Silvicultural Practices Supporting Northern Spotted Owl Habitat in Dry Forest Ecosystems

Workshop Report

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See website:
http://www.fws.gov/oregonfwo/FieldOffices/Bend/ForestWorkshop/NSOWorkshop-06.htm for Workshop Powerpoint presentations, an electronic copy of this document and additional appendix material.

Executive Summary

This report contains information discussed and developed at the May 2006 workshop held in Ashland, Oregon, entitled, Silvicultural Practices Supporting Northern Spotted Owl Habitat in Dry Forest Ecosystems. It is intended to provide dry-forest-silvicultural treatment concepts and tactics for use by agency managers, policy makers, and resource practitioners. We believe this report also provides beneficial information to aid spotted owl recovery efforts.

Approximately 100 people attended the workshop, with 70 attending the field trip and working through an inter-disciplinary team experience. The highlight of the workshop was the field trip and associated discussions among the specialists of different disciplines representing multiple agencies and organizations.

Common themes emerged throughout the workshop with respect to designing treatments that will be neutral or beneficial to spotted owl habitat while addressing fuel hazards. We characterized these themes as operational principles, needs, and impediments to implementation (p. 9). Operational principles included: 1) No action is not an option; 2) Temporal and spatial scales must be addressed; 3) Communication is key; 4) Treatments must be strategic; 5) Clearly describe the desired outcome. Needs included: 1) Multi-scale analyses; 2) Common language; 3) Clear objectives; 4) Province-scale treatment prioritization. Impediments to successful implementation included: 1) No consensus on appropriate action; 2) Misperceptions; 3) Lack of funding; and 4) Gaps in knowledge and understanding.

Seven products were developed and included within this report to help fill in some of the gaps identified in the operational principles, needs and impediments (Table 1).

- Two of the products are designed to improve the knowledge base. One is a bibliography of spotted owl and fire literature primarily related to the Klamath province (p. 12 and Appendix F). We have also provided a summary of province specific spotted owl habitat parameters (p. 17), including a checklist of habitat parameters to consider at multiple scales when designing and evaluating stand treatments (Table 3). We encourage other provinces to modify these tools for their own local area.

- Three products serve as analysis tools for identifying valuable spotted owl habitat and strategically locating fuel treatments. These products comprise the abiotic model (p. 14), the spotted owl occupancy model (p. 15), and the landscape treatment prioritization framework (p. 16). We encourage all provinces to consider these tools as part of their management of spotted owls in dry forests.

- Two products in this report are designed to improve communication and understanding among wildlife biologists, silviculturists and fire specialists. The structural component matrix (p. 12 and Appendix G) and the specialist's glossary

(p. 13 and Appendix H) will reduce the risk of misunderstanding among disciplines and aid in more clearly describing forest stand features of interest to wildlife biologists, silviculturists and fuels specialists.

While the products described in this report can be valuable tools in and of themselves, there are other steps that are necessary to improve management of at-risk habitat for spotted owls and fuel hazards. We lay out a strategy of actions that can be implemented as next steps to move agencies towards more effective management of spotted owl dry forest habitat (p. 23). These steps include: 1) implementing the 2005 Redmond Workshop recommendations; 2) implementing the 2006 Ashland Workshop products; 3) answering specific research questions identified at the workshop; and 4) implementing a suite of priority steps to carry the momentum gathered at these workshops.

In conclusion, we believe the Redmond and Ashland workshops have fostered a new level of collaboration among agencies and disciplines. However, reducing the risk of catastrophic fire in spotted owl habitat must become an interagency priority at all levels. Strong leadership and commitment from regional executives to field level managers will be necessary to adopt the strategies in this report and address the needs of spotted owls and fuel hazards in dry forest environments.

Acknowledgments

We would like to express our gratitude to a number of people who provided considerable time and effort in the planning and implementation of the Silvicultural Practices Supporting Northern Spotted Owl Habitat in Dry Forest Ecosystems Workshop (Ashland Workshop). We would like to thank our cooperating agencies, the U.S. Forest Service and the Bureau of Land Management for their support in developing and implementing this workshop. The U.S. Fish and Wildlife Service's Oregon Fish and Wildlife Office provided the funding and support to hold this workshop. In particular we want to thank all of the speakers who provided excellent, thought provoking presentations. Thanks to Miel Corbett, Fish and Wildlife Service, for providing the field trip photos for this report. We thank for following for their thoughtful, constructive review of the final document: Sarah Madsen, Bill McArthur and Elaine Rybak of the Forest Service; Terry Fairbanks, Joe Lint and Charley Martin of the Bureau of Land Management; Miel Corbett, Nancy Gilbert, Kemper McMaster and Jennifer O'Reilly of the Fish and Wildlife Service. For all of their efforts to carry out this workshop, a special thanks goes to the workshop planning team: Alan Baumann, Umpqua National Forest; Greg Chandler and Coreen Francis, Medford District Bureau of Land Management; Cindy Donegan, Doug Laye, Sue Livingston, Jim Thrailkill, Craig Tuss and Brian Woodbridge, Fish and Wildlife Service.

Introduction

In May 2005, the U.S. Fish and Wildlife Service (Service) in cooperation with the U.S. Forest Service (USFS) and Bureau of Land Management (BLM) convened a workshop entitled "*Managing Northern Spotted Owl Habitat in Dry Forest Ecosystems*" (Redmond workshop). This workshop was held in Redmond, Oregon, with an overarching purpose of initiating dialogue among the agencies regarding ways to improve future federal forest management in the dry forest provinces within the range of the northern spotted owl (*Strix occidentalis caurina*) (spotted owl). A primary catalyst for the workshop resulted from Courtney et al. (2004) and the Northern Spotted Owl 5-Year Review (USDI FWS 2004). These documents highlighted the need to manage forests, including spotted owl habitat, in dry provinces to address fuel loading concerns and restore forests to within their natural range of variability. A synthesis report (http://www.fws.gov/oregonfwo) with numerous recommendations was a product from the Redmond workshop (Appendix A). One recommendation included more intensive dialogue among federal resource practitioners regarding development and application of stand-level silvicultural practices in spotted owl-dry forest habitat.

This report contains information discussed and developed at the May 2006 workshop held in Ashland, Oregon, entitled, *Silvicultural Practices Supporting Northern Spotted Owl Habitat in Dry Forest Ecosystems* (Ashland workshop). It is intended to provide dry-forest-silvicultural treatment concepts and tactics for use by agency managers, policy makers, and resource practitioners. We believe this report also provides beneficial information to aid spotted owl recovery efforts.

Background

The loss of late-successional forest due to timber harvest was recognized as a major threat to the spotted owl, leading to its listing as threatened in 1990 and eventually prompting Federal land management agencies to develop the 1994 Northwest Forest Plan (Plan). Since its adoption, the Plan has achieved several important goals for spotted owl conservation. Most notably, the Plan has protected the majority of existing suitable spotted owl habitat on federal lands through the establishment of Late Successional Reserves (LSR) (i.e., large blocks of mature and old-growth forest) (Courtney et al. 2004), thus assisting in spotted owl recovery.

The Plan recognized that there were areas of the warmer, drier physiographic provinces (i.e., the Washington and Oregon Eastern Cascades, the California Cascades and the Oregon and California Klamath Provinces) where decades of fire exclusion and timber harvest had resulted in changes to forest composition and structure, increasing the potential for stand-replacing wildfires in areas that had been reserved for late-successional species. In addition, few acres of spotted owl habitat have been treated outside of reserves in the dry provinces. Much of this habitat developed recently (within the past 100 years) due to fire exclusion, and is currently at risk to stand-replacement fires, pests and pathogens (Irwin and Thomas 2002).

It is believed that active management to address fuel loading concerns and restore forests to within a natural range of variability is necessary to reduce these risks and protect the late-successional forest structure. However, such active management has been delayed due to factors such as inadequate funding, competing management priorities, potential public controversy, and uncertainty regarding the potential impact of treatments (i.e., positive or negative) on the spotted owl and its habitat.

Courtney et al. (2004) reported that wildfire has resulted in the loss of 2.3 percent of spotted owl habitat within the first decade of the Plan. The loss of this habitat due to such uncharacteristically large stand-replacement fires has not occurred range-wide, although it has been locally extensive (Lint 2005).

The paradox land managers face today is a need to treat spotted owl habitat in order to save it (USDI 1992). Management and regulatory agencies recognize and are attempting to restore the ecological balance of forests in the dry provinces. However, it will take much time, planning, financial resources, and interdisciplinary and interagency collaboration to overcome almost a century of effective fire suppression to return these landscapes to within their natural range of variability.

Workshop Goals

This 2006 Ashland workshop and report build on and implement several of the consensus recommendations from the 2005 Redmond workshop (Appendix A). Those recommendations include:

- Implement interagency planning for projects.
- Manage for long-term sustainability of spotted owl habitat regardless of land use allocation. Manage the most productive sites with the highest sustainability for spotted owl habitat regardless of the land use allocation boundaries. Manage surrounding areas to allow for low severity fire.
- Facilitate information, education and public involvement.
- Review and establish local spotted owl habitat definitions.

The goals of the Ashland workshop included: 1) "calibration" among resource specialists from different agencies and disciplines on the issue of spotted owl habitat and high fuel loads in dry forests, and; 2) collaboratively develop a process for applying stand level silvicultural practices beneficial to spotted owls while addressing high fuel loads, keeping in mind a landscape context.

The Klamath Province (southwestern Oregon and northwestern California) was a primary focus area for most of the information presented at the workshop. While the information may be most relevant for the Klamath Province, the basic concepts, tools, and suggestions presented have utility throughout the range of the spotted owl.

Workshop Structure

To achieve the Ashland workshop goals, the workshop team developed the following program (Appendix B):

- Day 1 Researchers and land management personnel presented applied research and case studies of silvicultural and fuel treatments within dry forest habitats with an emphasis on the Klamath Province. Contact information and biographies for the speakers can be found in Appendix K.

- Days 2 and 3 Participants worked through a process of identifying silvicultural techniques at the stand level to reduce fuel loads while maintaining spotted owl habitat. To aid in sharing of perspectives and knowledge, participants were assigned to be in one of six interagency/interdisciplinary groups (IDTs).
    a. A field trip was held on day 2, allowing participants to view fuels reduction projects in northern spotted owl habitat. This exercise allowed biologists, fuels specialists and silviculturists to identify and discuss forest structural elements critical for spotted owl habitat and fuels concerns. This trip included a set of field-based exercises (Appendix D) asking participants to:
        - Identify and describe the forest structural elements of spotted owl habitat and describing those structural elements in silvicultural terms, where possible.
        - Identify the forest structural elements (including concentrations and distributions) that are of concern to fuels managers.
        - Describe silvicultural practices, including prescribed fire, that manipulate forest stand structural elements for the purpose of identifying stand level silvicultural prescriptions and situations that reduce fuel hazards and are neutral or beneficial to spotted owl habitat.
        - Address landscape-scale questions regarding spotted owl dry forest habitat and fuels management.
        - Examine and discuss examples of actual treatments.
    b. On day three, field trip participants worked collaboratively in their assigned IDTs to summarize the previous day's discussion. Representatives from each IDT then presented their ideas, issues and recommendations to the audience, with subsequent discussion by all participants.

Approximately 100 people attend the workshop, with 70 attending the field trip and working through the IDT experience. Over 80 percent of attendees were from federal agencies. Nearly half the attendees were wildlife biologists, 17 percent were silviculturists, and 9 percent were fire/fuels specialists (Appendix C). The highlight of the workshop was the field trip and associated discussions among the multiple disciplines representing multiple agencies and organizations. As one participant noted, "the barriers were down and participants really were ready to share and learn from each other."

