Southwest Oregon Secretarial Pilot Projects on BLM Lands: Our Experience So Far and Broader Considerations for Long-term Plans

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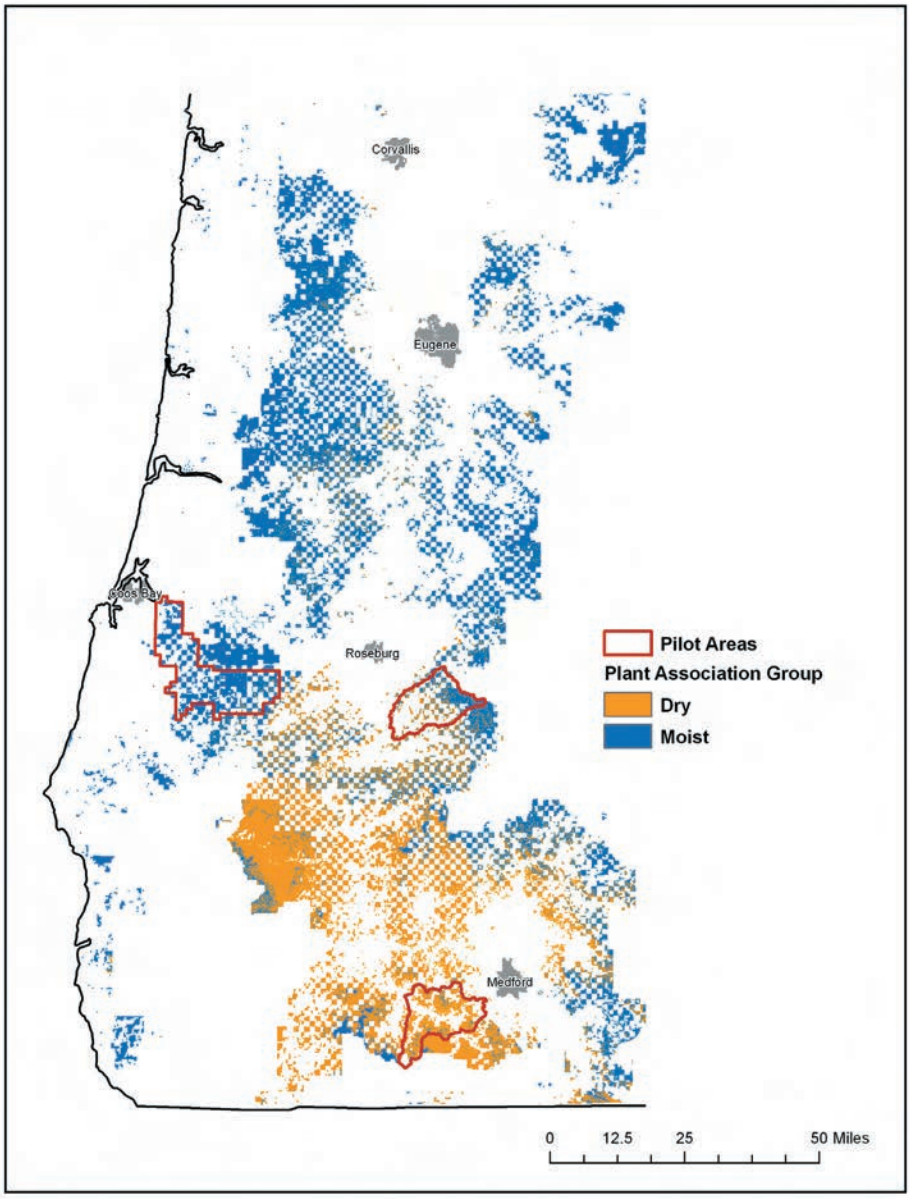

Southwest Oregon Secretarial Pilot Projects on BLM Lands: Our Experience So Far and Broader Considerations for Long-term Plans[1]

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I. SUMMARY

Background and Problem Definition

The Bureau of Land Management's (BLM) western Oregon forests play a crucial role in the conservation strategies institutionalized in the Northwest Forest Plan (NWFP). These forests are strategically located in portions of the region important to species listed under the Endangered Species Act such as Northern Spotted Owl, Marbled Murrelet, and coho salmon. As conceived in the NWFP, BLM lands would provide a sustainable level of timber harvest while fulfilling conservation objectives. Expectations regarding timber harvests have not been met, however, due to legal and social challenges to activities and escalating conservation requirements, such as for the Northern Spotted Owl, which have created uncertainty regarding the land base available for sustained timber production. In addition, the potential end of Congressionally-appropriated county payments--historically derived from federal timber stumpage--and high unemployment in southwest Oregon counties have refocused attention on timber harvest from these lands.

Harvest projections in the NWFP assumed that stands currently over 80 years of age in the Matrix and Adaptive Management Area allocations would be subject to regeneration harvests over time (harvests that remove most of the mature stand followed by planting seedlings to produce the next stand of trees), especially during the first 30 years of the NWFP. Such harvesting has generally not occurred.

Most of BLM's western Oregon lands can be categorized as highly productive "Moist Forests." BLM's current risk-adverse strategy of thinning Moist Forest plantations can, at best, continue to produce current levels of timber harvest volume for a decade or so, but with relatively low levels of revenue return, particularly as compared with regeneration harvests.

Some of BLM's western Oregon lands can be categorized as "Dry Forests." Although Dry Forests are significantly less productive than the Moist Forests, they require active restoration management to improve their diversity and sustainability in the face of risks from wildfire and insect outbreaks associated with drought, which are expected to increase due to climate change. As in the Moist Forests, the BLM has been largely unable to undertake the necessary level of active restoration management in the Dry Forests, which would also contribute to the timber harvests projected in the NWFP.

Over the last few years we have analyzed issues on federal forest lands in the Pacific Northwest and proposed restoration strategies that could contribute to both the ecological health and economic benefits from these lands, including those managed by the BLM in western Oregon. Subsequently we were asked by the Secretary of the Interior to work with BLM personnel in applying these principles in three pilot projects, and help understand their implications for long-term plans for these lands.

Goals of the Pilots

- In collaboration with the BLM, demonstrate how the Franklin/Johnson forest restoration principles on the BLM's western Oregon forests can provide both ecological and economic benefits;

- Apply these principles in both Moist Forests and Dry Forests;
- Develop the pilots in the context of the NWFP (the guiding plan for the last 15 years), recovery of the Northern Spotted Owl, and other administrative authorities;
- Involve both the US Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration Fisheries Service (NOAA-F) (the two agencies that administer the Endangered Species Act) from the beginning of project development;
- Produce viable timber sales within 12-18 months; and
- Describe how the approaches used in the pilot projects might fit into the long-term plans.

Preliminary Observations

Sustained yield timber harvest levels and revenue to counties from the BLM western Oregon forests will largely be determined by activities in Moist Forests. Moist Forests provide the foundation of sustained yield on BLM's western Oregon lands because they represent the vast majority of their productivity (over 3/4).

The Roseburg and Coos Bay Pilot Projects demonstrate the character and feasibility of variable retention harvesting in younger (50-110 year old) "Moist Forests" with the goals of restoring diverse early successional ecosystems--an ecologically important, but largely missing, forest development stage--while also providing timber harvest. We describe these types of harvest as "early successional harvests" to distinguish them from classical "regeneration harvests" that focus exclusively on establishing the next crop of trees. Our strategy considers this type of harvest to be only one element in a comprehensive silvicultural system that includes management of mixed-age, mixed-species forests on long rotations. Achieving the sustained yield from Moist Forests envisioned in the NWFP under this restoration strategy, will require expansion of lands available for timber production (i.e. Matrix) to compensate for additional lands occupied by older forests that would be reserved and the lower yields that would be produced compared to more traditional timber production.

The Medford Pilot Project demonstrates restoration treatments designed to reduce stand densities and increase heterogeneity in Dry Forest landscapes with the goal of improving their ecological functioning and sustainability, including current and future threats from wildfire, drought, and insects. The restoration strategy includes retaining dense forest patches needed as habitat for the Northern Spotted Owl (NSO) and retaining riparian trees that provide shade and large wood recruitment for coho salmon.

BLM, with the assistance of the USFWS and NOAA-F, has demonstrated that it has the expertise and capability to implement both the Dry Forest and Moist Forest restoration strategies.

Gaining broad support for these strategies will require new perspectives on active forest management. An intensive program of engagement and education will be needed.

Suggestions for Moving Forward

Creation of a stable land base for timber and revenue production--while maintaining a commitment to conservation of species and ecosystems, an important goal of long-term planning--faces several challenges and requires a variety of efforts.

- Scientific reviews can help:
  - Determine where special protection measures are needed for the Red Tree Vole;
  - Provide systematic analysis and reconsiderations of the interim Riparian Reserves developed under the NWFP to create customized, site-based approaches consistent with the intent of the Aquatic Conservation Strategy; and
  - Undertake analysis of the potential for some new alternatives, such as allowing sustained timber harvests in some young previously-harvested forests within Late Successional Reserves, or integrating ecologically-based timber harvests with habitat protection within Critical Habitat for the Northern Spotted Owl.
- Approaches implemented in the pilots could increase the compatibility of long-term timber production with species and ecosystem conservation.
- Determining the "appropriate" land base for timber production can be informed but not defined by scientific considerations. Policy makers are responsible for identifying important resource values, determining acceptable trade-offs among resource outputs and risks to species and ecosystems, and deciding where the burden of proof lies when uncertainty exists. Within a decision framework provided by expression of those preferences, science and scientists can help develop and evaluate choices for resource management.

Field trip last fall to the Dry Forests of the Roseburg District to begin application of the Dry Forest strategy in a mature stand. All old trees (like the one behind Jerry and Norm) would be protected.

Field trip last fall to the Moist Forests of the Roseburg District to begin application of a Moist Forest Strategy to a 60- year old stand that came in after a previously clear-cut.

Scoping out the candidate stands at the top of Myrtle Creek (Chris Foster BLM Wildlife biologist and Debbie Johnson).

Working with the BLM professionals on stand selection and retention placement (Lisa Ranen BLM wildlife biologist in middle)

Remnant down wood from a previous clearcut that will be part of an aggregate retained during regeneration harvest.

Checking out the potential for a variable-retention regeneration harvest in simple 50 year old previously clear-cut stand. This is the youngest stand in our Moist Forest demonstration.

