Nature Conservancy, Yakima, and Todd Chaudhry, The Nature Conservancy, Wenatchee.
1130-1150	*Risk assessment and silvicultural treatments in spotted owl sites in mixed conifer forests.* Larry Irwin, National Council for Air and Stream Improvement (NCASI), Stevensville, MT, and Dennis Rock and Suzanne Rock, NCASI, Amboy, WA.
1150-1300	**Lunch**
1300-1320	*Silvicultural experiments on Pringle Falls Experimental Forest.* Andy Youngblood, PNW Research Station, La Grande.
1320-1340	*Silvicultural experiments exploring linkages between stand structural diversity and ecological variables in California.* Carl Skinner and Martin Ritchie, PSW Research Station, Redding.
1340-1400	*Developing silvicultural practices through large-scale studies.* Paul Anderson, PNW Research Station, Corvallis.
1400-1430	Panel discussion. John Bailey, Oregon State University, moderator.
1430-1500	**Break**

1500-1650 Multi-disciplinary break-out groups (geographically organized) to review and evaluate a proposed prescription matrix considering the day's discussions and three existing habitat conditions in the landscape:

(a) Existing high-quality NSO habitat (e.g. in dry, mixed-conifer forest),

(b) Potential NSO habitat as supplemental or replacement habitat, and

(c) Other surrounding forested areas that likely will not be habitat in the foreseeable future (e.g., pine-dominated forest)

Modify/add and describe silvicultural tools and techniques within this proposed prescription matrix. John Bailey, OSU.

1650-1700 Wrap-up. John Bailey, OSU.

Thursday, AM

Objectives: Present group reports and develop recommendations. Describe possible next steps for landscape-scale planning, implementation. and monitoring.

800-915 *Group reports* to the entire workshop audience relative to the three types of habitat conditions.

915-1000 *Discussion and recommendations.* John Bailey, OSU.

1000-1020 **Break**

1020-1040 *Methods for landscape-scale planning of fuel treatments.* Alan Ager, PNW Research Station, Western Wildlands Environmental Threat Assessment Center, Prineville, and Nicole Vaillant, US Forest Service, Adaptive Management Services Enterprise Team, Sparks, NV.

1040-1100 *Landscape planning for fire and fuels issues on National Forests in California.* Don Yasuda, US Forest Service, El Dorado National Forest.

1100-1120 *The Pacific Northwest Consortium for Fire Science Delivery.* Thomas DeMeo, US Forest Service, Region 6, Portland.

1120-1145 *Moving forward: How can we best implement, test, and improve these ideas? Implementation in a management study template and a regional study network.* John Lehmkuhl, PNW Research Station, Wenatchee.

Thursday, PM

Field Trip to Pringle Falls Experimental Forest.

Andy Youngblood, La Grande Forestry Sciences Lab, will lead a field trip to visit sites at Lookout Mountain that are planned for treatment under five different experimental prescriptions. The 3000-acre project area grades from mixed conifer at high elevations to pure ponderosa pine at low elevations. Prescriptions involve various levels of thinning and fuel reduction to create and assess different stand structures. Lookout Mountain is on the eastern edge of NSO range, and also has goshawk habitat. The Deschutes NF is very interested in overlaying NSO habitat studies on planned treatments in one block of the experiment. Opportunities also exist for collaborative studies of pine-associated wildlife and other issues. The study plan has been approved, and the Deschutes NF is currently completing a major EIS.

APPENDIX II - ABSTRACTS (listed by author)

Methods for landscape-scale planning of fuel treatments.

Alan Ager[1] and Nicole Vaillant[2]

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[2]US Forest Service, Adaptive Management Services Enterprise Team, Sparks, NV, nvaillant@fs.fed.us

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Developing silvicultural practices through large-scale studies

Paul D. Anderson

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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

William L. Baker,[1] Chad T. Hanson,[2] Dennis C. Odion,[3] and Dominick A. DellaSala[4].

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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

Christy Cheyne[1] and Dan Blessing[2]

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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

Matt Dahlgreen [1] and Scott McLeod [2]

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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

Thomas DeMeo

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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

Stephen A. Fitzgerald

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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.

Jerry F. Franklin

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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

Richy J. Harrod

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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

Paul F. Hessburg

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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

Larry L. Irwin[1], Dennis Rock[2], and Suzanne Rock[2]

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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

Eric E. Knapp, Becky L. Estes, and Carl N. Skinner

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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

John F. Lehmkuhl[1] and Kim Mellen-McLean[2]

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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

John F. Lehmkuhl

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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

Sue Livingston

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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 Washington

M. Reese Lolley[1], Betsy Bloomfield[1], and Todd Chaudhry[3]

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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

Jennifer O'Reilly[1] and Joan Kittrell[2]

[1]US Fish and Wildlife Service, Bend Field Office, Bend, OR, Jennifer_OReilly@fws.gov

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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

Carl Skinner and Martin Ritchie

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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.