(Appendix E). Based on participant evaluations, the workshop was a success; 84 percent of the respondents believed they would practice on-the-ground implementation of the concepts they heard at the workshop, and 67 percent felt the workshop was very valuable to their job (Appendix E).

Figure 1. Workshop participants work through a set of questions to engage discussion about spotted owl management in dry forest landscapes.

Knowledge Gained or Reinforced by Workshop Attendees

Several operational principles, needs and impediments to implementation continued to emerge throughout the workshop. These came up multiple times not only in the field trip questionnaires (Appendix D), notes and discussions that occurred during the presentations and group discussions, but also in the workshop evaluations (Appendix E). These operational principles, needs and impediments captured the content of the workshop, and were the foundation for developing the products and next steps included in this report.

Operational Principles

1. <u>"No action" is not an option</u> As identified at the Redmond workshop there is consensus that a failure to take action threatens the long-term sustainability of spotted owls and their habitat.
2. <u>Temporal and spatial scales must be addressed</u> Placement of fuels treatments should be prioritized spatially and temporally at various scales to maintain spotted owl habitat. Provincial scale assessments can provide a context for where fuel treatments would facilitate maintenance and restoration of spotted owl habitat.
3. <u>Communication is key</u> Interdisciplinary/interagency communication is the key to successful planning and implementation of fuels treatments that reduce the risk of large, stand replacement fire within suitable habitat for spotted owls.
4. <u>Treatments must be strategic</u> The biological community, including the Service, recognizes there are necessary risks to implementation of fuel reduction treatments within spotted owl dry forest habitat.

5. Clearly describe the desired outcome A clear understanding of the objectives of each discipline, combined with early collaboration on individual projects, will facilitate the use of the right tools in the right areas to meet multiple objectives to the greatest extent.

Needs

1. Multi-scale analyses (stand to provincial) A hierarchical multi-scale analysis (e.g. products discussed in this report) is needed to identify those areas of spotted owl habitat that may benefit most by strategic placement of fuels reduction treatments. Conducting this analysis will offer broad potential for the mutual attainment of effective fuels reduction, conservation of spotted owl habitat and silvicultural treatment objectives.
2. Common language Develop a clear understanding of the discipline-specific terminology used to describe forest stands and treatments by the forest resource management specialists. Both commonalities and important differences are present in the terms used to describe similar features of forest stands. Identifying those commonalities and differences will facilitate an understanding of the needs of each discipline, which will in turn facilitate the successful design and implementation of fuels treatments that reduce fire risk to spotted owl habitat.
3. Clear objectives A well defined purpose for any fuels reduction treatment, along with a clearly identified desired future condition that recognizes the dynamic nature of natural systems are needed when identifying treatment areas and developing treatment prescriptions. Consideration of the capability of an individual site, the current condition and a trajectory of what that site will be post-treatment will facilitate the placement of treatments in those areas that may provide the best conservation benefit to spotted owls and their habitats.
4. Province-scale treatment prioritization As identified in Recommendations three and four of the Redmond workshop (Appendix A), the need to develop interagency and interdisciplinary teams at the province level for prioritizing landscape level treatments and at the forest scale for implementation of those treatments to manage spotted owl habitat still exists. Development of these teams will likely require commitment of and support from the Regional Executives.

Impediments

1. No consensus on appropriate action There is a lack of consensus and direction from agency leaders regarding how to proceed with this new paradigm (taking actions in and adjacent to spotted owl habitat in order to protect spotted owl habitat). This lack of direction has manifested as “no action”. Appropriate treatments in spotted owl dry forest habitat needs to be a priority for agency executives.
2. Misperceptions There is a perception that existing laws and agency regulations are at conflict and do not allow staff to do the “right thing”. While this may be true in some situations, many times valuable resources are spent perpetuating this perception rather than fully understanding the existing flexibility of the laws and regulations.
3. Lack of funding There is a lack of funding to plan and implement actions outside of the wildland urban interface.

4. <u>Gaps in knowledge and understanding</u> There is a lack of information or sometimes a lack of common understanding among various specialists, regarding the what, how, where and when of taking specific actions to benefit spotted owl habitat while addressing fire and fuel loading issues. Lack of monitoring information pertaining to the effect of silvicultural treatments to spotted owls is an example.

Products and Their Recommended Uses

Several products were derived from the workshop and serve as aids in addressing some of the operational principles and needs that surfaced from the participants (Table 1). These products are designed as tools to further the workshop goals of calibrating among resource practitioners and collaboratively developing a process to benefit spotted owl habitat by treating high fuel loads through silvicultural practices.

Table 1. Workshop products, value to resource professionals and the relationship of the product to knowledge gained from workshop participants.

Product	Value to resource professionals	Operational principles and needs addressed[1]
1) Bibliography Page 12 and Appendix F	▪ Readily available source of best available science on managing spotted owl habitat in the Klamath Province. ▪ Foundation from which other provinces can build a local bibliography.	Operational Principles: 3,5 Needs: 3,4
2) Structural Component Matrix Page 12 and Appendix G	▪ Highlights the stand structural components important to spotted owl habitat. Crosswalks the importance of those components in determining stand health, trajectory and fire behavior.	Operational Principle: 3,5 Needs: 2,3,4
3) Specialist's Glossary Page 13 and Appendix H	▪ Builds understanding and a common language among different specialists.	Operational Principles: 3,5 Need: 2
4) Abiotic model Page 14 and Appendix I	▪ A systematic way of "predicting" persistence of habitat conditions & likelihood of spotted owl presence. ▪ Provides information for prioritizing or placing treatments.	Operational Principles: 2,4,5 Needs: 1,2,3,4
5) Spotted Owl Occupancy Model Page 15	▪ A tool for estimating amounts of spotted owl habitat within spotted owl core areas.	Operational Principles: 2,4,5 Needs: 1,3,4
6) Landscape Treatment Prioritization Framework Page 16	▪ Identifies the areas of high value to spotted owls and of high fire hazard to help prioritize what treatments to do where and when.	Operational Principles: 2,3,4,5 Needs: 3,4
7) Province-specific Spotted Owl Habitat Parameters Page 17 and Table 3	▪ Enhances habitat description by using local provincial information.	Operational Principles: 2,3,5 Needs: 3,4

[1] See operational principles and needs on page 9.

1) Bibliography

Description In an effort to provide field specialists with accessible information to more effectively manage for spotted owls while addressing fuel concerns, we compiled a bibliography of the most current literature on this topic, with emphasis on the Klamath Province (Appendix F). We asked workshop speakers to provide bibliographic sources for their presentations and we combined this with spotted owl literature that had been compiled within the Service's Oregon and Yreka Fish and Wildlife Offices. The bibliography lists research papers covering several topics, including Klamath Province specific literature on spotted owls and spotted owl habitat; responses of northern spotted owls and their prey to stand treatments; fire regimes, history, behavior, severity and management within dry forests in the range of the northern spotted owl.

Recommended uses and further refinements of this product

- Use available literature to make more informed analyses and decisions regarding effects of projects on spotted owls and their habitat, as well as effectiveness of projects in meeting fuels reduction needs.
- Much of the bibliography is specific to the Klamath Province. Administrative units in other areas are encouraged to revise this bibliography with literature more specific to their province.
- Administrative units are encouraged to update the bibliography as new information becomes available.
- Administrative units are encouraged to share new information as it becomes available, and to contact their local Service office for recent literature summaries.

A bibliography will help administrative units implement treatments to retain spotted owl habitat and address fuel load concerns.

2) Structural Component Matrix

Description The structural component matrix (matrix) (Appendix G) is designed to improve communication among the biology, silviculture and fire disciplines. The matrix will help biologists, silviculturists and fuels specialists see the stand through the eyes of the other specialists and understand the importance of a particular stand structural feature to each of the disciplines. The matrix is designed to calibrate the specialists to ensure that they are indeed discussing the same stand structural features. As such, it helps pull conversations away from the discipline specific jargon that is not always fully understood among disciplines and moves towards identifying the specific stand structural feature of interest. The matrix also looks at the influence of forest stand structural elements on spotted owl habitat, stand health and trajectory, and fire behavior.

Recommended uses and further refinements of this product

- Interdisciplinary teams should review the matrix and ensure that the different specialists are "calibrated" with respect to the terminology they use with each other.

- The matrix should be used during field assessments or reviews of projects to ensure that all components are discussed. Interdisciplinary teams should customize the matrix to fit their locale.
- Interdisciplinary teams also should use the forest residue photo series (e.g. Maxwell and Ward 1980) and the natural fuels photo series publications (Vihnanek et al, 2004) to get a visual image of what different amounts of stand structural components such as snags, down wood, and forest overstory look like. Viewing the pictures alongside the corresponding stand data will help specialists calibrate their eye with respect to what is important to other disciplines.
- Individual units should consider supplementing pictures within the photo series with data of local interest. Such information could include suitability as spotted owl habitat (specific to which structural components are missing or present) or results of fire modeling runs under both extreme and not-so-extreme conditions. This would further encourage cross-discipline communication relating to stand values and probabilities of loss. Creating such a photo series to describe spotted owl habitat was a specific recommendation from workshop participants.

Figure 2. Interdisciplinary groups look at a forest stand and describe the structural features that influence spotted owl habitat, fuels management and stand development.

Use of the structural component matrix should improve communication among different resource specialists and reduce the chance of misinterpretations. Calibration among specialists gives field units better opportunities to implement treatments to retain spotted owl habitat and address fuel load concerns.

3) Specialist's Glossary

Description Another tool to improve communication among the disciplines is a glossary of terms that the different specialists use when discussing forest stands (Appendix H). Comprehensive glossaries for the silviculture and fire professions, such as Helms (1998) and National Wildfire Coordinating Group (2005), provided most of the definitions. While there may be several wildlife or wildlife habitat related documents that contain brief or abridged glossaries, we are unaware of any comprehensive glossary similar in scope to what is available for foresters and fire specialists. Consequently, there may be confusion and misperception when people from different disciplines talk about stand conditions, treatments, and desired future conditions (see Appendix H, Background).

Recommended uses and further refinements of this product

- Biologists, silviculturists and fire specialists should review the glossary and become familiar with the terminology used by the other disciplines. They should consult with the other specialists they work with to make sure all disciplines are applying the same meanings to the same terms. Any questions or discrepancies in meaning should be resolved.
- Documents prepared by all disciplines in support of treatments should use consistent and agreed upon language and meanings. A glossary of language specific to the project documents should be included with the project record.
- Biologists should adopt silviculture terminology because it is standardized and is used in developing stand prescriptions (e.g. example prescription at bottom of Table 3). The structural component matrix, described above (Appendix G), is a way to identify those common stand features and move towards that end.

Use of the specialist's glossary will improve communication among different resource specialists and reduce the chance of misinterpretation. By improving communication, project IDTs have increased opportunities to implement successful treatments to retain spotted owl habitat and address fuel load concerns.

4) Abiotic Model

The abiotic model, as well as products #5 and #6, are models dealing with different aspects of spotted owl habitat. Each model can stand alone for its intended uses or be integrated into the other models to provide for enhanced analysis of spotted owl habitat. The spotted owl occupancy model (#5) is different than the abiotic model (#4) in that the abiotic model uses only abiotic features (e.g., slope, aspect, etc) to suggest areas of potential spotted owl occupancy. In contrast, the spotted owl occupancy model uses amount, configuration and ratio of nesting and foraging habitat, to model probability of habitat occupancy by spotted owls. The landscape treatment model (#6) integrates spotted owl habitat and fire risk to habitat to assist in planning habitat protection and restoration activities in spotted owl habitat.