Discussion of proposal for 60-year old Pilot stand that came in after a clearcut: variable retention early successional harvest to create diverse early-seral ecosystems.

Congressman DeFazio expressing his vision for the O&C lands on one of the field trips.

Jerry Franklin covers strategy for a 110-year old stand that has not been previously harvested: early successional harvest with retention of complex structure aggregates and old trees like the one near him.

Paul Henson (USFWS) discusses Northern Spotted Owl recovery in 110 year old stand with Senator Merkley (light shirt, left), and Congressman DeFazio (center, cap). This 110 year old stand is illustrative of type of stand that could be produced under the proposed strategy.

Amy Amrhein, (Senator Merkley's staff) asks a clarifying question.

Abe Wheeler, BLM forester explains: Most trees in the foreground would be harvested, creating openings for early successional communities. None are old growth.

BLM employee searches for a Red Tree Vole nest in 110 year old stand.

Diverse Early Successional Ecosystems and Variable Retention Regeneration Harvest

Representative diverse early successional ecosystem fifteen years after a timber harvest on BLM lands on the Roseburg District. The area is currently dominated by several shrub species with Douglas-fir saplings beginning to emerge above the shrub cover. Retention on this unit was in the form of dispersed dominant conifers; in the Franklin-Johnson strategy retention would be primarily in forest patches ("aggregates") with dispersed snags and down logs elsewhere in the unit.

Interior view of the early successional community shown above. Shrub species include snowbrush, manzanita, bitter cherry, trailing blackberry, and elderberry as well as a variety of herbaceous plants. Douglas-fir saplings are beginning to emerge from the shrub communities with one visible behind BLM forester Abe Wheeler (black t-shirt).

Example of variable retention harvesting as practiced on the trust lands managed by the Washington State Department of Natural Resources under terms of a Habitat Conservation Plan with US Fish and Wildlife Service. Retention is primarily in the form of forest patches ("aggregates), some of which are associated with riparian habitat. Some dispersed retention is also included to provide for distributed sources of snags and down logs. Retention covers approximately 20% of this harvest unit.

Initial stand reconnaissance with Coquille Tribal professions including John Gordon (left), Jason Robison (middle), and Tim Vredenberg (right)

Typical 60-year old stand in BLM Coos Bay District that developed after the previous stand was clearcut (notice old growth stumps).

Jerry Franklin working with BLM and Tribal professionals on retention patch layout. These patches would be distributed across harvest units, protecting special features such as this draw.

Debbie Johnson GPSing boundaries of retention patches that would be left at regeneration harvest.

Typical Coast Range scene–intensively managed industrial lands interspersed with BLM forests (lower right).

A standard industrial prescription is to clearcut followed by planting and suppression of competing vegetation–good for growing wood but not for creating diverse early successional ecosystems.

Travis Joseph (aide to Congressman DeFazio) examines old growth logs and stumps in the Pilot stand from the harvest long ago.

Jerry Franklin explaining the proposed early successional harvest (approx. 30% retention) followed by modest planting and nurturing of the shrub/wildlife community as a stage of forest development–a stage that the Coast Range lacks.

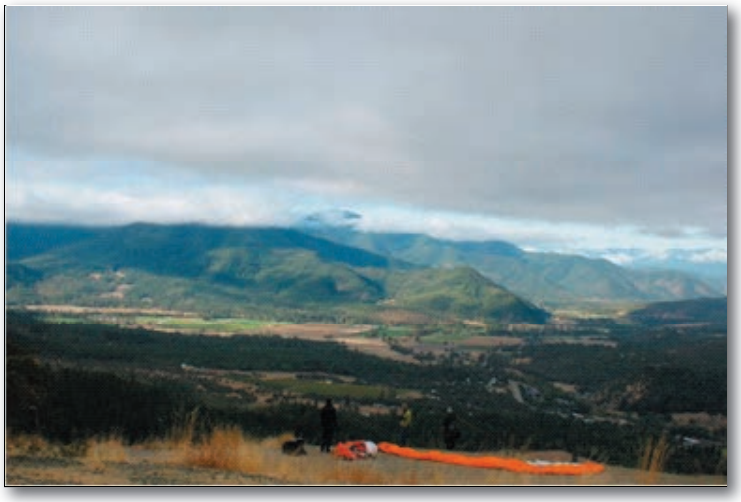
Old growth remnant–this tree would be retained during early successional harvest.

Older Port Orford cedar would be retained. (Norm at base of tree on right.)

Larger hardwoods like this cluster of golden chiquapin would be retained.

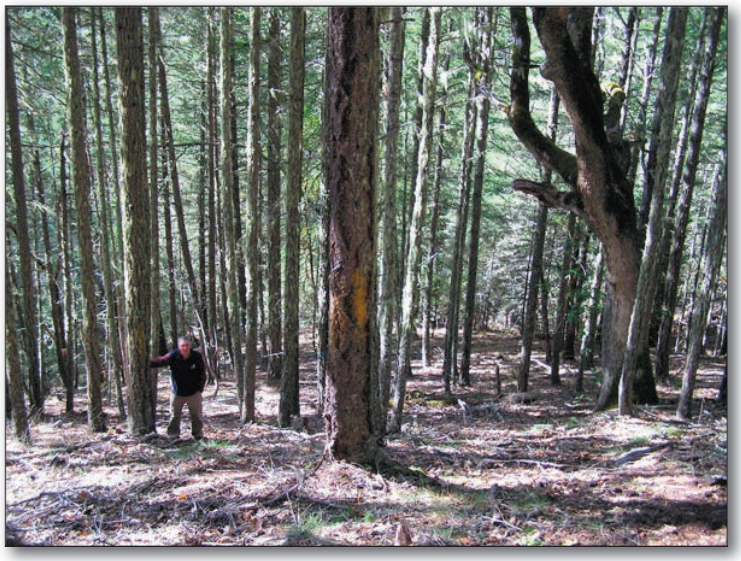
Coquille Tribe professional explaining the application of the Franklin/Johnson strategy to the Pilot stand on a recent field trip.

Eva Bailey, forester for Coos Bay BLM responsible for unit layout in the Pilot stand, explaining her approach.



Looking toward the site of the Pilot restoration demonstration within the Middle Applegate.

Dense stands of Douglas-fir in the middle Applegate–most probably first generation forests.



Ed Reilly, BLM professional, showing occasional large, old pines (foreground) and madrone (right) from the past more open forest are now being crowded out by younger, dense stands of Douglas-fir.

A cavity in an old hardwood – a key forest component for wildlife

Brian Woodbridge (USFWS) talking about northern spotted owl recovery along with Cindy Donegon (USFWS) on an initial trip into the middle Applegate to discuss the restoration strategy.

Jerry Franklin and professionals from the Medford BLM discussing restoration principles. After initial demonstration of the desired outcomes, the Medford BLM marked the stands and Norm and Jerry reviewed them and made suggestions.

Jerry Franklin describing his approach to restoration–hardwoods would be retained to the degree possible (especially large, old hardwoods) while many of the smaller, younger Douglas-fir would be harvested, creating a less uniform, more heterogeneous structure. All old growth conifers would be protected.

A cluster of old Douglas-fir marked for retention. These scattered old Douglas-fir, found especially in draws and on north-facing slopes, provided the seed source for the dense stands that now dominate the middle Applegate.

Old ponderosa pine (left), black oak (middle), and madrone (right) marked for retention, while the surrounding Douglas-fir would be cleared out from around them. Assistant Secretary Sylvia Baca (blue coat).

Loren Kellogg, OSU Forest Engineering Professor, discussing logging and road building options on a field trip.

Fishery and hydrology experts, including Jim Muck (in orange) (NOAA-F), discuss protecting/restoring aquatic systems.

II. KEY FINDINGS

1. Purpose of the Secretarial Pilot Projects: Demonstrate the Franklin/Johnson forest restoration principles on the BLM "O&C" forest lands in southwest Oregon.

Specific objectives include:

- Developing the pilots in the context of the Northwest Forest Plan (NWFP) (the guiding plan for the last 15 years), recovery of the Northern Spotted Owl (*Strix occidentalis caurina*) (NSO), and other administrative authorities;
- Planning and implementing silvicultural treatments that provide both ecological and economic benefits;
- Utilizing stands that meet the intent of the demonstration, but that also tend toward the less contentious; and
- Producing viable timber sales within 12-18 months.

Our experiences so far:

2. Pilot Projects illustrating the Franklin/Johnson restoration strategy are being implemented on Medford, Roseburg, and Coos Bay Districts of the BLM (Figure 1).

- All pilot projects are progressing through administrative processes and one has already been sold. Litigation could delay implementation of one or more of the pilot projects. No protests or administrative appeals were received on the Medford Pilot Phase I project, which sold for over four times the appraised value. The Coos Bay Pilot timber sale is scheduled for this winter and the Roseburg Pilot units for sometime in 2012.

- In each case, we sought sufficient acreage to demonstrate restoration principles for a "classroom in the woods"--250 acres in Roseburg and Coos Bay and 500 acres in Medford. The Roseburg Pilot stands, in aggregate, total a little more than 250 acres and the Coos Bay Pilot covers a little less. The Medford Pilot covers 900 acres of which about 250 will undergo commercial treatments and at least that many acres will undergo non-commercial treatments.

- All pilot projects are located in either the "Matrix" or the "Adaptive Management Area" allocations of the NWFP, which currently guides BLM activities (Figure 2). These allocations have long-term timber production as one of their goals.

- We purposely located pilots in both "Moist Forests" and "Dry Forests" to illustrate restoration principles in fundamentally different types of forests (Figure 3).

- We focused on aspects of our restoration strategy that are important to conservation and management of BLM western Oregon forests--such as regeneration harvests (which we have renamed "early successional harvests" to better reflect their ecological goal) in Moist Forests and density reduction in Dry Forests--but that are now limited in application due to social controversies.

- We sought a variety of stand condition and ages to illustrate different ecological and economic issues and opportunities.