Jim Thrailkill

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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.

Don Yasuda

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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

Andrew Youngblood

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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.

APPENDIX III - Summary of Workshop Evaluations

Creating Stand-Level Prescriptions to Integrate Ecological & Fuel Management Objectives for Dry Forests of the Eastern Cascade Range

Redmond, Oregon, 15 December 2009

We received evaluation forms from 66 participants, representing roughly one third of attendees. In general, respondents found the workshop effective and relevant, and they were supportive of participating in a management study network. Responses to each question on the evaluation form are summarized below.

1. a. Did the workshop meet your expectations?
b. If so, what was most effective?
c. If not, what was missing?

a. Met expectations? Yes - 37; No - 7; Partly - 21

b. Most effective? Common responses listed in order of decreasing frequency:

- Science delivery
- Interdisciplinary interaction and networking
- Breakout group discussions

c. Missing?

- Time for questions after presentations
- Guidance and sideboards to "tighten-up" group discussions
- Case studies
- Specific quantitative guidance for prescriptions
- Managers/planners/entomologists

Responses included a variety of unique suggestions reflecting the diversity of attendees (see questions 6 and 7 below).

2. What is the most important idea or concept that you are taking away from this workshop?
One predominant theme emerged:

- Manage for landscape heterogeneity, including gaps, clumps, and messiness at fine and coarse scales (24 responses)

Beyond this common theme, there was remarkable diversity in responses to this question. Some of these sentiments are contradictory. Only ideas shared by two or more people are listed here.

- A management study network is a desirable approach for learning more about how to manage dry forests, but we need more resources for adaptive management. (6)
- Leave overstory trees and develop replacement NRF. (5)
- We all want to do ecosystem management, but we're not sure how. (4)
- Consensus is building about how to manage dry forests based on improving science/management integration. (4)
- Monitoring is critical. (3)
- Doing nothing isn't an option. (3)
- Leave suitable NSO habitat alone. (3)
- We need more precise definitions and use of language. (3)
- Historic stand reconstructions and an understanding of stand dynamics are essential to guiding management. (3)
- Lots of different ideas exist about how to deal with spotted owl habitat. (2)

3. a. Are the prescription strategies developed in this workshop applicable to a future project in your area?
b. If no, what would make them more applicable?
c. If yes, would you and your organization support designing such a project as a management study, as part of a potential management study network?

a. Prescription strategies applicable? Yes - 42; No - 8; Maybe - 7

b. How to make them more applicable?
- Need more development, specificity.
- We need to work on landscape and mid-scale applications - use sample landscapes w/nested projects.

c. Management study network participation?
Most respondents who answered "yes" to the applicability question also supported participation in a management study network.

4. What would you or your organization need most to participate in a management study network?
Most respondents named several factors.
- Money (25)
- Management support (9)
- Personnel/expertise (7)
- Clear objectives (6)
- Specific prescriptions (5)
- Study design and monitoring support (4)
- NEPA support (4)
- USFWS support (3)

- Public support (2)
- Enough spotted owls to allow experimentation (2)
- A broad-scale landscape plan into which this study fits (1)
- Multidisciplinary consensus (1)
- Credibility of a systematic, science-based approach (1)
- An invitation (1)

5. Recommendations for future topics.
Again, there was remarkable diversity in the responses.

- Spotted owl use of burned areas (4)
- Implementation case studies (4)
- Project design tools, including decision-tree protocols for treatment, and monitoring design (4)
- Local, site-specific, workshops (3)
- Barred owl responses to treatments and fire (3)
- Economics of small-diameter wood (2)
- More frequent workshops (2)
- Sessions for marking teams
- Disturbance agents other than fire and interactions with fire.
- Marten and fisher
- NSO prey species requirements and responses to disturbance.
- Checkerboard landscape management
- Sessions for full IDTs.
- Making heterogeneity happen

6. Affiliation

- FS = 48
- BLM = 8
- USFWS = 4
- Other = 3
- Academe = 2
- ODF =1

7. Job position

- Wildlife = 29
- Silviculture = 16
- Planning = 9
- Fire = 4
- Botany = 3
- Plant Pathology = 2
- Ecology = 1
- Other = 2