Description In his overview of spotted owl habitat, B. Woodbridge presented this model. The abiotic model is a tool managers can use to identify locations on the landscape to promote spotted owl activity centers by identifying and modeling abiotic factors associated with known activity centers (Appendix I). Briefly, developing the model entails measuring abiotic variables--such as distance to stream, distance to road, slope position, slope percent, 7th field watershed position, elevation, aspect and curvature--around known spotted owl activity centers and unused or random sites. The data is then analyzed to determine which variables are significantly different between used and unused sites. The final product is a map that identifies and prioritizes specific areas in the project area to promote and develop future spotted owl activity centers based solely on abiotic factors.

Recommended uses and further refinements of this product

- Provinces could explore developing an abiotic model to assess the likelihood of areas containing spotted owls and sustaining habitat. Many of these abiotic features are digitally mapped and simple GIS analyses can be used to show portions of the landscape that may be suitable spotted owl habitat. However, model development is relatively labor and data intensive.

Using this technology to highlight areas that may be suitable habitat helps identify valuable spotted owl sites and aids in determining what treatments should, or should not, be applied to particular locations on the landscape.

5) Spotted Owl Occupancy Model

The spotted owl occupancy model, as well as products #4 and #6, are models dealing with different aspects of spotted owl habitat. See the prelude paragraph under the abiotic model for the distinction among these three products.

Description The spotted owl occupancy model is a tool for estimating amounts of spotted owl habitat within spotted owl core areas. The original work for this model can be found in Zabel et al. (2003). The occupancy model tested predictive capability at several scales in the California Klamath Province, with the best model showing the 500 acre scale best suited for predictive capability. The relationship between varying quantities of nesting/roosting and foraging habitat using this model indicated that the optimal combination of habitat in which the probability of occupancy was highest (90.1percent) was 341 acres of nesting/roosting and 153 acres of foraging habitat. Whereas, the probability of occupancy declined to 56 percent with 500 acres of nesting/roosting and 0 acre of foraging habitat and to <0.1 percent with 0 acre of nesting/roosting and 500 acres of foraging habitat. Although nesting/roosting and foraging habitats are both crucial to spotted owls, these results suggest that owl occupancy in the Klamath Province in California is influenced more by the amount of nesting/roosting than foraging habitat.

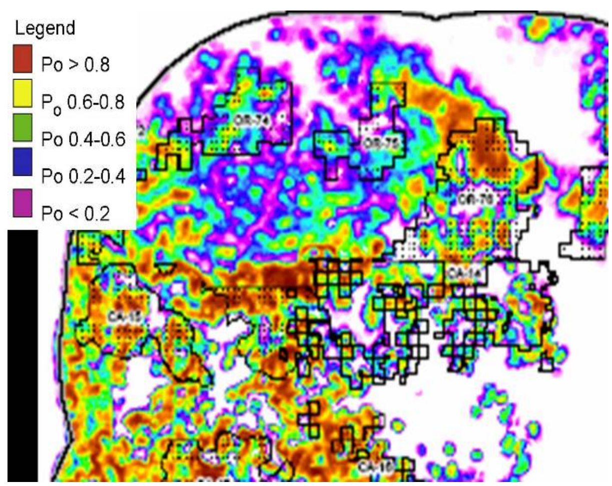


Figure 3. The occupancy model can help determine probabilities of spotted owl occupancy in an analysis area.

Recommended uses and further refinements of this product

- Use of the occupancy model can likely be extended from the California Klamath province into the Oregon Klamath province because of the similar habitat characteristics between the provinces.
- The ratio of habitat within the core area is mostly reaffirmed by Dugger et al. (2005) for southwest Oregon. Therefore, land managers are encouraged to use

this information in project planning in southwest Oregon. The Service's Yreka Field Office and land management agencies currently use this information in project planning in northwest California.

- This modeling approach should be explored for the other Northwest Forest Plan area provinces. Spotted owl habitat suitability maps (Davis and Lint 2005) and other associated data under the monitoring program can be used in occupancy model development. We encourage the Northwest Forest Plan Regional Monitoring Team take the lead in the development of such models. However, local administrative units should also consider building their own models.

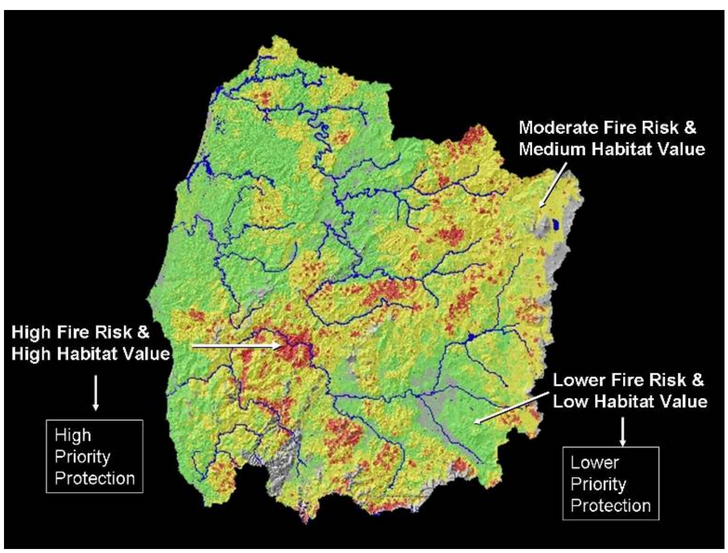
Modeling landscape suitability using forest habitat features can yield valuable management information. The resulting information has tremendous value to Endangered Species Act Section 7 consultations and spotted owl recovery needs by evaluating the effect of changing habitat on estimated probability of occupancy.

6) Landscape Treatment Prioritization Framework

The landscape treatment prioritization framework, as well as products #4 and #5, are models dealing with different aspects of spotted owl habitat. See the prelude paragraph under the abiotic model for the distinction among these three products.

Description A common question that arises when planning a fuel treatment project is, "Is this the right project in the right place at the right time?" Fires operate across landscapes and it is impossible to address the issues of fuels management and its impact on spotted owl habitat without looking at large scales (e.g. 5th field or larger Hydrologic Unit Code). A landscape treatment prioritization framework can help answer that question with respect to addressing spotted owl habitat and fuels treatments.

Figure 4. Combining spotted owl habitat value with fire hazard can allow managers to strategically locate treatments that will most effectively protect spotted owl habitat and reduce fire.



A case study was presented at the workshop by R. Davis and J. Thrailkill describing one potential way of prioritizing fuel reduction treatments on the landscape while retaining valuable spotted owl habitat. The case study presented a conceptual model that merged the wildfire elements that characterized fire hazard on the landscape with the elements that characterized habitat of value to spotted owls. The wildfire elements included: crown fire potential, wildfire density, and fire regime condition class. Spotted owl habitat elements for this case study included: Critical Habitat Units, Forest Plan reserved land allocations, habitat connectivity areas, and known spotted owl sites. A rule set was applied to develop a series of maps that culminated in a composite map depicting the spotted owl habitat categorized by both it's value to owls and it's risk to loss by wildfire. Such a map can guide land managers to prioritize key treatment locations, given limited resources and staffing. This information can also provide greater assurance that the treatments, which themselves can result in some short-term loss or degradation of habitat, are located in areas that are likely to do the greatest good as far as reducing the risk of losing the more valuable spotted owl areas to wildfire.

<u>Recommended uses and further refinements of this product</u>

- A landscape treatment prioritization framework should be done as part of a range-wide, province level analysis (see Priority next steps, Step 2, page 25). The analysis should be a hierarchical, multi-scale, landscape analysis done within National Forests and BLM Districts, as well as across land ownerships to help agencies strategize treatments both spatially and temporally. The data that went into the case study presented is readily available within all spotted owl provinces and doesn't require collecting new information. Map preparation time for the case study took approximately two days (J. Thrailkill, pers. comm. 2006).
- The framework presented at the workshop can be used as a template for a province level analysis. To ensure that similar, compatible map products are developed across the spotted owl's range, coordination would likely need to be done at the regional level. One way to achieve this would be for the Regional Interagency Executive Committee (RIEC) or Senior Manager's Group (SMG) to endorse and support GIS personnel to produce the maps and have the resulting maps reviewed at the local level, for example by Level 1 Teams, for adequacy and accuracy. Resulting maps and GIS themes could then be distributed to local administrative units for project planning.

Doing a landscape prioritization analysis, particularly at the province level, will help identify high value and high risk areas both within and outside management units, providing better context and more support for planning fuel reduction projects that benefit spotted owl habitat in dry forest systems. Combining this information with the specific prescription information described below furthers the strategic goal of identifying what treatments need to be done where and when.

7) Province-Specific Spotted Owl Habitat Parameters Using Klamath Province as an Example

<u>Description</u> Presentations on Day 1 of the workshop described key information specific to the mixed conifer forests of the Klamath Province that can be integrated into projects to more effectively manage spotted owls, owl habitat and fuel hazards. Similar data can refine the current spotted owl habitat descriptions in other provinces.

The following is a description of spotted owl habitat in the Klamath Province. The research community cautions extending these results beyond the Klamath Province.

Spotted owls in the Klamath Province mixed conifer forest consumed woodrats at a rate 2-3 times higher than most other areas within its range, with woodrats comprising nearly one-third of a spotted owl's diet and making up nearly half of the biomass owls consume (Forsman et al 2004). As a result, key features of woodrat habitat (typically brushy areas or younger forest stands) strongly influence how spotted owls use available habitat. Where spotted owls have woodrats as a primary food source, their home ranges are significantly smaller and contain significantly more edge habitat and less older forest (Zabel et al 1995, Carey et al. 1992).

Figure 5. A principle prey species of the spotted owl in the Klamath Province, the dusky-footed woodrat.

Spotted owl distributions and densities are affected by a combination of habitat features, abiotic components and territorial behaviors of the owls themselves. At the home range scale, abiotic features strongly correlated with spotted owl nest site locations are elevation, slope position and distance to streams. See the abiotic model product above for more information.

Habitat composition at the larger, home range scale is probably too variable and general in description to have much predictive value. However, habitat composition within a 500 acre core-use area can be more readily described and has predictive value. Core areas encompass that portion of a spotted owl home range that receives a disproportionate amount of use and is an important determinant of spotted owl occupancy and fitness (Franklin et al. 2000). In the Klamath Province, multiple studies have found roughly 500 acres to be the approximate size of core areas (Hunter et al. 1995, Meyer et al. 1998, Zabel et al. 2003). In all studies reviewed, core areas contained significantly more old growth/mature forests than random sites (Hunter et al. 1995, Meyer et al. 1998, Gutierrez et al 1998). Recommendations from multiple studies as to the amount of core area that should contain old growth/mature forest ranged from 30-60 percent (Bart 1995, Alan Franklin, pers comm. 2006, Hunter et al., 1995, Meyer et al., 1998). Effects of forest fragmentation and heterogeneity on spotted owl survival and reproduction varies among studies. When considering both survival and reproduction, spotted owls appeared to benefit from a mixture of mature/old forest and other cover types in the California Klamath Province. Home ranges composed of entirely pristine old forest may not be optimal for spotted owls in the Klamath Province, although large patches of older forest within the home range do appear to be necessary to maintain a stable population. A mix of 60:30:10 of old forest with other forest types and clearcut has been suggested by A. Franklin (pers. comm. 2006.).

Foraging habitat is usually described in very general terms, such as forest seral stage classes. However, a few studies have described it in terms of forest structural features that managers can use. Densities and sizes of trees in foraging stands are variable (Table 2). However, coarse woody debris tends to be greater (10-15 tons/acre) and shrub cover tends to be sparser (7-8% cover) at foraging sites than at random sites (Gutierrez et al. 1992, Solis 1983).

While nesting habitat may be easier to define than foraging habitat, there are still very few quantitative descriptions of its key components besides a canopy closure (the biological definition, not the silvicultural definition—see specialist's glossary product, Appendix H) typically >70 percent. Multilayered stands with a variety of tree sizes and densities, along with some degree of decadence typically describe nesting habitat and are common features of old-growth/mature forests. Individual nest trees are typically large diameter (>30" dbh) with some structural feature suitable for a nesting site such as a cavity, deformity, or mistletoe broom (Forsman et al. 1984).