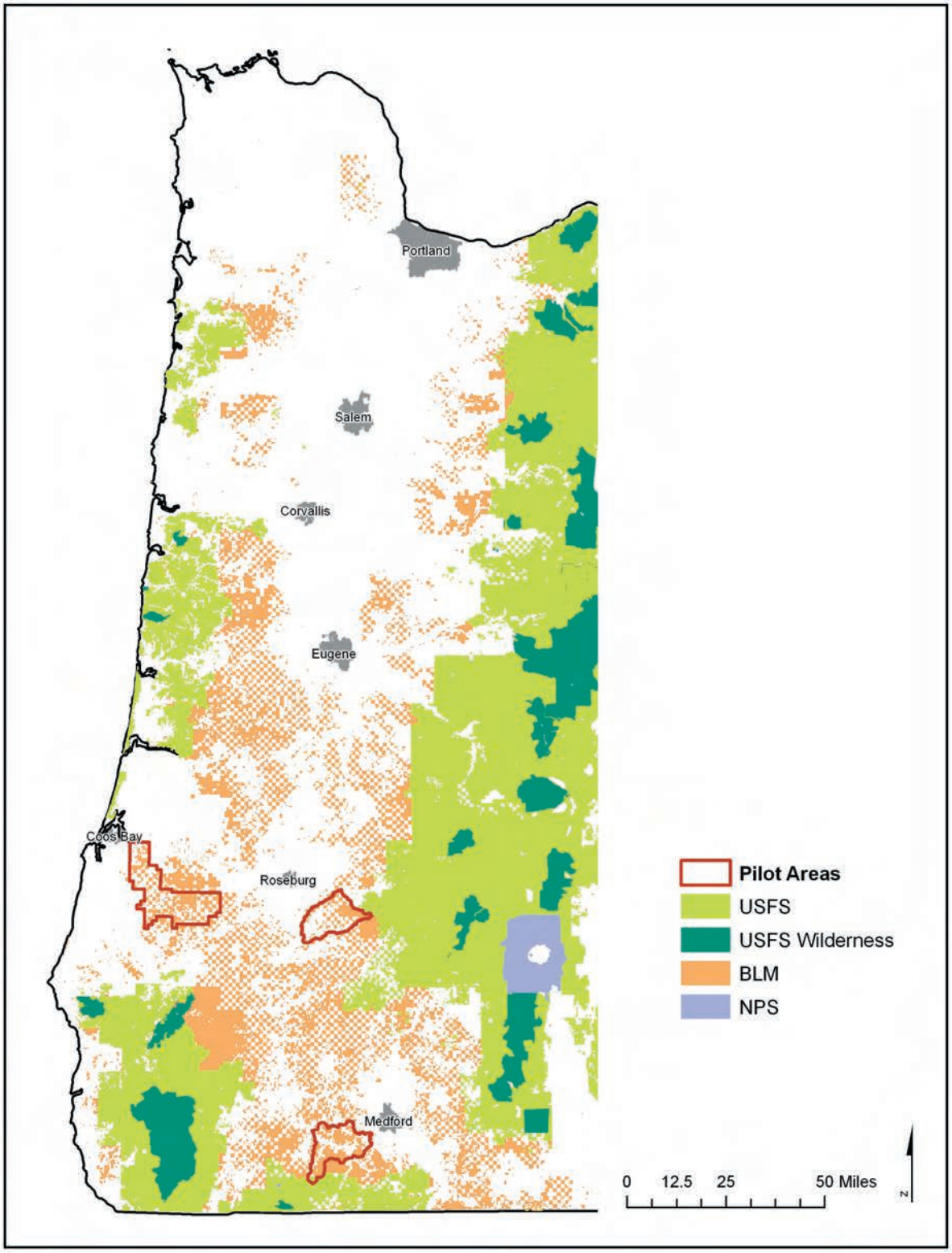


Figure 1. US Forest Service, BLM, and National Park Service lands in western Oregon, with Pilot Areas highlighted. (Note: the Pilot Projects occupy only a small portion of the Pilot Areas.)

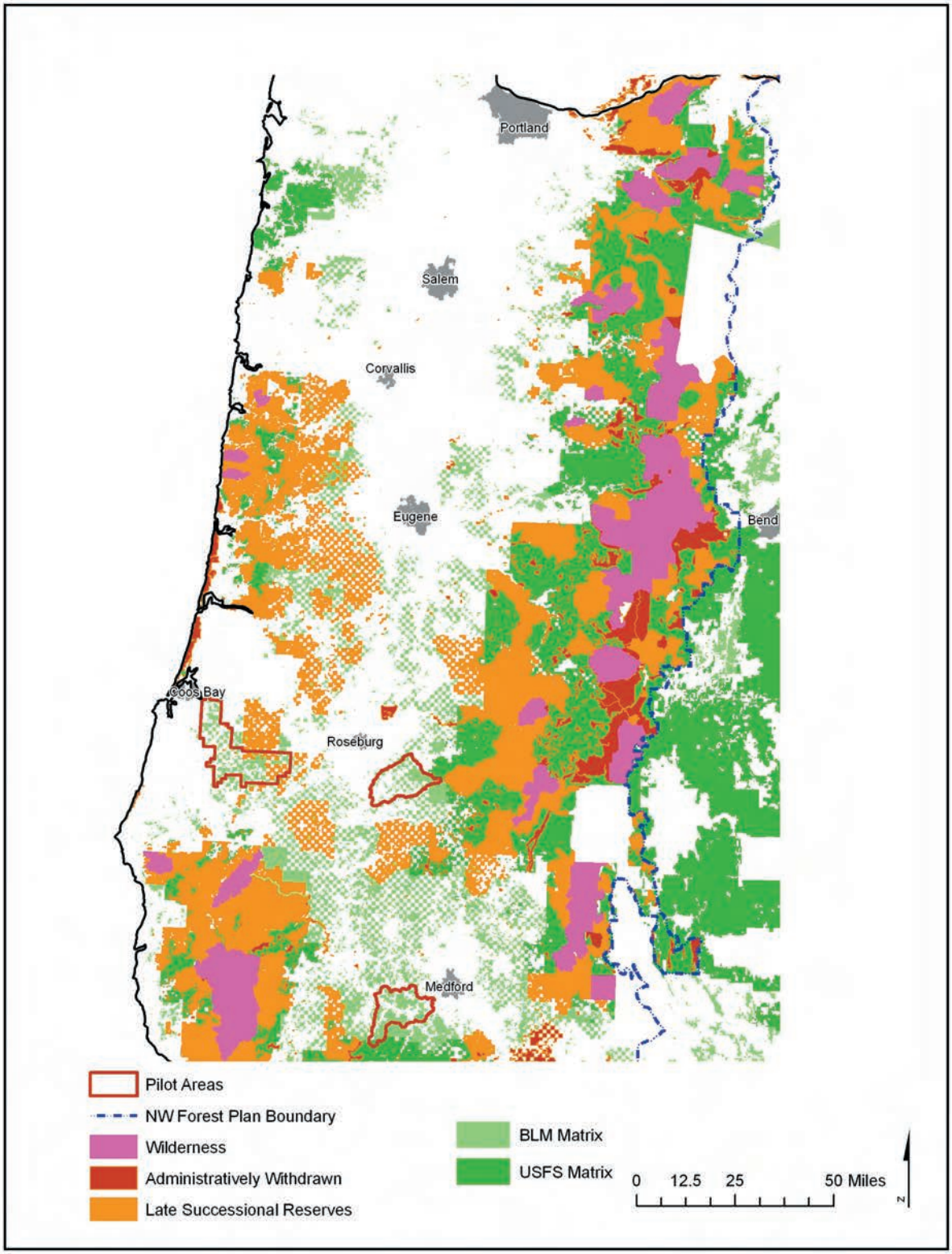


Figure 2. Northwest Forest Plan land allocation in Oregon, with Pilot Areas highlighted. Adaptive Management Areas are included in Matrix. Approximately 40% of the area shown as Matrix is actually Riparian Reserves. Thinning in stands less than 80 years of age is generally allowed in Late Successional Reserves and some Riparian Reserves, but not regeneration harvest. (Note: the Pilot Projects occupy only a small portion of the Pilot Areas.)

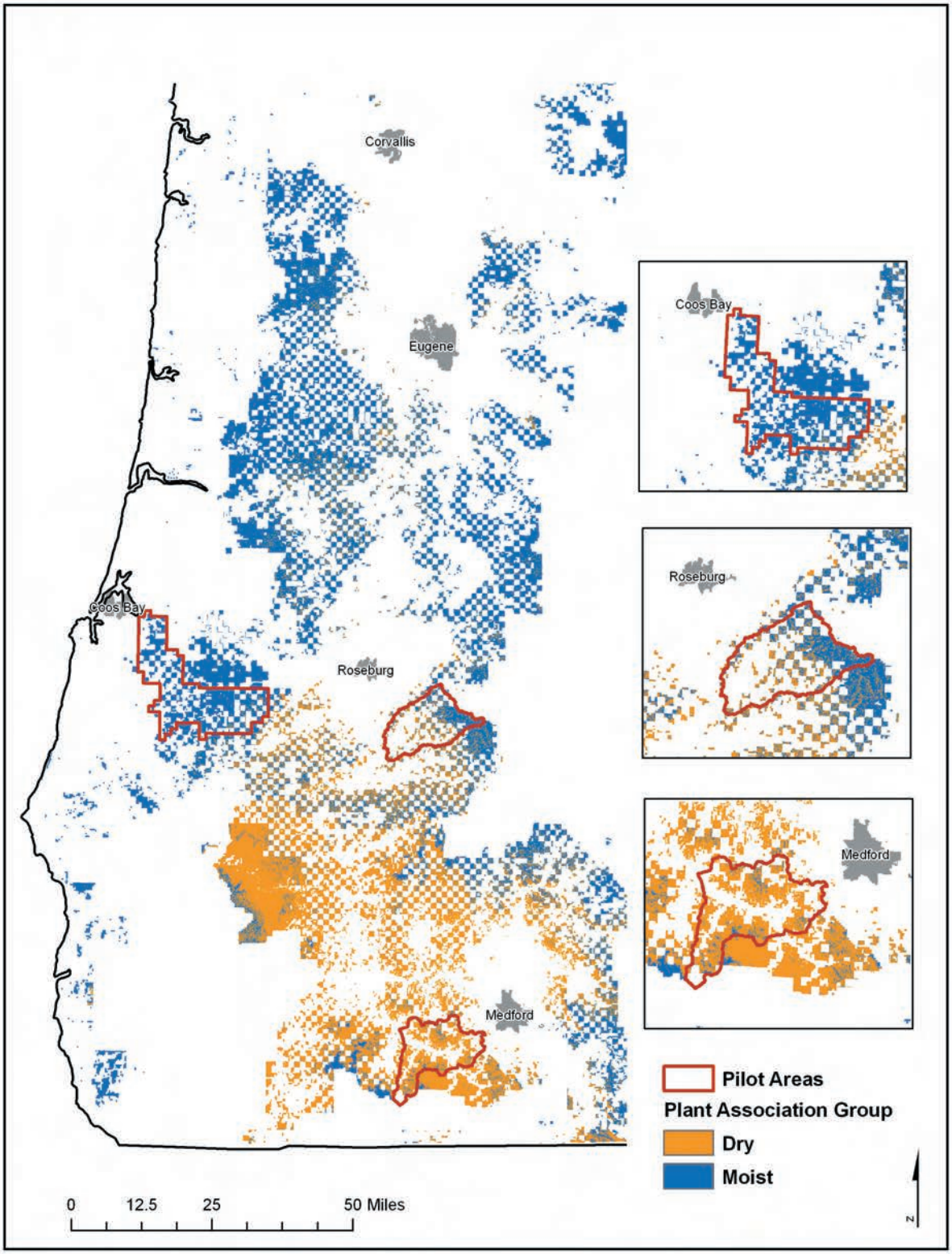


Figure 3. Moist Forests and Dry Forests on BLM Western Oregon Lands (south of Corvallis), with Pilot Areas highlighted. (Note: the Pilot Projects occupy only a small portion of the Pilot Areas.)

3. **The Roseburg and Coos Bay Pilot Projects demonstrate the character and feasibility of variable retention early seral harvesting in younger (50-110 year old) Moist Forests to restore diverse early successional ecosystems--an important forest development stage--on the O&C lands.**

   - Moist Forests have evolved with intense, infrequent (intervals of 100 years or more) disturbances that included significant areas of stand-replacement severity. Following such events Moist Forest sites typically experienced an extended, open, pre-forest stage. This early successional period exhibits high biodiversity, including a large array of habitat specialists and provision for elk and deer, as well as distinctive ecosystem processes, such as significant nitrogen fixation. The harvests demonstrated in the pilots attempt to create that stage as the initial step in a management regime that will include mixed-age, mixed species stands managed for multiple economic (e.g., diverse wood products) and ecological values on long rotations.

   - Current timber harvest practices across ownerships in Moist Forests in southwestern Oregon generally do not allow for development of diverse early successional ecosystems; thus, this important forest stage is poorly represented in current Moist Forest landscapes.

   - Younger forest stands of both previously harvested and natural origin have proven to be excellent candidates for variable-retention early seral harvests in the pilot projects. Using this partial cutting approach, small areas of pre-harvest forest (retention patches or aggregates) are left throughout the harvest units. The aggregates are augmented by retention of individual old-growth trees or other trees of special character in the harvested openings. Existing Riparian Reserves that intrude into the unit provide some of the retention patches.

   - A modest level of tree planting, using variable spacing and a diversity of species, is planned to ensure a long-term timber supply.

4. **The Medford Pilot Project demonstrates the nature and the feasibility of active management to reduce stand densities and increase heterogeneity in Dry Forests, thereby improving their ability to survive current and future threats from wildfire, drought, and insects, while retaining dense forest patches for the Northern Spotted Owl within the Dry Forest landscape.**

   - Dry Forests generally evolved with frequent, low- to mixed-severity wildfire regimes. Dry Forests and landscapes typically have been significantly altered by fire exclusion during the last 100 to 150 years. These effects have fundamentally altered the Dry Forests of the Middle Applegate, increasing their density and dominance by conifers, putting competitive pressures on old conifers and hardwoods, and reducing forest heterogeneity. The pilot project prescription is designed to begin reversing the ecological effects of these past policies and increasing the ability of these forests to survive and flourish in the future.

   - To achieve that goal, we used a two-step approach to Dry Forest restoration:

     - First step: development of a landscape-level plan in which: 1) Larger forest patches are selected for retention as areas of dense closed-canopy forest to meet needs of the NSO and other dense-forest related species and processes; and 2) Restorative

treatments were prioritized within the remaining landscape, with the highest priority being areas where treatments would reduce threats to the retained dense forest patches. While these dense patches will eventually be lost to wildfire or insects over time and require replacement, a thoughtful treatment strategy can lengthen their "hang time" and prepare other patches to provide that replacement habitat.

- Second step: development of silvicultural prescriptions for restorative treatment of selected individual stands with goals being reductions in the density of Douglas-firs, release of suppressed pines and hardwoods, reduction in risks of severe wildfire and accelerated mortality during drought, and increased levels of forest heterogeneity.

- In treated stands, densities will be reduced by almost 40%, while creating much more spatial heterogeneity through leaving trees in clumps and patches and creating small openings.

5. **BLM staff, with the assistance of the US Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration Marine Fisheries Service (NOAA-F) personnel, demonstrated their ability to implement both Dry Forest and Moist Forest restoration strategies.** No significant training of BLM staff was necessary for them to effectively implement the Franklin/Johnson restoration strategies. After office briefings and limited field demonstrations, BLM staff was fully capable of comprehending the general objectives and technical details of the restoration approaches and applying them in field situations.

6. **From the beginning, we involved others in our efforts by: 1) working with local agency professionals (BLM, USFWS, and NOAA-F) and those of the Coquille Tribe to help them understand our approach and work collaboratively on effective implementation; and 2) engaging interested groups and citizens to demonstrate our approach to them and to better understand their interests and concerns.**

- During the last nine months we have worked with professionals from BLM, USFWS, NOAA-F, and the Coquille Tribe and with the public in a variety of settings. These include office meetings to develop criteria for stand selection, public workshops, and a series of field trips to selected stands, where we discussed our approach and showed sample marks.

- A broad spectrum of interested groups and citizens participated including members of Congress, County Commissioners, and a number of congressional aides from the House and Senate.

- In general, we utilized the same steps in each pilot. A detailed timeline of interactions is provided below, which includes preliminary work in Roseburg and Medford in 2010 that led, in part, to the pilots.

- Within this common framework, each of the pilots had its own rhythm and dynamic in terms of the collaborative capacity/leadership in the surrounding communities:

  - The Medford Pilot was started by the Southern Oregon Small Diameter Collaborative, a collection of interested groups and citizens, before we were involved. The

Small Diameter Collaborative provided leadership in implementing the pilot, engaging the broader public, and creating a broad collaborative working environment.

- The Roseburg Pilot followed an attempt by the Roseburg BLM to create a collaborative group to advise the District. The participants ultimately chose not to form their own collaborative group and disbanded. As a result, our interactions with the public generally followed the classical pattern of somewhat contentious discussions and debate.

- The Coos Bay Pilot was co-led by the BLM and the Coquille Tribe; much of our interaction was with Tribal professionals and the Tribal Council.

7. **Good attendance and discussions at our workshops and field trips indicated substantial public interest in alternative approaches to forest management, such as is represented by the pilots.** Stakeholders seemed genuinely interested in development and application of credible alternatives to the black/white contrast of either a) managing forests for intensive wood production or b) preserving them--i.e., in a "middle ground."

8. **There was also concern and skepticism about our proposed strategies:**

   - In Moist Forests, the most controversial aspects of the pilots were: 1) cutting trees in a previously unharvested 110-year old stand; 2) desirability and intensity of tree planting following the early seral harvest; and 3) the relatively small portion of the landbase available for this kind of harvest. Also, questions were raised about the ecological value of early seral harvests in Moist Forests.

   - In Dry Forests, the most controversial aspects of the pilot were: 1) cutting in suitable NSO habitat; 2) cutting larger trees; 3) road construction; and 4) the relatively small area of commercial harvest in the pilot.

   - At almost every meeting, people asked "how will you learn whether these strategies are working?"-- i.e., interest in monitoring and adaptive management was high.

9. **Gaining broad public support for these strategies will require people to look at the approaches we suggest from new points-of-view. This can be aided by new terminology, which we have begun to introduce in this report.**

<u>Moist Forests</u>

- The nearly universal equating of "regeneration harvests" with "clear-cutting" by stakeholders and many professionals creates an inherent bias against our Moist Forest strategy that is hard to overcome. It will take significant professional and public engagement to develop mutual understanding about the:

  - Ecological benefits that can flow from the proposed early seral harvests;
  - Nature of diverse early successional ecosystems and why they are not "brush fields" and evidence of regeneration failure;
  - Long-term plan for subsequent forest development (e.g., long rotations);
  - Similarities between the proposed early seral harvest prescriptions and the conditions under which existing natural forests were initiated; and
  - Goal of using the proposed approach is "forest renewal" and not "forest destruction."

Dry Forests

- It will take significant professional and public engagement to develop mutual understanding about how and where:
  - Partial cuttings are needed to increase health and longevity of mature and even old forests; and
  - Harvest of some Northern Spotted Owl habitat might help increase the longevity of other, more valuable Northern Spotted Owl habitat.

10. Adaptive management and monitoring are important components of the pilot projects. These activities can result in substantial learning about the mechanics of forest restoration and effects on the environment and the economy.

- The public consistently expressed great interest in how it would be determined whether the proposed projects were implemented as intended and whether they had the desired effects. The expectation is that both we and the BLM will do appropriate checks and make necessary adjustments, as has been the case so far.

- We propose a four-part monitoring plan for both the initial pilots and any future expansion of these approaches:
  - We check to see that the design and implementation of the projects accurately reflect the Franklin/Johnson restoration strategy and ecological principles;
  - BLM implements a monitoring program to assess outcomes from the initial projects, with participation of stakeholders in design and implementation of the monitoring, if possible;
  - BLM plans and implements an early review of initial and subsequent pilot projects by an interdisciplinary team of scientists; and
  - If BLM continues to develop ecological forestry-based management approaches through additional projects, BLM develops an independent third-party review process based either on a broadly representative citizen group or a recognized certification process.

- Much will be learned over time by systematically collecting and using information gathered about the pilots. In the near term, expert knowledge, professional judgment, and management experience can enable adaption and application of these restoration strategies more widely.

Broader Considerations

The Secretary of Interior has called for development of new long-term plans for the BLM western Oregon forests. One of our goals is to describe how the strategies employed in the pilot projects might fit into new long-term plans. That description includes where the strategies might be utilized, how existing plans might need to be modified, and some resource outputs that might be expected.

We begin with a discussion of basic characteristics of the BLM western Oregon forests, especially the age class and disturbance history. Then, we describe key aspects of the plans under which the BLM operates--the NWFP and associated regulatory requirements in the Endangered Species Act and other laws. Finally we describe potential changes to these plans and associated planning processes. At each stage, we discuss how the strategies in the pilot projects might fit.