Table 2. Basal area of structural features used by northern spotted owls for foraging in the Klamath Province. See Woodbridge slide presentation, slide number 45.

Structural feature	**Basal area optimal range (ft^2/acre)**	**Source**
Live trees	307-334	Solis 1983*
Live trees >35" dbh	157-176	Solis 1983*
Live trees <11" dbh	10	Solis 1983*
Snags	31-38	Solis 1983*
Live trees	180-220	Gutierrez et al. 1992
Live trees >20" dbh	50-60% of total	Gutierrez et al. 1992
Snags > 15" dbh	7-17	Gutierrez et al. 1992
Live trees	160-240	Irwin et al. 2005

*study conducted in Douglas-fir/tanoak

<u>Recommended uses and further refinements of this product</u> Currently, many definitions of spotted owl habitat are used throughout the species range. Per the example above, one can enhance the habitat definition by using the local provincial information on spotted owl habitat use. Most provinces have some level of spotted owl habitat use studies that have been conducted during the past decade (Courtney et al. 2004; Habitat Associations Chapter). Table 3 is an example of how local information can be organized at several different scales. The last portion of Table 3 is one example of a prescription that was presented at the workshop by Dr. Larry Irwin as a starting point for project planning that incorporates quantitative structural spotted owl habitat features based on local information.

Table 3 represents various parameters and their associated attributes and information source(s) to consider when developing prescriptions for spotted owl habitat in the Klamath Province. Though the supporting information may not be applicable to other provinces, we believe the checklist parameters, by providing a framework for compiling information, has application elsewhere within the spotted owl's range.

For each of the dry forest provinces that manage for spotted owl habitat, we recommend the following:

- Use and review best available science for the province, and compile available data for use by local planning team (e.g. bibliography, Appendix F).
- Assemble and organize abiotic and biotic information into some form of a matrix such as Table 3, showing the associated values of habitat parameters at applicable

- scales and state these elements in silvicultural terms. This will help ensure all important habitat parameters and attributes are addressed in project planning.
- Develop project prescriptions based on the summarized values.
- Identify information gaps and prioritize research or monitoring needs to fill those gaps.

Table 3. Northern spotted owl (NSO) dry forest habitat prescription checklist.

Parameter	Attributes	Information Source(s)
	Landscape Level	
Density/Distribution of NSO territories	Nearest neighbor; NSO behavior; competitors	Lint 2005; Hunter et al. 1995; Franklin et al. 2000, Zabel et al. 2003; Courtney et al. 2004; local info (e.g., Anthony and Andrews demography progress reports, USFWS and private industry NSO survey data)
Abiotic features (sites)	Elevation, slope position, aspect, distance to water	Lint 2005; local info; Yreka FWO abiotic model (Appendix I)
Habitat features	Seral stage distribution, forest community types, past disturbance regime	Lint 2005; Zabel et al. 2003; and local info,
Fire Severity and NSOs	Pattern, frequency, position on slope, project planning/prioritization	Taylor and Skinner 1998; Skinner presentation, slide 44; Davis and Thrailkill presentation; Irwin presentation, slides >#21
	Home Range and Stand Levels	
Home range	Size • Home range influenced by degree of forest fragmentation and proportion of home range in mature and old forest • Primary prey species consumed by spotted owls was also related to home range size, with larger home ranges occurring where flying squirrels dominate the diet and smaller home ranges where woodrats dominate the diet	Thomas et al. 1990; Courtney et al. 2004; Irwin et al. 2005; Wagner & Anthony 1999; Carey et al. 1992
Nesting habitat	**Home Range Level** How much, patch sizes, distribution • Much of the more recent information (summarized by Courtney et al. 2004) confirmed the “nesting” habitat definition established by Thomas et al. 1990 • The proportion of older forest within spotted owl home ranges varies by region, ranging from a low of 30 percent to a high of 75 percent (average = 47 percent)	Thomas et al. 1990; Hunter et al. 1995; Gutierrez et al. 1992; Zabel et al. 2003; Meyer et al. 1998; Ripple et al. 1997

Parameter	Attributes	Information Source(s)
Nesting habitat (cont.)	**Stand Structure Level** • Described as closed-canopied mature to old-growth forest, multilayered, with some degree of decadence • Canopy closures typically >70% • High degree of variation in mean diameter, basal area, & trees per acre • At microhabitat level, nest sites typically associated with large (>30") trees with structure (mistletoe, cavity, deformity)	Thomas et al. 1990; Hunter et al. 1995; LaHaye and Gutierrez 1999; White 1996; Hershey et al. 1998
Foraging habitat	**Home Range Level** How much, amount of edge, distribution • Few published studies have used radio telemetry and plot data to describe habitats used by foraging NSOs in the Klamath area • Even fewer have described habitat in terms useful to managers (i.e. structural parameters) • Most studies used seral classes (OG/mature/pole/sapling) or remotely classified vegetation maps (WHR, timber typing)	Zabel et al. 1995; Solis 1983; Irwin et al. 2005; Franklin et al. 2000; Gutierrez et al. 1992
	Stand Structure Level • The following tend to be greater than at random locations: canopy diversity, canopy closure, snag diameter, snag volume, dbh of large trees, & amount of large woody debris • 10-15 tons/ac (Gutierrez et al. 1992) • shrub cover: typically less at foraging than random sites • 6.7 – 8% shrub cover (about ½ of random) • Anthony and Wagner (1998) showed a relationship between increasing canopy layers and spotted owl foraging use in their southwest Oregon study area.	Courtney et al. 2004; Solis 1983; Chow 2001; Ting 1998; Irwin et al. 2005; Gutierrez et al. 1992; Anthony and Wagner 1999; Woodbridge presentation, slides 45-47, plus Table 2 above
Prey habitat	**Home Range Level** Species specific information; habitat composition, elements • Habitats supporting prey populations may not be the same as those typically associated with NSO use • In Klamath Mixed Conifer habitats, habitat relationships of two primary prey species; dusky-footed woodrats and flying squirrels likely dictate optimum home range composition • Woodrats occupy brushy openings, riparian and early-seral habitats; may disperse into adjacent mature stands • Woodrat populations are often unstable at local level, woodrat habitat is short-lived due to succession	Sakai & Noon 1993;, Zabel et al. 1995; Forsman et al. 2004; Carey et al. 1992; USDI 1992; Ward et al. 1998

Parameter	Attributes	Information Source(s)
Prey habitat (cont.)	**Stand Structure Level** • In southwest Oregon, Carey et al. (1992) found that foliage height diversity was an important feature of NSO roost and foraging sites. Hunting success should be improved by stands with a canopy that facilitates location and capture of prey • In areas with woodrats, NSOs might be expected to preferentially forage in stands young enough to contain an abundance of woodrats, yet old enough to allow maneuverability (Thome et al. 1999) • In some other areas, NSOs select foraging areas around talus slopes (Forsman et al. 1984), or in riparian areas (Carey and Peeler 1995, Glenn et al. 2004), probably in response to bushy-tailed woodrat abundance • Ward (1990) showed that NSOs hunted in areas with higher abundance of both woodrats and mice • Pocket gophers, red tree voles and deer mice may be regionally important • Flying squirrels are most abundant in mature, closed canopied stands, often use cavities in snags as den/nest sites • Flying squirrels are the dominant prey in western hemlock/Douglas-fir forest • Snag volume is important to NSO foraging sites because it influences local prey abundance (Carey 1995) • Snags, particularly large intact snags, are likely to have excavated cavities used by flying squirrels. (Carey 1995) • Carey et al. 1999 demonstrated a direct relationship between increasing levels of coarse woody debris (CWD) in a stand and the abundance of small mammals (e.g., flying squirrel) in those stands. The relationship is very clear up to a point where the study sites possessed 10-15 percent cover of coarse wood	Sakai & Noon 1993;, Zabel et al. 1995; Forsman et al. 2004; Carey et al. 1992; USDI 1992, Carey 1995; Thome et al. 1999; Ward et al. 1998; Glenn et al. 2004; Ward 1990
Core/edge; patch area	Core area size; • Size estimates generally converge at approx. 500 acres • Older forest composition 27-78 percent (mean 43 percent)	Zabel et al. 2003; Dugger et al. 2005; Bingham & Noon 1997; Franklin et al. 2000; Meyer et al. 1998; Bart 1995; Hunter et al. 1995; Woodbridge presentation, slide 26-32

Parameter	Attributes	Information Source(s)
Abiotic features - foraging	• Use of stands by NSO is strongly influenced by abiotic features (where it is versus what it is) • Distance to nest site: important variable for central-place forager • Slope Position: foraging activity is concentrated on lower 1/3 of slopes. Not equivalent to distance from water • Elevation: Some preference for lower elevations within home range • Aspect: Preference for north slopes (variable)	Yreka FWO abiotic model, (Appendix I); Rosenberg & McKelvey 1999
NSO behavior	• Known use patterns	Local info.
The information below was presented at the workshop as an example of a starting point for a prescription in NSO habitat. It contains the core concepts that would be included in developing a prescription but site specific details would need to be incorporated. The information represents, largely, the culmination of the information presented throughout the Products section of this report.		
Prescription example for Core Area **Disclaimer: The USFWS does not necessarily endorse this prescription, but supports the concepts presented.**	• 500 acre core area • Emphasize lower slopes for protection vs. ridges • Thin from below but w/heterogeneity • Down wood – 2 logs/ac > 66 ft x 2 inches • 50 percent of core 150 – 225 sq ft/ac, >60 percent canopy cover • < 20 percent of core with 225 sq ft/ac • < 20 percent of core with < 60 sq ft/ac – ridges • Remainder of core 80 – 150 sq ft/ac • Plus the consideration of other parameters/attributes included above in this table	Irwin et al. 2005 Irwin presentation slide 16 Notes: • Spatial characteristics of NSO home range use, combined with the influence of abiotic factors, can be used to assist planning of silvicultural and fuels treatments (and risk assessments) • Tree composition (for some areas)- ponderosa pine<white fir<hardwoods<Douglas fir

Next Steps

Having completed two workshops, Redmond 2005 and Ashland 2006, regarding management of spotted owl dry forest habitat, the question is: Where do we go from here in improving management of at-risk habitat? There are a number of pathways to follow in answering this question. We have summarized the pathways as the following: A) Implementation of the Redmond Workshop Recommendations, B) Implementation of the Ashland Workshop's Products, C) Conduct Research-Research Needs, and D) Priority Next Steps in Managing Spotted Owl Dry Forest Habitat. These are actions that can be implemented immediately to move towards successful management of spotted owl habitat while addressing fuel concerns. Each of the four is briefly discussed below.

A) Implementation of the Redmond Workshop Recommendations.

The Redmond Workshop was intended as an initial step to address fuels treatment within spotted owl habitat. The workshop was well attended by over 100 participants representing multiple disciplines from across the Northwest. A primary product from the workshop included a final report with consensus recommendations. Please see the website: http://www.fws.gov/oregonfwo/ for Appendices and Powerpoint presentations from the Redmond Workshop. It was the overwhelming view of participants, that *No Action Is Not An Option.*

A total of 14 recommendations were distilled from the Redmond Workshop (see Appendix A for a list of the recommendations as well as an update on their implementation status). We encourage the continued implementation of these recommendations. For example, the Ashland Workshop served to implement several of the recommendations (see Introduction herein). However, several of the recommendations will require additional support and commitment from senior managers of the federal forest management agencies to help implement. We encourage the continued dialogue among these executives toward implementation of the recommendations.