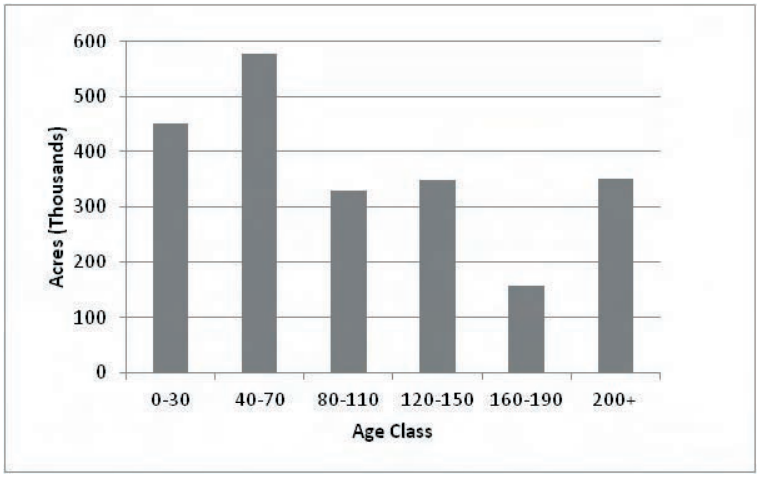


Figure 4. Acres by age class on BLM Western Oregon Forests (All graphs in this report are based on information provided by the BLM Oregon State Office. We are responsible for presentation and interpretation.)

11. BLM's western Oregon forests are almost equally divided between stands less than 80 years of age and stands greater than 80 years of age (Figure 4).

- Almost all BLM stands less than 80 years of age are young stands that developed following clearcutting or fire salvage. Those less than 60 years of age are generally "plantations" that developed from conifer plantings after clearcut harvests.

- Most BLM stands over 80 years of age have not been subjected to timber harvesting. Such stands have special significance in conservation strategies for species associated with mature and old forests, such as the NSO and the Red Tree Vole (*Arborimus longicaudus*).

- Because of past cutting patterns, older, natural stands and younger, previously harvested stands form an intricate mosaic across the landscape--complexity at the scale of 10s of acres. This complexity occurs across the landscape, including Late Successsional Reserves and Riparian Reserves (Figures 5,6,7). In addition, as will be shown in the detailed pilot discussions, older patches and individual trees occur in stands labeled less than 80 years of age. Assigning older stands and younger stands to different management organizations will compound the classic "checkerboard" problem.

12. Stratifying the BLM western Oregon land base into Dry Forest and Moist Forest categories is a critical element in any restoration strategy (Figure 8).

- Almost 2/3 of BLM acres are Moist Forest sites and are mostly found from Roseburg District north.

- Almost 3/4 of BLM's young stands are on Moist Forest sites, because of past harvesting activity.

- Moist Forest sites typically are more productive. Existing old-growth forests on moist sites generally have retained their historic structure and composition and restoration treatments are not required for their conservation.

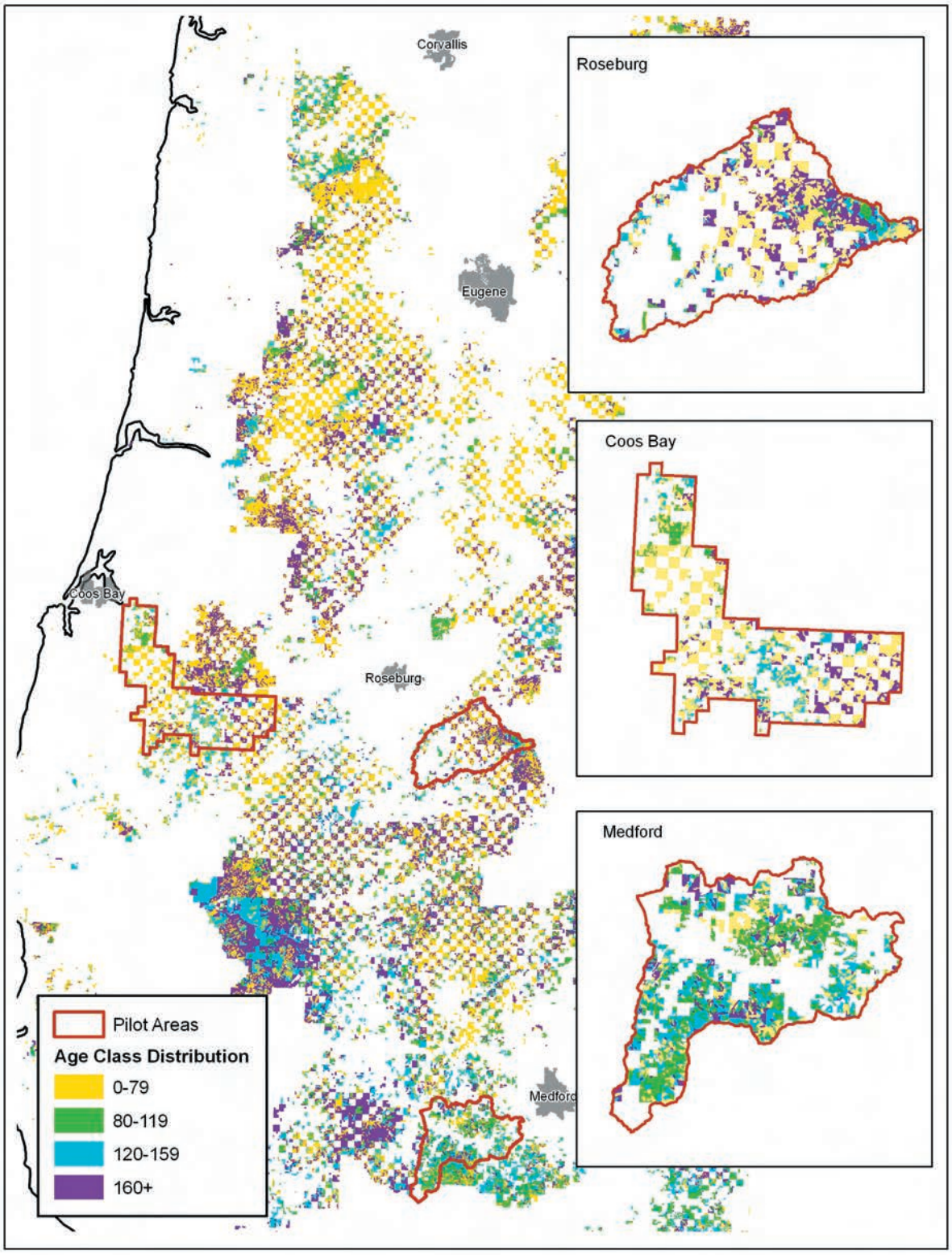


Figure 5. BLM Western Oregon Forests broken into four age classes, with the Pilot Project areas highlighted. Past harvest patterns and disturbances have created a very complex mosaic of age classes.

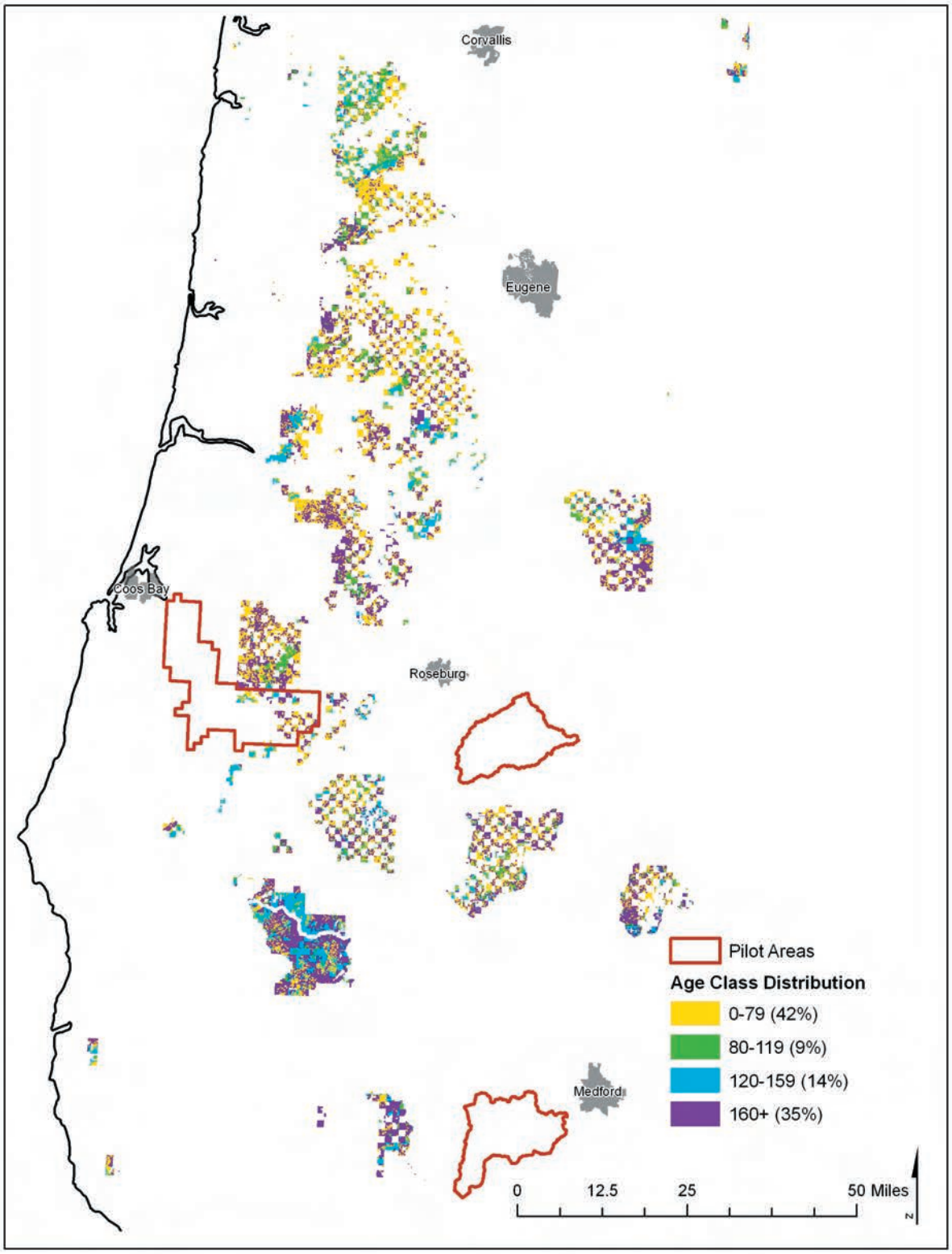


Figure 6. Late Successional Reserves on BLM Western Oregon Lands under the Northwest Forest Plan broken into four age classes. Thinning in stands less than 80 years of age is generally allowed in Late Successional Reserves, but not regeneration harvest.

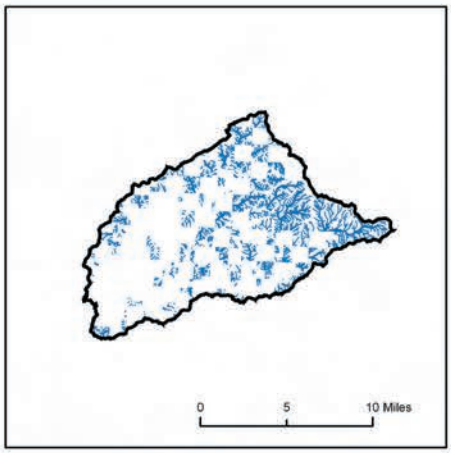


Figure 5a. Riparian Reserves under the Northwest Forest Plan on BLM lands in the Roseburg District Pilot.

40% in Riparian Reserves (52% under 80 years of age, 5% 80-119, 11% 120-159, 32% 160+)

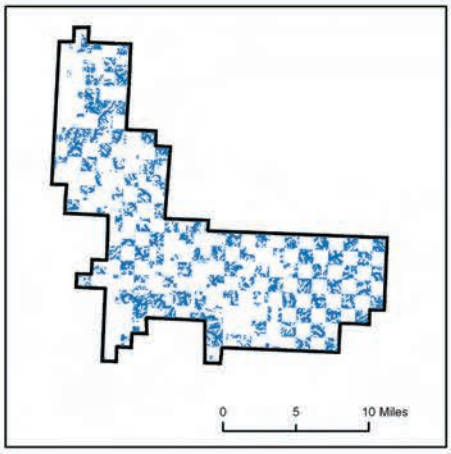


Figure 5b. Riparian Reserves under the Northwest Forest Plan on BLM lands in the Coos Bay District Pilot.

56% in Riparian Reserves (60% under 80 years of age, 9% 80-119, 12%120-159, 18% 160+)

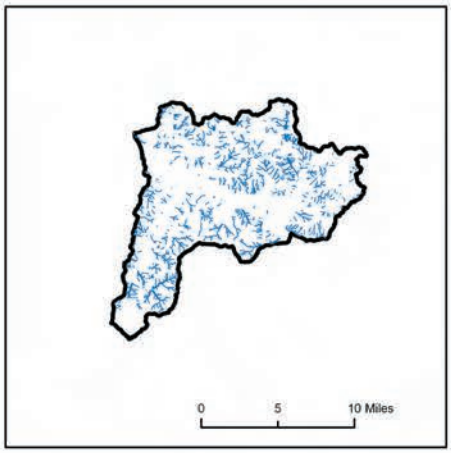


Figure 5c. Riparian Reserves under the Northwest Forest Plan on BLM lands in the Medford District Pilot.

21% in Riparian Reserves (28% under 80 years of age, 30% 80-119, 31% 120-159, 12% 160+).

Riparian Reserves

Figure 7. Riparian Reserves (and other reserves with riparian buffer areas) under the Northwest Forest Plan on BLM lands in Pilot Areas. Thinning in stands less than 80 years of age is allowed within some riparian reserves, but not regeneration harvest.

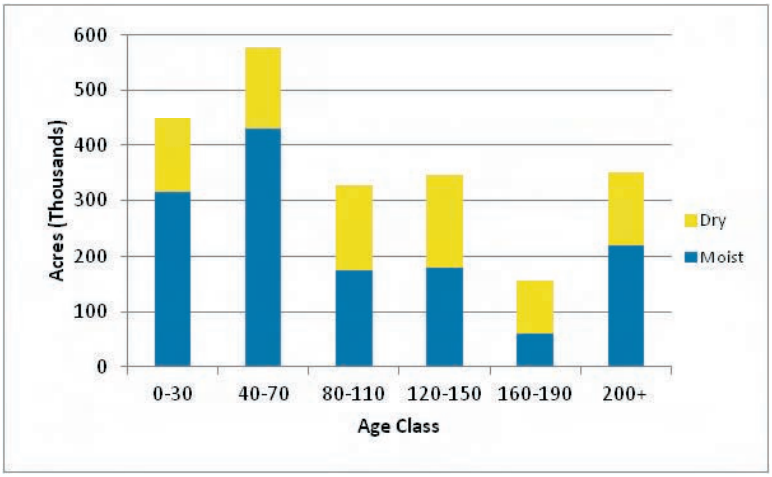


Figure 8. Acres of Moist and Dry Forests by age class on BLM western Oregon forests

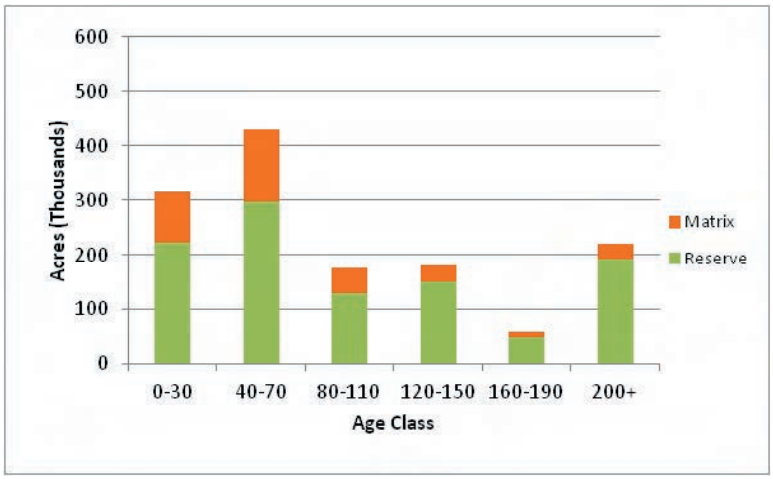


Figure 9. Acres of Reserves and Matrix on Moist Forests of BLM in western Oregon.

- While Dry Forest sites are generally less productive than Moist Forest sites, active management, including thinning, is typically needed to restore more resilient and sustainable conditions, including the conservation of old-growth trees.

Moist Forests

13. The sustained yield timber harvest level and revenue to counties from BLM's western Oregon forests will largely be determined by decisions about management of Moist Forest sites (Figure 9).

- Moist Forest sites provide more than three-fourths of the productivity and, consequently, are the potential foundation of sustained yield on BLM's western Oregon forests. Much public focus is, understandably, on the future of the Dry Forests, due to the potential for wildfire and major insect outbreaks in these forests and their greater vulnerability to climate change. Future timber supply and revenue from BLM's western Oregon forests hinges primarily on management decisions regarding the Moist Forests, however.

- Approximately 3/4 of Moist Forest stands are in reserves (as are over 2/3 of stands under 80 years of age). Under the NWFP most of these stands are in the large Late Successional Reserves and in streamside Riparian Reserves (Figure 6 and Figure 7). Limited harvest is allowed in forests less than 80 years old in reserves to advance their ecological development, but regeneration harvests are not permitted. These reserves were established under the assumption that management in areas outside reserves would include regeneration harvests and long-term timber production.

14. The NWFP harvest projections assumed that the stands currently over 80 years of age on Moist Forest sites in the Matrix would be subject to regeneration harvests over time, especially during the first 30 years of the Plan. Such harvesting has generally not occurred.

- Loss of acres from the Matrix occurred because of protection requirements for Survey-and-Manage species (especially the Red Tree Vole) and sites occupied by the Marbled Murrelet (*Brachyramphus marmoratus*), which are located during project implementation.

- Appeals and litigation surrounding the NSO, Survey-and-Manage species requirements, and implementation of the Aquatic Conservation Strategy of the NWFP have prevented many proposed regeneration harvests in forests >80 years of age in the Matrix.

- Consequently, BLM has stopped planning regeneration harvests in Moist Forest stands in the Matrix and AMA allocations—the potential backbone of long-term sustained yields.

- The Northern Spotted Owl Recovery Plan released this year puts great emphasis in protection of complex (old) forest and other high quality NSO habitat in project planning. It is expected that Critical Habitat for the owl will re-emphasize the importance of forests over 80 years of age for NSO recovery.

15. BLM's current risk-adverse strategy of thinning Moist Forest plantations (stands created through past clearcutting and reforestation) is, at best, a short-term activity that can provide some timber volume for perhaps a decade or so but relatively little revenue.

- Thinning plantations to increase structural and compositional complexity in Late Successional Reserves is an appropriate part of a comprehensive restoration program; however, this is not a sustainable source of timber.

- The absence of regeneration harvests has created an unsustainable emphasis on commercial thinning that will shorten the time period over which thinning can contribute significant timber volumes. Furthermore, thinning in reserves, which has been a substantial contributor to timber harvest in some Districts, can occur once or twice, at most.

- In contrast with regeneration harvest proposals, a series of compromises and legal settlements among different groups has allowed much of the proposed commercial thinning to proceed in essentially all NWFP land allocations including reserves.

- Thinning can maintain current harvest levels (150-200 million board feet/year from all land allocations) for perhaps a decade or so after which harvests from this source will decline.

16. Early seral harvests in younger Moist Forests using variable retention prescriptions could contribute to both ecological and economic goals in western Oregon.

- Research has substantiated that Oregon Coastal Moist Forests are deficit in diverse early seral ecosystems, as discussed later in this report. We expect research on Oregon Cascade Moist Forests to yield similar results. BLM early seral harvests could fill a needed ecological niche.

- These harvests could be part of a long-term forest management regime for a portion of the O&C lands that provides for multi-species, multi-aged, structurally diverse forests managed on long rotations, producing diverse ecological and economic benefits, increasing societal options, and reducing risks to forest health. This management regime would more closely emulate native forest development, as compared to practices used in intensive wood production--i.e., clearcutting and creation of even-aged plantations.

- Variable retention early successional harvests in younger stands, which typically would involve removal of 60-70% of the stand, would complement and reduce the pressures on the short-term thinning program.