B) Implementation of the Ashland Workshop's Products

Herein, this report is intended to provide dry-forest-silvicultural treatment concepts and tactics for use by agency managers, policy makers, and resource practitioners and is included under the report's heading – Products and Their Recommended Uses. We encourage the use of this information, all of which was either presented or developed at the Ashland Workshop for the purpose of improving management of spotted owl dry forest habitat. Please see the Products and Their Recommended Uses section (p. 11) of this report for the specifics. Also refer to Section D) Priority Next Steps in Managing Spotted Owl Dry Forest Habitat (p. 25) for the incorporation of these products into priority actions.

C) Conduct Research – Research Needs

In November 2004, the Service completed a five-year review of the status of the spotted owl (USDI FWS, 2004). Within this review, the Service recommended future actions for research. Several of the research needs resulting from the workshop correspond with the Service's five-year review recommendations. These include the two topics of 1) prey and their response to wildfire and silvicultural treatment and 2) effects of wildfire on spotted owls. For example, information on how spotted owls respond to silvicultural treatments like thinning and fuels reductions is still very limited. Thus, the question becomes, "how does the risk of habitat loss due to wildfire compare to that of habitat treatment?" Research that addresses this question may help balance short-term effects of forest management against long-term effects to habitat in the absence of management.

As mentioned above, a priority research need is to "know more about spotted owl prey response to treatments." A treatment could include fire, either prescribed or natural. Throughout the range of the northern spotted owl, relatively few studies describe prey response to treatments; however studies results are emerging on this topic (e.g., Lemkhul et al. 2006a & b, Gomez et al. 2005, and others; see attached bibliography (Appendix F)). Also, some information on prey response to fire has been compiled within the range of the Mexican spotted owl (Jenness 2000). While the habitat conditions between the

Mexican spotted owl and Klamath Province spotted owls are different, some things may be learned from the prey response relationships to burned habitat.

Another research topic included “how to effectively measure forest stand trajectory.” Based on the workshop discussion on this topic, we assume the interest to be less about measuring trajectory and more about effectively predicting stand trajectories and describing what they will look like in the future. There are several fire and silvicultural tools that can be beneficial in developing silvicultural prescriptions and assessing trajectories and future stand conditions (Appendix J).

All of the research needs presented herein will be shared with the spotted owl research community that meets annually.

D) Priority Next Steps in Managing Spotted Owl Dry Forest Habitat

Information compiled from the Ashland Workshop along with the Redmond Workshop has led the workshop team to develop the following five-point plan as the priority next steps for management of spotted owl dry forest habitat.

1) Take it on the road Because some resource disciplines were not well represented at the workshop(s), take the information to them. Utilize existing meetings (e.g., Province Interagency Executive Committees, Province Advisory Committees, resource discipline technical meetings, local professional meetings such as The Wildlife Society or Society of American Foresters, etc) to present findings from the workshop(s). There is also a need to inform non-federal landowners of information in this report.

2) Produce landscape prioritization maps Use the conceptual process and product presented by R. Davis and J. Thrailkill at the Ashland workshop to produce similar provincial and Forest and BLM District fuels/spotted owl habitat restoration priority maps. The Senior Managers Group received the Davis and Thrailkill presentation in September, 2006 and supported moving forward with this Next Step. An interagency team has been formed to develop and distribute the maps.

3) Action is needed The federal agencies (i.e., FWS, FS, and BLM) should work closely together from design through implementation of a stand-level restoration project(s). An initial step will be to utilize the landscape prioritization map product developed in #2 for project area identification.

4) Hold future workshops The spotted owl habitat—fuel reduction dialogue needs to continue across all scales. This could be accomplished by additional workshops, which both the Redmond and Ashland participants highly recommended.

Figure 7. The Redmond and Ashland Workshops have been valuable venues for interagency and interdisciplinary discussion on managing spotted owls in dry forests . . . especially when combined with a field trip!

Ashland workshop participants suggested a number of future workshop topics (e.g. case history examples), which can be found in Appendix E.

5) Linking science to management Each workshop has recommended the need to understand pre and post-treatment utilization of habitat by spotted owls and their prey. One means to address this is for Service and federal partners to work with research entities to develop funding proposals (e.g., Joint Fire Sciences Program) assessing fuels treatment utilization by spotted owls.

In Conclusion

We believe the Redmond and Ashland workshops have fostered a new level of collaboration among agencies and disciplines, helping specialists understand one another and improving the likelihood of successful integration and collaborative partnership in overcoming impediments to managing spotted owl habitat in dry forests. Furthermore, this workshop has spawned several products to help further this collaboration.

However, implementing those products will take more than just making them available to the field. It will take strong leadership and commitment from regional executives down to field level line officers. Managers need to do much more than just verbally support the workshop outcomes and products. Reducing the risk of catastrophic fire in spotted owl habitat must become an interagency priority. Agencies need to commit staff time and money in a coordinated interagency approach across the range of the spotted owl to make the best use of the limited resources available in addressing spotted owl habitat and fuel hazards in dry forest environments.

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Appendix A. Recommendations from the Redmond Workshop

The recommendations below are outputs of the Redmond Workshop and can be found in full at http://www.fws.gov/oregonfwo/Oregon%20ES%20Field%20Offices/Bend/ForestWorkshop/NSOWorkshopPage.htm They are presented as next-steps and realistic actions that could be taken to address the situation of restoring and maintaining spotted owl habitat in dry forest ecosystems. We have also included brief summaries of accomplishments to date with each recommendation. These recommendations are not in order of priority, however, there is scale associated with them.

1. "No action is not an option". We must continue to move forward.
   Accomplishments: Stand treatment projects with the purposes of reducing fuel loads and maintaining spotted owl habitat are occurring in several areas. For example we are aware of these projects on the Rogue-Siskiyou, Deschutes and Mt. Hood National Forest along with the Medford District Bureau of Land Management.

2. Convene a recovery team to develop a spotted owl recovery plan.
   Accomplishments: The USDI FWS has convened a northern spotted owl recovery team with the purpose of developing a recovery plan for the spotted owl. The plan is scheduled for release in late 2006. It is anticipated that the plan will include goals and objectives for managing dry forest northern spotted owl habitat.

3. Establish interagency provincial teams with the role of setting a provincial context for where fuel reductions would facilitate maintenance and restoration of spotted owl habitat.
   Accomplishments: R. Davis and J. Thrailkill presented a conceptual process and product at the Ashland workshop to produce similar provincial and Forest and BLM District fuels/spotted owl habitat restoration priority maps. See Product 6, Landscape Treatment Prioritization Framework (p. 16). The Senior Managers Group received the Davis and Thrailkill presentation in September, 2006 and supported moving forward with this Next Step. An interagency team has been formed to develop and distribute the maps.

4. Establish interagency Forest level teams to prioritize where to protect existing owl habitat and cores, restore areas most likely to sustain owl habitat, and enhance existing owl habitat through the use of silvicultural and fuels treatments.
   Accomplishments: We are aware of no teams formed for this specific purpose. We do recognize that some Level 1 teams have devoted additional time and resources addressing this issue.

5. Implement interagency planning for projects.
   Accomplishments: Subsequent to the Redmond Workshop, we are aware of several BLM and FS administrative units where FWS personnel have become more integrated into the project planning process. However, we believe this approach is needed to a greater extent across administrative units.

6. Manage for long-term sustainability of owl habitat regardless of land use allocation. Manage the most productive sites with the highest sustainability for spotted owl habitat regardless of the land use allocation boundaries. Manage surrounding areas to allow for low severity fire.

Accomplishments: The accomplishments presented in recommendations #2 and #3 above help toward satisfying accomplishments for this recommendation.

7. Conduct pilot treatment projects.

Accomplishments: As presented in recommendation #1 above, several administrative units are conducting silvicultural treatments within and adjacent to spotted owl habitat. However, these projects do not necessarily include spotted owl monitoring information to more fully ascertain the projects' affects. The exception to this is on the Rogue-Siskiyou National Forest. This Forest, in conjunction with Oregon State University, is collecting pre-project data on spotted owl use patterns in the proposed project area. Data will also be collected during and post project. This monitoring should help provide much needed information on the effects of various fuels reduction treatments on spotted owls.

The REIC has also established a team to design Management Template Experiments. This design will enable more areas to gather information on project implementation in relatively short time periods and under a valid scientific design.

8. Conduct up-to-date surveys and assess habitat conditions for spotted owl.

Accomplishments: The FWS, utilizing National Fire Plan funds, has partnered with the Forest Service in using NFP funds to assist in ESA section 7 consultation efforts. Part of the effort is conducting spotted owl surveys in support of the consultation. However, these funds will be decreasing in the out years, making collection of this much needed information more difficult.

9. Dedicate funding to treatment of habitat outside of the Wildland Urban Interface (WUIs) areas.

Accomplishments: A REIC subcommittee is examining budget options for fire-prone, non WUI, spotted owl habitat projects. We are not aware of any results from this subcommittee.

10. Conduct additional and more frequent workshops on managing dry forest ecosystems within the NWFP area.

Accomplishments: The workshop, Silvicultural Practices Supporting Northern Spotted Owl Habitat in Dry Forest Ecosystems, was held in Ashland, OR, May 2006. Several of the Redmond recommendations were integrated into the development of and resulted in the products from the Ashland workshop. Topics for future workshops, as expressed by Ashland workshop participants, can be found in Appendix E.

11. Facilitate information, education and public involvement.
    Accomplishments: We are not aware of any comprehensive or coordinated strategy to address the recommendation. Implementation of this recommendation could be characterized as mostly opportunistic.

12. Review and establish local habitat definitions.
    Accomplishments: A product from the Ashland 2006 workshop included stand level silvicultural information that can be used for the Klamath province to better describe spotted owl habitat. Similar information and summaries are being encouraged for other NWFP provinces.

13. The Forest Service, BLM and Fish and Wildlife Service should evaluate and make recommendations on the potential use of the NWFP BIOMapper to map suitable owl habitat in dry forests ecosystems.
    Accomplishments: The FWS Northern Spotted Owl Consultation Coordination Team is reviewing the BIOMapper map product. No formal recommendation has yet come from the team on the use of the maps. We are not aware of any formal effort by the BLM or Forest Service for utilizing the maps in their project planning or having these become their “corporate” maps.

14. Address key research questions.
    Accomplishments: We are aware of several research or administrative studies that are being implemented addressing several of the research issues. In particular, studies are addressing barred owl-spotted owl interactions, spotted owl response to habitat treatments, stand level prescription development and landscape level treatment prioritization strategies.

Appendix B. Final Ashland Workshop Agenda

Contact information and biographies of presenters are found in Appendix K of this report.

Silvicultural Practices Supporting Northern Spotted Owl Habitat in Dry Forest Ecosystems: Implementing the 2005 Workshop, "Managing Northern Spotted Owl Habitat in Dry Forest Ecosystems."
May 16-18, 2006
Ashland, OR

Tuesday, May 16, 2006 Stevenson Union, Southern Oregon University Campus

Introduction and Welcome. *Craig Tuss, USDI Fish and Wildlife Service, Roseburg, OR*	8:00-8:05
Setting the stage: Recap from the 2005 workshop. *Nancy Gilbert, USDI Fish and Wildlife Service, Bend, OR*	8:05-8:12
Setting the Stage: Regional executive perspective. *Cal Joyner, USDA Forest Service, Portland, OR*	8:13-8:20
Setting the Stage: Overview and focus for this workshop. *Jim Thrailkill, USDI Fish and Wildlife Service, Portland, OR*	8:20-8:30
Overview: Global to local - Factors influencing Klamath dry forest ecosystems. *Tom Sensenig, USDA Forest Service, Medford, OR*	8:30-9:15
A synthesis of the science on northern spotted owl habitat in the Klamath Province (nesting, roosting, foraging and prey habitat). *Brian Woodbridge, USDI Fish and Wildlife Service, Yreka, CA*	9:15-10:00
Managing for other late-successional species in dry forest environments—moving away from single species management using the fisher as an example. *Laura Finley, USDI Fish and Wildlife Service, Yreka, CA*	10:00-10:15
BREAK	10:15-10:30
Fire and owls, part I: A synthesis of the science on fire dynamics in the Klamath Province. Fire and owls, part II: Integrating the ecology of fire and spotted owls in the Klamath Province. *Carl Skinner USDA Forest Service, Pacific Southwest Research Station, Redding, CA*	10:30-11:30
LUNCH	11:30-1:00

Treatments and methods to manipulate stand structure suitable for fuel reduction or spotted owl habitat. *Greg Chandler, USDI Bureau of Land Management, Medford, OR*	1:00-1:30
Stand response to vegetative treatments: *long-term owl habitat development and fire risk*. *Cori Francis, USDI Bureau of Land Management, Grants Pass, OR*	1:30-2:00
Developing prescriptions within NSO habitat in dry forests of northern California. *Larry Irwin, National Council for Air and Stream Improvement, Stevensville, MT*	2:00-2:30
BREAK	2:30-2:45
Case Study: A conceptual approach for prioritizing landscapes for fuel treatments in northern spotted owl habitat. *Ray Davis, USDA Forest Service, Roseburg, OR; Jim Thrailkill, USDI Fish and Wildlife Service, Portland, OR*	2:45-3:30
Additional questions & answers; wrap-up; logistics for Wednesday field trip. *Craig Tuss*	3:30-4:00

Wednesday, May 17, 2006 Field trip participants to meet at the Medford Interagency Fire Center, located at the Medford BLM District Office at 8:30. (maps provided on Day 1 of workshop)

Participants gather in their small groups & load into appropriate vans	8:30-9:00
Travel from Interagency Fire Center to Squires Fire site	9:00-10:00
Review effectiveness of fuels treatment projects on Squires Fire	10:00-11:00
Travel to Deming Gulch	11:00-11:30
LUNCH	11:30-12:00
First field exercise	12:00-1:15
Second field exercise	1:15-2:30
Third field exercise	2:30-3:45
Travel from Deming Gulch back to Interagency Fire Center	3:45-4:30

Thursday, May 18, 2006 Stevenson Union, SOU Campus

Small groups prepare for report-out on field exercise questions at their assigned field trip stop	8:00-8:30
Small groups report out on field trip exercise questions with group discussion	8:30-10:00
BREAK	10:00-10:15
Evaluation of fire/silviculture/owl habitat checklist	10:15-11:15
Final question & answer session, wrap-up and fill out evaluations	11:15-12:00

Appendix C. Registration Summary

We had 117 people register for the workshop, including 9 members of the workshop planning team. Approximately 100 people attended the workshop. Some were only able to attend a portion of the sessions.

The vast majority of those attending were wildlife biologists (Figure C-1). Forest Service was the agency most represented at the conference, with Fish and Wildlife Service and BLM following (Figure. C-2). Registrants falling into the “other” affiliation category were from the Environmental Protection Agency, National Council for Air and Stream Improvement, and from other private groups. Nearly 70 percent of the registrants were from Oregon, 22 percent were from California, and 8 percent were from Washington.

Roughly 70 people (62% of the original registrants) attended the field trip on the second day of the workshop. By the third day of the workshop, about 60 people were still participating.

Figure C-1: Registrants by Discipline (some claimed multiple disciplines) (n-120)

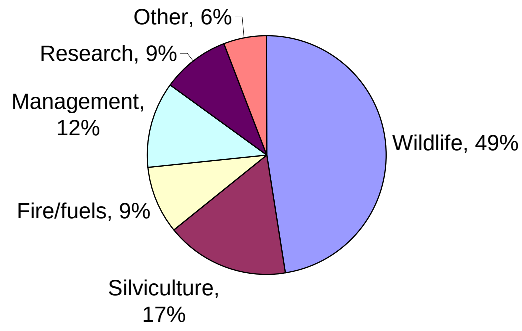
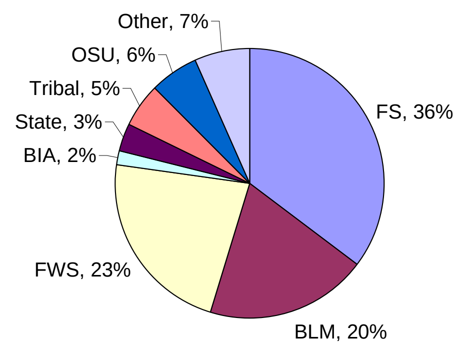


Figure C-2: Registrants by Affiliation (some claimed multiple affiliations) (n-119)



Appendix D. Field Exercise Questions and Responses

A copy of the field exercise questionnaire used on day 2 of the workshop, as well as a compilation of the responses to the questionnaire from field participants can be found on the web at http://www.fws.gov/oregonfwo/FieldOffices/Bend/ForestWorkshop/NSOWorkshop-06.htm

Appendix E. Summary of Evaluation Forms

The following summarizes what participants derived from the workshop, as well as suggestions for improvement and recommendations for future workshops. For a copy of the evaluation form and a compilation of all responses, please go to http://www.fws.gov/oregonfwo/FieldOffices/Bend/ForestWorkshop/NSOWorkshop-06.htm

Introduction

We received evaluations from 42 of the participants. All but 2 of the evaluations received were from people who were at the workshop on the last day; most people who left early did not turn in evaluations. Evaluations were helpful in determining what participants got out of the workshop, the usefulness and practicality of the information they received, suggestions for improvement, and recommendations for future workshops. Some of the information from the evaluations was used to shape the products and recommendations found in this report.

Quantifying the Value of the Workshop to Participants

Two questions on the evaluation form allowed quantification of the responses. One of the questions was, "Will you actually practice on-the-ground implementation of the concepts you heard at this workshop?" 84 percent of the respondents answered "Yes", 13 percent answered "No" and 3 percent answered "Not Applicable". All those who answered no to this question had a caveat to their response noting that their job was not an "on-the-ground" position but they still got something out of the workshop that can be useful in their jobs.

The other quantifiable question asked about the "value of this workshop to your job position: Very, Moderate, Not at All". Nobody responded with a "Not at All" answer, 33 percent responded "moderate" and 67 percent responded "very".

For the most part, those who responded to the evaluations represented their

Figure E-1: Evaluation response by discipline (n=42)

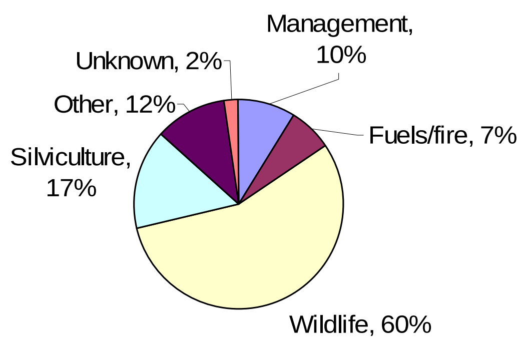
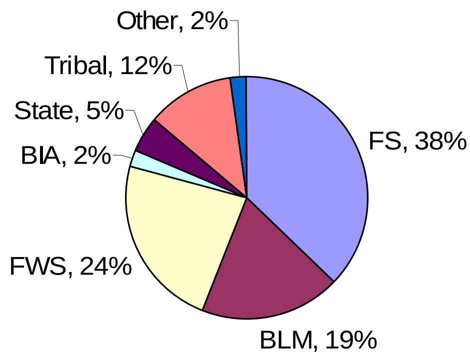


Figure E-2: Evaluation response by affiliation (n=42)



agency/organization and disciplines roughly proportionate to the total attendees (Figs E-1, E-2, also see Appendix C). Note that "research" was not a discipline option on the evaluation sheet, and likely represents some of those who responded as "other".

Interagency and Interdisciplinary Participation a Highlight

Participants highlighted the value of the field trip and associated discussions. Participants also indicated strong support for the integration and ability to interact with multiple disciplines representing multiple agencies and organizations. As one participant noted, "the barriers were down and participants really were ready to share and learn from each other." Several participants highlighted the value of attending this workshop with the specialists representing other disciplines on their home unit. Others expressed their intention to work more collaboratively with and learn more about the other disciplines on their units.

Related to this, a common complaint was that there were not enough participants from fire/fuels and silviculture, and, to a lesser degree, management and the research/scientific community. One participant suggested that a personal outreach to Forest Service managers would be more effective in getting them to attend rather than just sending them an agenda. Another suggested that participation from the fire/fuels specialists may be greater if the workshop occurred outside of fire or the prescribed burning season.

Things to Improve Upon and Need for Future Workshops

While we noted in the workshop announcement that much of the workshop content would be specific to the Klamath Province, we tried to design the exercises and discussions to provide key information and processes usable to derive silvicultural practices for managing spotted owl habitat in other dry provinces. However, we still received a few complaints that the workshop was too region-specific and not useful in areas where issues such as spruce budworm, white-fir and flying squirrels were a more prevalent feature in spotted owl habitat. A few others were disappointed that there was not more new information for them, or that there was too much repetition in the concepts presented. Some felt that parallel workshops in other spotted owl dry forest provinces would be beneficial to discuss issues relevant to their local areas. Washington was specifically mentioned as a suggested location.

Several participants would have liked to have seen additional information on the following topics:

- Managing decadence to provide for spotted owl habitat yet still retain stand vigor and health
- More introductory information on extent of efforts to maintain habitat, policies governing active management, near- and long-term plans
- More practical applications
- More information on spotted owl telemetry data on stand use
- More information on time scale; e.g. when will habitat recover from treatments

- More specific information, such as reasonable basal area targets. A discussion on Larry Irwin's proposed prescription would have been helpful. More information on prey response to treatments and a discussion on fire refugia characteristics.
- Case study or presentation of treatments that have been tried.
- There was a desire to see specific types of treatments, such as:
    - Fuels treatments 5-10 years post treatments and a discussion of its effectiveness
    - Real projects that implemented the concepts presented, with more details, access to data sources used to evaluation and generate treatment prescriptions (e.g. stand info, etc)
    - Prescriptions in young stands (<50 year old plantations) & how to develop late-successional habitat.

Participants provided several recommendations for topics to cover in future workshops, including:

- Monitoring and evaluation results, including implementation and validation monitoring. Specifically, how do treatments affect northern spotted owls; results of using spatially explicit models that integrate spotted owl habitat/presence prediction models with disturbance elements & generates spatial and temporal distribution of forest stands.
- Guidelines for operating in dry forests and success stories
- Specifically define foraging/dispersal habitat vs. nesting/roosting & use silvicultural terms
- Language calibration
- Focus on prescriptions in young (<50 years) stands & best methods to develop late-successional habitat & look at such treatments in the field
- Provide guidance for provincial assessment. Look at riparian & fish issues & apply same tools to riparian reserves
- Focus on barred owl interactions
- Biologists need more knowledge of fire behavior (either through direct observation, conducting suppression or classroom training) and seem to avoid fire and opportunities to understand its potential and likelihood
- Planning for future habitat & projecting long-term effect of treatment
- Assess spotted owl habitat at landscape scale & determine spatial & temporal prioritization for treatment & type of treatment
- Conduct workshops annually to share updates on research & projects

As for the organization and structure of future workshops, people repeatedly noted the field trip as a highly valued experience and would like to see those continue. Some recommended more field time and one wanted to see the stops be away from the road. While people felt the field trip questions helped provide valuable discussion, several felt they were too general and recommended that the scope be narrowed to focus the learning and problem solving capabilities and to better understand the differences among disciplines. Breakout sessions in quiet rooms would have helped some people. A few commented on the workshop length and mix of activities (presentations, field and discussion times), but there was nothing indicating major changes were desired in this area; in general, people seemed to think the length and structure were adequate. There was one suggestion for more, shorter presentations with a panel discussion.