- In the long run, we estimate that this overall management regime could contribute about 2/3 of the per-acre timber yields expected under the silvicultural strategies of the NWFP and about half of the per-acre "full yield" that might be produced under the intensive wood production strategies proposed in the Proposed Resource Management Plan in the Western Oregon Plan Revision (WOPR) (USDI BLM 2008); the latter utilized clearcutting and rapid re-establishment of a new conifer stands. The lower long-term per-acre yields under our restoration strategy are a consequence of higher retention levels at the time of early seral harvest and slower rates of stand closure. Existing wild stands are the source of the estimates for yields under our strategy.

- To achieve equivalent long-term harvest levels under our silvicultural approach would require a larger managed land base than the silvicultural strategies under the NWFP or the Proposed Plan in the WOPR. However, the compatibility of our approach with conservation of species and ecosystems could make it possible to utilize a larger land base for timber production, partially offsetting the reduced yields per acre.

- Previously harvested stands on Moist Forest sites (generally those less than 80 years of age) are probably the least controversial locations for early seral harvests. Approximately 15% of Moist Forests (about 225,000 acres) are both less than 80 years of age and outside of reserves. Early seral harvests of some of these young forests still may be challenged, ostensibly because of biodiversity and other environmental concerns. Moist Forest Coast Range forests of ages 60-80 have significant volumes for an early seral harvest. A question remains, however, of how much volume could be produced by early seral harvests in Moist Forest stands of these ages in lower quality sites of the eastern Roseburg District and the Medford District.

- The potential for future early seral harvests in forests over 80 years of age in the Matrix appears increasingly problematic in the current institutional environment (laws, regulations, and associated litigation). Past difficulties in harvesting these stands are likely to

be reinforced by the greater focus on protecting older, more complex forest in the Final Recovery Plan for the Northern Spotted Owl (USDI USFWS 2011). Still, we placed one of our variable retention, early successional cuts in a 110-year old stand that had not been previously harvested to illustrate the strategy in such a stand and to further the policy dialogue (which it certainly did!).

- Policy processes have not yet formally resolved the cutoff between "younger" stands that might be part of this Moist Forest strategy and "older stands" that would be reserved. Elsewhere we have suggested three thresholds for that break: 80 years, 120 years, and 160 years, leaving the choice among those options to the policy process (Johnson and Franklin 2009).

Dry Forests

17. Dry Forests in southwest Oregon, including older forests there, require active management to sustain them in the face of risks from wildfire and insect outbreaks

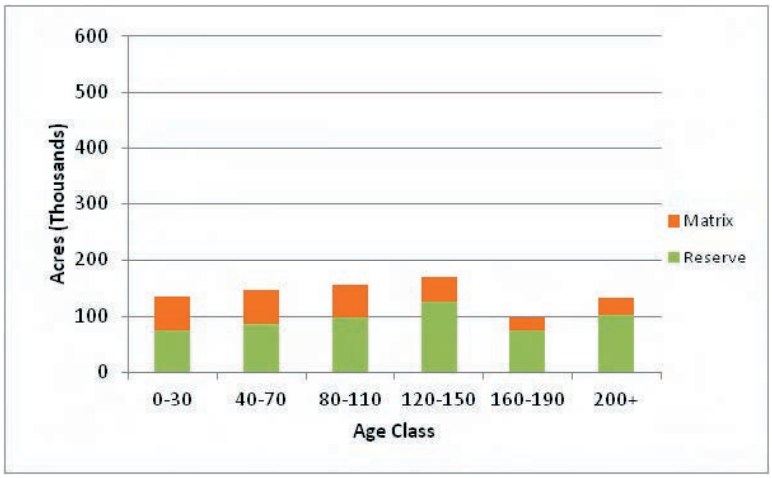


Figure 10. Acres of Reserves and Matrix on Dry Forests of BLM in western Oregon.

associated with drought, both of which are likely to increase under climate changes (Figure 10).

- A higher proportion of Dry Forests than Moist Forests are in older age classes (> 80 years of age). Treatments will continue to be needed in many of these older forests.

- An important ecological goal of management at the landscape level is to locate and shape forest management activities so as to increase the "hang-time" of dense forest patches retained in the Dry Forest landscapes as habitat for NSOs and their prey.

- Up to half of the federal forest in Dry Forest landscapes might need a combination of commercial and noncommercial treatments to improve resiliency over time.

- A landscape-level analysis and plan is needed to identify the network of dense patches needed by the NSO and associated species and, conversely, locating and prioritizing the areas available for restoration activities.

- Dry Forests can contribute only modestly to the long-term sustained yield of BLM's western Oregon forests because of their relatively low productivity. Their management, though, will contribute significantly to protection of life and property and to the sustainability and ecological values of these forests.

18. Measures of success in forest management will need refinement to successfully implement these restoration strategies

- Moist Forests and Dry Forests need to be seen as distinctly different, requiring distinctly different conservation and management approaches.

<u>In Moist Forests:</u>

- Achievement of diverse early successional ecosystems with their constituent biota will be seen as a "success" and not as a "regeneration failure"; and

- Retention of old growth forest stands and of older trees in younger stands will be seen as a high priority in management activities.

<u>In Dry Forests:</u>

- Success in restoration treatments will be recognized as improvements in the resistance and resilience of the majority of forest ecosystems within the Dry Forest landscapes, while still retaining largely continuous forest cover (i.e. no clearcuts);

- Stands with concentrations of old-growth trees (both conifers and hardwoods) will be viewed as having a high priority for treatment, along with stands that are critical to increased survivability of the selected dense forest patches within the landscape; and

- Development and implementation of Dry Forest landscape plans that provide for retention and improved survivability of dense forest patches will guide management

19. Integrated project implementation is critical to pilot success

- Efforts are needed to insure that adequate coordination occurs among BLM staff specialists in implementing restoration precriptions from planning through "finish" work.

- Allowing sufficient staff time for communication and collaborative field assessments and strong support from district managers are also important.

- Involving USFWS and NOAA Fisheries from the beginning makes the projects proceed much more smoothly.

An Unresolved Problem: Solidifying a Stable Land Base for Timber Production

20. One fundamental goal of the NWFP--that of identifying a portion of the federal landscape where sustained commercial timber production will be allowed--has not been achieved.

- Despite the best efforts of BLM, USFWS, NOAA-F, and the US Forest Service (USFS), it has not yet proven possible to craft a stable land-base for sustained timber production under current applications of the NWFP.

- It is still not clear how much and which parts of the BLM western Oregon forests will be needed to recover the NSO. While the NWFP intended that sustained timber production would occur on the Matrix lands, the abundance of NSO activity sites in the BLM's Matrix lands (Figure 11), combined with continued declines in populations of the NSO, make honoring that intent difficult. The Revised Recovery Plan for the Northern Spotted Owl (released July 2011) and draft Revised Critical Habitat (due for release January 2012) are intended to help clarify this situation; administrative and legal interpretation of these documents could take many years, however.

- The majority of Moist Forests were allocated to protection of species and ecosystem processes under the NWFP; subsequent administrative and legal actions have now largely brought regeneration harvests on the remaining Moist Forests to a halt.

- Uncertainty also surrounds the disposition of the Dry Forest matrix.

21. Creating a stable land base for timber production while maintaining a commitment to conservation of species and ecosystems will require a variety of efforts.

- Scientific reviews can help clarify policy choices related to conservation issues.

  - Protection measures for the Red Tree Vole. A review is needed of conservation measures for the species in southwest Oregon where it is more common.

  - Revision of the Riparian Reserves developed during creation of the NWFP. The Riparian Reserves were wide buffers created for interim protection of aquatic resources until detailed watershed analyses provided the basis for scientifically-based aquatic conservation measures. Adjustments in the interim buffers have been miniscule and only one scientifically-based alternative approach (the Blue River strategy) has been proposed. A comprehensive scientific re-assessment of riparian protective measures on federal forest lands is needed--using new analytic tools and results of watershed analyses--to determine how best to fulfill the original intent of the Aquatic Conservation Strategy in the context of the multiple goals of the NWFP.

  - Softening the lines between different land allocations under the NWFP. With the increasing removals of older natural forests from the timber base (and the near-term potential of total removal) there have been no compensating reductions in the amount of previously harvested forests located in reserves. Similarly, the NWFP approach assumed a black-and-white landscape of reserves and even-aged plantations; an evaluation has never been done of the ecological consequences of integrating conservation of mature and old forests with ecologically-based harvesting