Appendix F. Northern Spotted Owl Dry Forest Habitat Bibliography

A Microsoft Excel version of this bibliography that can be sorted by subject, geographic location, and by workshop presenter, is also available online at http://www.fws.gov/oregonfwo/FieldOffices/Bend/ForestWorkshop/NSOWorkshop-06.htm

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Appendix G. Structural Component Matrix

The following table shows a general cross walk between the stand structural components that are important to spotted owls and the influence of these characteristics on stand health and trajectory and fire behavior. We think this table will be of interest to wildlife biologists, silviculturists and fire managers. Hyperlinks are for terms found in the Specialist's Glossary, Appendix H.

Table 2. Matrix showing influence of stand structural components on spotted owl habitat, stand health and trajectory and fire behavior.

Stand scale structural component (important to owl habitat)	Influence on Northern Spotted Owl habitat	Influence on stand health and trajectory	Influence on Fire behavior
Multi-layered canopy and vertical canopy structure	• Provides variable thermal microhabitats for roosting • Provides cover from aerial predators • Provides cover for nest sites; hunting perches • Prey (tree voles and flying squirrel) habitat • Must be open enough below canopy to allow for owls to move through the stand	• Can be indicator that light is penetrating stand sufficiently to maintain lower canopy and branches	• Increasing the number of layers and their depth increases ladder fuel and probability of surface fire reaching canopy • Increasing canopy closure percentage increases fuel moisture content under canopy
Diversity of species within canopy	• Increases the likelihood of a rich prey base (species richness) • Increase opportunities for cavities or platform nesting structure development	• Indicates stand succession trajectory • Appropriate species diversity in stand is an indicator of stand health	• May change the type of fine fuels accumulating on the ground which will affect amount and burning behavior of surface fuels For Example: The higher the percentage of long needled pines the greater the density of fine fuels on ground. Green deciduous trees

Stand scale structural component (important to owl habitat)	**Influence on Northern Spotted Owl habitat**	**Influence on stand health and trajectory**	**Influence on Fire behavior**
			can reduce crown fire movement but madrone can contribute leaves which are good agents for spotting
Large overstory trees	• Provides suitable nesting site (typically has features suitable for nesting, such as cavities, platforms)	• Provide site adapted seedlings for future stand development unless limited by previous management. • An indicator of a healthy, resilient stand	• Larger trees tend to be more fire resistant than smaller diameter trees In general, the greater the proportion of the stand that has large overstory trees the lower the concern for wildfire
Crown densities and canopy closure	[Desired range for Nesting and roosting is Moderate-High (60-80%) canopy closure] • Provides variable thermal microhabitat • Provides cover from aerial predators • Provides cover for nest sites	• Lower canopy closure increases the ability to retain or develop healthy live-crown ratios (LCRs) • Higher canopy closure can impede development or maintenance of certain understory species • The lower the canopy closure the more likely individual trees (if young) will develop larger diameters and limb sizes.	• Increasing canopy closure percentage increases fuel moisture under canopy • Increasing canopy closure increases the ability of stand to develop and maintain a crown fire
Presence of decay elements (e.g., cavities, broken tops, mistletoe infections, & other evidence of decadence)	• Provides greater probability of cavities and platforms for nesting • Provides greater amounts of foraging and nesting habitat for prey	• Low levels evidence of normal, healthy stand. Moderate levels may change the species composition. Presence above endemic levels can	• Amount, distribution, arrangement, and quality (e.g. rotten, partially rotten, sound) of dead fuels, including horizontal/vertical continuity, influences fire spread rate and

Stand scale structural component (important to owl habitat)	Influence on Northern Spotted Owl habitat	Influence on stand health and trajectory	Influence on Fire behavior
		increase risk to long term condition of stand.	behavior, affecting ability to sustain low severity fires. • Broken tops are more likely to catch sparks and smolder for days • The more mistletoe a stand has in it the greater its potential as a ladder fuel. • Other elements may not drive fire behavior greatly but will impact fire suppression operations (snags as a hazard).
Large diameter snags	• Provide greater probability of cavities and platforms for nesting • Provides greater amounts of foraging and nesting habitat for prey	• Can be vectors of root disease if that is the mortality agent	• Burning snags are more likely to fall and spread fire • While not necessarily affecting fire behavior, snags can affect suppression activities by: • Falling and injuring firefighters. • Blowing over during helicopter operations or fixed wing retardant drops
Fallen trees and other coarse woody debris accumulation on the ground	• Large debris (logs) can provide den sites for wood rats and microhabitat for mushrooms and fungi (food for flying squirrels) • Smaller debris can provide nest-building material for woodrats	• Provide nutrient and moisture reserves (nurse logs) for understory seedling establishment • Contribute to development of soils	• Greater the amount of wood on ground that is not incorporated in to the soil, the greater fuel load in the 10 hour, 100 hour, and 1000 hour class. Finer fuels will influence fire behavior, while larger fuels will affect fire severity.

Stand scale structural component (important to owl habitat)	Influence on Northern Spotted Owl habitat	Influence on stand health and trajectory	Influence on Fire behavior
			• Quality of fuels (rotten, partially rotten, sound) influence fire behavior and spread because they burn and hold moisture differently

Appendix H. Specialist Glossary of Terms

Background

Workshop participants identified two types of miscommunication between forest resource management disciplines that relate to uses of terminology. The first miscommunication can occur either when terms are broad or contextual, or when there are two standardized definitions for the same term. For example, the term “fuel” is broad and includes many different structural components in a forest stand. Without defining the specific type of fuel of interest, different specialists or individuals within a particular discipline can conjure up different scenarios about the “fuel” present within the stand. Some individuals may consider “fuels” to include only the dead material, while others may include all the vegetative material. Still others may include only the material that will carry a fire. Conversely, the term canopy closure, which is a measure of the amount of foliar cover provided by trees in the stand, has a standardized definition that differs between foresters and biologists. Foresters do not account for the light coming through the canopy, while biologists do (see the different definitions below under Forest/Silviculture Terms and Wildlife Biology Terms). Thus, foresters have a mental image of a stand with 70 percent canopy closure that is much less dense relative to what biologists think of when picturing a 70 percent canopy closure. This situation is corrected by aligning or getting agreement (calibrating) between team members as to the specific meaning of the word in the context of the immediate discussion.

The second type of miscommunication can be thought of as a problem of translation, where an individual from one discipline may be unfamiliar with the terminology of the other discipline. An individual may use a particular term incorrectly, such as referring to ground fuels when one really means surface fuels. Another example occurs with terms such as basal area, where biologists, who do not regularly use this term, may have difficulty translating it into biological terms that express forest stand elements important for wildlife.

The following are commonly used terms by fire, silviculture, and wildlife specialists, organized by discipline. Categorizing the terms does not imply that they are unique to a specific discipline, only that the definitions included within a discipline are predominant for that discipline. For some terms, there were subtle and not-so-subtle differences in the definitions found in the primary references used by the different disciplines; where this occurred, all definitions are included and cross referenced among the discipline categories.

Fire Terms

All fuel and fire terms in this section from the National Wildfire Coordinating Group (2005)

Aerial Fuel: The standing and supported live and dead combustibles not in direct contact with the ground and consisting mainly of foliage, twigs, branches, stems, cones, bark, and vines.

Bulk Density: Weight per unit volume. For fuels, this is usually expressed as pounds per cubic foot; for soils, grams per cubic centimeter.

Canopy: The stratum containing the crowns of the tallest vegetation present (living or dead), usually 20 feet. (compare with definition under Forest/silviculture terms).

Crown Fire: A fire that advances from top to top of trees or shrubs more or less independent of a surface fire. Crown fires are sometimes classed as running or dependent to distinguish the degree of independence from the surface fire.

Fire Behavior: The manner in which a fire reacts to the influences of fuel, weather, and topography.

Fire Resistant Tree: A species with compact, resin-free, thick corky bark and less flammable foliage that has a relatively lower probability of being killed or scarred by a fire than a fire sensitive tree.

Fire Suppression: All work and activities connected with control and fire-extinguishing operations, beginning with discovery and continuing until the fire is completely extinguished.

Fuel Class: Part of the National Fire Danger Rating System (NFDRS). Group of fuels possessing common characteristics. Dead fuels are grouped according to 1-, 10-, 100-, and 1000-hour timelag, and living fuels are grouped as herbaceous (annual or perennial) or woody.

- **1-hour Timelag Fuels:** Fuels consisting of dead herbaceous plants and round wood less than about one-fourth inch (6.4 mm) in diameter. Also included is the uppermost layer of needles or leaves on the forest floor.
- **10-hour Timelag Fuels:** Dead fuels consisting of round wood 1/4 to l-inch (0.6 to 2.5 cm) in diameter and, very roughly, the layer of litter extending from immediately below the surface to 3/4 inch (1.9 cm) below the surface.
- **l00-hour Timelag Fuels:** Dead fuels consisting of roundwood in the size range of 1 to 3 inches (2.5 to 7.6 cm) and very roughly the layer of litter extending from approximately three-fourths of an inch (1.9 cm) to 4 inches (10 cm) below the surface.

- **1,000-hour Timelag Fuels:** Dead fuels consisting of round wood 3-8 inches in diameter and the layer of the forest floor more than about 4 inches below the surface.

Fuel Loading: The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area. This may be available fuel (consumable fuel) or total fuel and is usually dry weight.

Fuel Moisture Content: The quantity of moisture in fuel expressed as a percentage of the weight when thoroughly dried at 212 degrees F.

Ground Fire: Fire that consumes the organic material beneath the surface litter ground, such as a peat fire.

Ground Fuel: Combustible material below the surface litter, including duff, tree or shrub roots, punky wood, peat, and sawdust, that normally support a glowing combustion without flame.

Heavy Fuels: Fuels of large diameter such as snags, logs, large limbwood, which ignite and are consumed more slowly than flash fuels. Also called coarse fuels.

Ladder Fuels: Fuels which provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease. They help initiate and assure the continuation of crowning (i.e. crown fires).

Light (Fine) Fuels: Fast-drying fuels, generally with a comparatively high surface area-to-volume ratio, which are less than 1/4-inch in diameter and have a timelag of one hour or less. These fuels readily ignite and are rapidly consumed by fire when dry.

Live Fuels: Living plants, such as trees, grasses, and shrubs, in which the seasonal moisture content cycle is controlled largely by internal physiological mechanisms, rather than by external weather influences.

Retardant: A substance or chemical agent which reduces the flammability of combustibles.

Snag: A standing dead tree or part of a dead tree from which at least the leaves and smaller branches have fallen. Often called a stub, if less than 20 feet tall. *Compare with definitions under Forest/Silviculture Terms and Wildlife Biology Terms.*

Spotting: Behavior of a fire producing sparks or embers that are carried by the wind and which start new fires beyond the zone of direct ignition by the main fire.

Surface Fire: Fire that burns loose debris on the surface, which includes dead branches, leaves, and low vegetation.

Surface Fuel: Fuels lying on or near the surface of the ground, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low stature living plants.

Widow-Maker: A loose limb or top or piece of bark lodged in a tree, which may fall on anyone working beneath it.

Forest/Silviculture Terms

All forest/silviculture terms in this section from the Helms (1998) unless otherwise noted.

Basal area (BA): 1. The cross-sectional area of a single stem, including the bark, measured at breast height (4.5 ft or 1.37 m above the ground). 2, The cross-sectional area of all stems of a species or all stems in a stand measured at breast height and expressed per unit of land area.

Canopy: The foliar cover in a forest stand consisting of one or several layers. .*Compare with definition under Fire Terms.*

Canopy closure, Canopy cover or Crown cover: The ground area covered by the crown of trees or woody vegetation as delimited by the vertical projection of crown perimeters including small openings within the canopy and commonly expressed as a percent of total ground area. *Note* total canopy coverage may exceed 100 percent because of layering of different vegetative strata. *Note* crown cover measures the extent to which the crowns of trees are nearing general contact with each other. *Compare with definition under Wildlife Biology Terms.*

Coarse woody debris (CWD) – any piece (s) of dead woody material, e.g., dead boles, limbs and large root masses, on the ground in forest stands or in streams – *synonym* large woody debris (LWD), large organic debris (LOD), down woody debris (DWD) – *note* the type and size of material designated as coarse woody debris varies among classification systems. *Compare with definition under Wildlife Biology Terms.*

Composition (*species composition***):** The proportion of each tree species in a stand expressed as a percentage of the total number, basal area, or volume of all tree species in the stand.

Cover: 1. an area occupied by vegetation or foliage. 2. Vegetation that protects the soil and provides shading to ground vegetation and regeneration. *Compare with definition under Wildlife Biology Terms.*

Crown: The part of a tree or woody plant bearing live branches and foliage.

Crown (or canopy) class: A category of tree based on its crown position relative to those of adjacent trees – types of crown class are the following:

- **Codominant:** a tree whose crown helps to form the general level of the main canopy in even-aged stands or, in uneven-aged stands, the main canopy of the tree's immediate neighbors, receiving full light from above and comparatively little from the sides.
- **Dominant:** a tree whose crown extends above the general level of the main canopy of even-aged stands or, in uneven-aged stands, above the crowns of the tree's immediate neighbors and receiving full light from above and partial light from the sides.
- **Emergent:** a tree whose crown is completely above the general level of the main canopy, receiving full light from above and from all sides.
- **Intermediate:** a tree whose crown extends into the lower portion of the main canopy of even-aged stands or, in uneven-aged stands, into the lower portion of the canopy formed by the tree's immediate neighbors, but shorter in height than the codominants and receiving little direct light from above and none from the sides.
- **Overtopped (suppressed):** a tree whose crown is completely overtopped by the crowns of one or more neighboring trees – *note* the vigor of overtopped (suppressed) trees varies from high to low depending on individual circumstances.
- **Predominant:** a tree whose crown has grown above the general level of the upper canopy.

Crown closure: the point at which the vertical projections of crown perimeters within a canopy touch.

Crown density, Canopy density, Crown bulk Density: The amount and compactness of foliage of the crowns of trees or shrubs

Crown height: The vertical distance from ground level to the crown base (bottom of the live crown) of a standing tree.

Crown length (live crown): *of a standing tree* the vertical distance from the tip of the leader to the base of the crown, measured to the lowest live whorl (upper crown length) or to the lowest live branch, excluding epicormics (lower live crown length) or to a point halfway between (mean crown length).

Endemic: 1. indigenous to (native) or characteristic of a particular restricted geographical area. 2. A disease constantly infecting a few plants throughout an area. 3. A population of potentially injurious plants, animals, or viruses that are at low levels.

Hazard tree: Any potential tree failure due to a structural defect that may result in property damage or personal injury (Johnson 1981).

Height class: 1. Any interval into which a range of tree or plant heights may be divided. 2. The actual trees or plants falling into such an interval.

Live Crown Ratio: The ratio of crown length to total tree height

Mean Diameter *of a group of trees, crop, or stand*: **1.** quadratic mean diameter, the diameter corresponding to their mean basal area. **2.** arithmetic mean diameter, the arithmetic mean of the diameters.

Overstory: That portion of the trees, in a forest of more than one story, forming the upper or uppermost canopy layer.

Relative Stand Density: The ratio, proportion, or percent of absolute stand density to a reference level defined by some standard level of competition.

Shade density: The complement of the percent of light intercepted by crowns, assuming that uninterrupted light has, at the time of measurement, a value of 100 percent – *see* **crown density.**

Snag: **1.** A standing, generally unmerchantable dead tree from which the leaves and most of the branches have fallen. 2. A standing section of the stem of a tree, broken off usually below the crown. *Compare with definitions under Fire Terms and Wildlife Biology Terms.*

Stand: A contiguous group of trees sufficiently uniform in age-class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit

Stand Age: The mean age of the dominant and codominant trees in an even-aged stand. *Note* the concept of stand age is complex in the case of two-aged stands, uneven-aged stands, or stands with residual green trees.

Stand Density: 1. A quantitative measure of stocking expressed either absolutely in terms of number of trees, basal area, or volume per unit area or relative to some standard condition. 2. A measure of the degree of crowding of trees within stocked areas commonly expressed by various growing space ratios, e.g. height/spacing.

Stand Density Index (SDI): 1. A widely used measure that expresses relative stand density in terms of the relationship of a number of trees to stand quadratic mean diameter. 2. Any index that expresses relative stand density based on a comparison of measured stand values with some standard condition.

Understory: All forest vegetation growing under an overstory.

Wildlife Biology Terms

Canopy closure: The degree to which the canopy blocks sunlight or obscures the sky. It can only be accurately determined from measurements taken under the canopy, as openings in the branches and crowns must be accounted for. (Johnson and O’Neil 2001). *Compare with definition under Forest/silviculture Terms.*

Coarse Woody Debris: Portion of a tree that has fallen or been cut and left in the woods. Usually refers to pieces at least 20 inches in diameter (Johnson and O'Neil 2001).

Cover: Vegetation used by wildlife for protection from predators, to mitigate weather conditions, or to reproduce. May also refer to the protection of soil and the shading provided to herbs and forbs by vegetation (Johnson and O'Neil 2001). *Compare with definition under Forest/Silviculture Terms.*

Decadence: Descriptive term for a forest stand exhibiting high incidence of large trees, some with broken tops and other indications of old and decaying wood (part of the old-growth forest definition in Forest Ecosystem Management Assessment Team 1993).

Decay: 1. The decomposition of wood by fungi and other microorganisms resulting in softening, progressive los of strength and weight, and often in changes of texture and color. 2. The decomposing or decomposed wood (Helms 1998).

Habitat: 1. The place, natural or otherwise, (including climate, food, cover, and water) where an animal, plant or population naturally or normally lives and develops (Helms 1998). 2. The place where a plant or animal naturally or normally lives and grows (Forest Ecosystem Management Assessment Team 1993). 3. The place, including physical and biotic conditions, where a plant or an animal usually occurs (Johnson and O'Neil 2001).

Microhabitat: The specific combination of habitat elements in the locations selected by an organism for specific purposes or events. Note the term expresses the more specific and functional aspects of habitat and cover; distinctive physical characteristics distinguish the microhabitats within an organism's habitat (Helms 1998).

Multi-layered Canopy: Forest stands with two or more distinct tree layers in the canopy; also called multi-storied or multi layered stands (Forest Ecosystem Management Assessment Team 1993).

Snag: 1. Any standing dead, partially dead, or defective (cull) tree at least 10 inches in diameter at breast height and at least 6 feet tall. A hard snag is composed primarily of sound wood, generally merchantable. A soft snag is composed primarily of wood in advanced stages of decay and deterioration, generally not merchantable (Forest Ecosystem Management Assessment Team 1993). 2. A standing dead tree or stump that provides habitat for a broad range of wildlife, from beetle larvae (and the birds that feed upon them) to dens for raccoons (Johnson and O'Neil 2001). *Compare with definitions under Fire Terms and Forest/Silviculture Terms.*

Species Richness: A measure of the number of species present in a community, ecosystem, landscape, region, etc (Helm 1998).

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Appendix I. Process for Developing an Abiotic Model

A paper describing this process is available on the web at http://www.fws.gov/oregonfwo/FieldOffices/Bend/ForestWorkshop/NSOWorkshop-06.htm. For further information on this process, please contact either David Johnson or Brian Woodbridge at the U.S. Fish and Wildlife Service, Yreka Fish and Wildlife Office, 530-842-5763.

Appendix J. Silviculture and Fire Applications For Use in Developing Spotted Owl Habitat-Dry Forest Projects

We suggest that the following fire and silvicultural tools could be beneficial to developing silvicultural prescriptions and assessing resulting stand trajectory.

Computer applications for assessing wildland fire[1]: available at http://fire.org/or at http://www.fs.fed.us/fmsc/fvs/or at http://www.essa.com

- BehavePlus: This application can be used to predict a number of different factors given fuel loadings, arrangements, and weather that describe fire behavior, in terms of rate of spread, flame length, size of fire, and spotting distances.

- Fire Area Simulator (FARSITE): A fire growth simulation model that computes fire behavior and spread over a range of time under conditions of heterogeneous terrain, fuels, and weather. This model projects where and how fast a fire may spread and how hot or intense it may burn. It is a fire growth simulation model that uses spatial information on topography and fuels along with weather and wind files.

- Fire and Fuels Extension – Forest Vegetation Simulator (FFE-FVS): A model developed to simulate forest growth and yield but has been adapted to provide information for fuels reduction. It provides expected fire behavior and effects if a wildland fire burns through an area over the simulation period.

- FlamMap: A software program that creates geographic information system maps of potential fire behavior characteristics and environmental conditions. It is not a replacement for FARSITE or a fire growth simulation model. There is no temporal component in FlamMap. It uses spatial information on topography and fuels to calculate fire behavior characteristics in one instant.

- First Order Fire Effects Model (FOFEM): A computer program for predicting tree mortality, fuel consumption, smoke production, and soil heating caused by prescribed fire or wildfire. First order fire effects are those that concern the direct, indirect or immediate consequences of fire. Currently, FOFEM provides quantitative fire effects information for tree mortality, fuel consumption, mineral soil exposure, smoke and soil heating.

- NEXUS: A crown fire hazard analysis software that links separate models of surface and crown fire behavior to compute indices of relative crown fire potential.

[1] Reference document titled the "Wildland Fire Use Implementation Procedures Reference Guide" (2005 Guide) pages 33-35

- Vegetation Dynamics Development Tool (VDDT): This model uses state in transition models or box and arrow diagrams to show how vegetation can change over time

- Organon: A model developed to simulate forest growth and yield, similar to FVS but specific to Western and SW Oregon and Northern California. Used extensively by the BLM. For questions and user support contact: **organon**@oregonstate.edu. www.cof.orst.edu/cof/fr/research/**organon**/

- Stand Visualization System (SVS): This application creates images that show how fire behavior differs during wildfire under various scenarios, like wildfire only or with prescribed fire. This runs in the FVS program. A similar visualization program is embedded in the Organon program as well.

- Fuels Management Analyst (FMA): This application includes the photo series that depicts various fuel loads by stand composition and structure. It will predict fire behavior based on tree lists and fuel model parameter inputs. It also includes a valuable crown mass inventory that depicts pre and post crown fuel totals. An additional feature is an embedded fuel planer intercept program that runs Brown's fuel transects.

The following web sources may provide additional information regarding the topics discussed during the workshop**:**

Pacific Southwest Research Station web site: http://www.fs.fed.us/psw/

PSW Redding Laboratory web site: http://www.fs.fed.us/psw/redding/
Information on the Blacks Mountain Interdisciplinary Ecological Research project, the Goosenest Adaptive Management Area project, the Cone Fire, and other activities of the Redding Lab.

Fire and Fire Surrogates Study web site: http://www.fs.fed.us/ffs/

U.S. Fish and Wildlife Service web site: http://www.fws.gov/oregonfwo/
Synthesis reports from the 2005 Redmond and 2006 Ashland Workshops, presentations given at both workshops, and additional appendices for the 2006 Ashland Workshop report.

Appendix K. Presenter's Biography and Contact Information

Presenter's biographies can be found at http://www.fws.gov/oregonfwo/FieldOffices/Bend/ForestWorkshop/NSOWorkshop-06.htm. Contact information for the presenters is below.

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