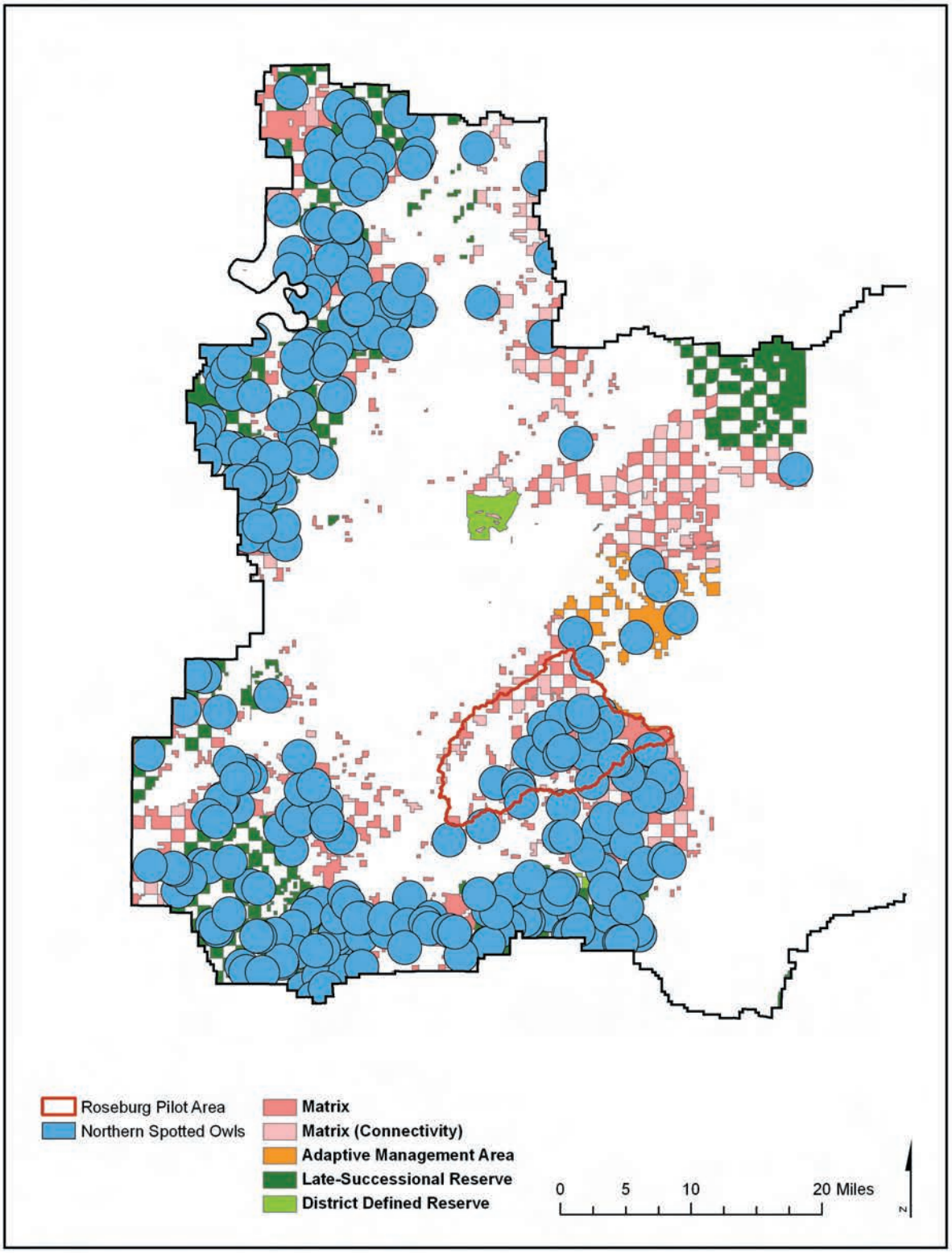


Figure 11. Home range circles for historically occupied Northern Spotted Owl sites (owl pairs) on the Roseburg District of the BLM. (Note: LSR and Matrix areas in upper right portion of map were not included in analysis.)

of some of the intervening younger, previously harvested and other younger forests (such as currently proposed in the Franklin/Johnson strategy). The BLM lands are a potential subject for such an evaluation, in which younger, previously harvested forests currently within LSRs are managed so as to provide for both long-term timber production and early successional ecosystems well distributed in time and space.

- Approaches implemented in the pilots could provide a middle path between the extremes of intensive wood production and preservation (i.e., reserves) by increasing the compatibility of long-term timber production and species and ecosystem conservation.

  - The ecologically-based forest management strategies for Moist and Dry Forests in the pilots could benefit both biota and critical ecosystem processes, such as nitrogen cycles, much more than traditional forest management practices, such as those allowed by Oregon Forest Practice regulations which are oriented toward maximizing wood production.

  - In Moist Forests, the pilot strategy provides for 1) retention of extensive biological legacies at harvest, 2) all forest developmental stages, including early successional ecosystems, and 3) managed stands that support diverse ecological processes--all while allowing for significant timber harvest. In Dry Forests the pilot strategy provides for 1) continuing forest cover while 2) incorporating timber harvest 3) maintaining a diversity of conditions (e.g., dense forest patches), and 4) reducing risks of forest loss to catastrophic disturbances. The Revised Northern Spotted Owl Recovery Plan specifically encourages ecosystem restoration activities similar to those proposed in the pilots. However, the land base to which these approaches would be applied has not been identified.

- Ongoing delineation of Critical Habitat for the NSO could be a vehicle for examining ecological and economic implications of alternative owl habitat policies for BLM's western Oregon forests. Specifically, it could be used to:

  - Examine the consequences of strategies for management of federal forest lands that are alternatives to the black/white approach of "reserves and traditional timber production", which was the basic premise of the NWFP.

  - NSO habitat requirements could be analyzed in the context of management approaches in which significant portions of the federal forest estate are managed simultaneously for ecological and economic values, using approaches similar to those demonstrated in the pilot projects.

III. Restoration Strategy and Policy Context

In this section we: 1) Briefly review key points in our restoration strategy; and 2) Place the pilot projects within the regional policy context, primarily the NWFP, the Northern Spotted Owl Recovery Plan, and the 1937 O&C Act.

Key Elements of the Franklin/Johnson Restoration Strategy

The scientific underpinnings and philosophy of the Franklin/Johnson restoration strategy are thoroughly covered in other documents, so this topic is not covered in this report. Interested readers should refer to the initial document, "*Restoration of Federal Forests in the Pacific Northwest: Strategies and Management Implications*" (Johnson and Franklin 2009) available on the senior author's web site. Additional material, including some based on the author's experiences with the southwestern Oregon pilot projects, is included in a manuscript (Franklin and Johnson 2012. *Restoration of Federal Forests in the Pacific Northwest: Strategies and Management Implications*) that is currently under consideration for publication by the Journal of Forestry.

Two definitions from the draft planning rule for the national forests are relevant to our work (USDA 2011, p. 8524):

> "Restoration. Assisting ecosystem in the recovery of resilience and the capacity to adapt to change if the environment where the system exists has been degraded, damaged, or destroyed. Ecological restoration focuses on reestablishing ecosystem functions by modifying or managing the composition structure, spatial arrangement, and processes necessary to make terrestrial and aquatic ecosystems sustainable, and resilient under current and future conditions."
>
> "Resilience. The capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks."

We utilize these definitions to frame our proposed strategy in three ways. First, restoration needs to focus on the entire ecosystem, rather than on individual attributes, such as fuels. Our experience and that of others (Gunderson et al. 1995) is that programs with singular resource objectives marginalize other important values and lead to less resilient ecosystems and communities. Focusing on ecosystem restoration serves a wide range of natural resource and stakeholder interests as described below. Second, restoration strategies need to focus upon desired future conditions, even while learning from past. Striving to return landscapes to some historical condition--even if it was possible to do so--is unlikely to provide either resilience in the face of current and future conditions or for socially desirable outcomes (e.g., see papers in Cole and Yung 2010). Recognizing this, some scientists propose substituting the term "intervention ecology" for restoration since so much management needed in the 21st century to sustain ecosystem function will be unrelated to historic conditions (Hobbs et al. 2011). In this paper, we use "restoration" in the broader sense of restoring ecosystem resilience and functionality, including adaptability to future environmental change, and not solely with reference to some historic condition. Third, management actions need to improve ecological conditions (structure, function, and composition) and resilience of degraded forest ecosystems and landscapes. What do we mean by "degraded?" Forest landscapes in which fire suppression and other activities, such as creation of plantations, have created conditions that are highly vulnerable to wildfire,

insect outbreaks, and drought are one example. Another example is regional forest landscapes with greatly reduced representation of important forest stages--such as early successional and old-growth ecosystems.

In sum, the Franklin/Johnson restoration strategy focuses on reestablishing ecosystem functions by modifying or managing the composition, structure, spatial arrangement, and processes necessary to make ecosystems sustainable and resilient under current and future conditions. The strategy is future rather than historically oriented. It is focused upon ecosystems rather than individual organisms or attributes (e.g., fuel loadings) because this better serves the broad array of natural resource values and stakeholder interests. Finally, the strategy focuses on restoration of ecological conditions and resilience in degraded forest ecosystems and landscapes, including those where past activities have greatly reduced representation of important forest stages.

Important elements of the Franklin/Johnson restoration strategy as they relate to the southwestern Oregon pilot projects are:

- Distinguishing Moist and Dry Forests because they have fundamentally different ecologies, management potentials, and restoration needs, which must be fully considered in development of policies and practices;
- Focusing on restoration of the under-represented early (preforest) and late successional (old growth) stages of forest development on Moist Forest sites;
- Focusing on restoration of more resilient conditions in forest ecosystems and landscapes on Dry Forest sites, which have been dramatically altered by management activities during the last 150 years;
- Conserving all older forest stands and trees on Moist Forest sites and all older trees on Dry Forest sites[2] ; and
- Utilizing ecological forestry principles to guide restoration and other silvicultural activities, including retention of significant legacies of pre-harvest stands during harvest treatments and planning and implementation of activities at the landscape scale.

Correcting deficiencies in early successional ecosystems by initiating variable retention harvests is one specific goal of our proposed restoration strategy. We call these "early successional harvests" to distinguish them from traditional "regeneration harvests." As stated by Nyland (1996, p. 176) in discussing regeneration cutting: "Normally, these treatments involve some kind of disturbance such as cutting and timber harvest. These methods may incorporate either natural or artificial means to secure the regeneration. All allow foresters to establish one new age class (cohort) to replace the trees deemed mature by a landowner. In silviculture, foresters use the term regeneration…interchangeably with reproduction. Either may denote the process of replacing one community of trees with a new one." In our restoration strategy we have a much broader goal for the variable retention harvests including the creation of diverse early successional ecosystems. Thus, our use of early successional harvests instead of regeneration harvests in describing these silvicultural treatments.

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[2]In our restoration report (Johnson and Franklin 2009), we recognize three thresholds for defining "older forest" on Moist sites: 80 years of age, 120 years of age, and 160 years of age, leaving the choice among those options to the policy process. For Dry sites, we generally use 150 years of age for the threshold for defining "older trees", although we recognize that 100 years and 200 years are alternative thresholds.

Regional Policy Context for the Pilot Projects

BLM's western Oregon forests have been managed under the Northwest Forest Plan (NWFP) for the last 15 years (USDA and USDI 1994). The BLM did develop a new plan for these lands in 2008 called the Western Oregon Plan Revision or WOPR (USDI BLM 2008). However, the Department of Interior chose not to defend that plan against legal challenges. Consequently, management direction for BLM's western Oregon lands has largely reverted to the NWFP, although some legal uncertainty still exists.

We have utilized the allocations and principles of the NWFP in designing the pilots. That included accepting the goals, restrictions, and extent of the Late Successional Reserves and the Aquatic Conservation Strategy, including the Riparian Reserves.

The recent release by the US Fish and Wildlife Service (USDI USFWS 2011) of a Revised Recovery Plan for the Northern Spotted Owl has re-established a major focus on the owl and its habitat as a key consideration in restoration activities. We tried to design restoration activities that would be consistent with the recovery plan. However, the way in which the restoration plan will ultimately be implemented and interpreted by the USFWS and the BLM is not yet clear. There are also uncertainties in how the recovery plan will be litigated and ultimately, interpreted by the courts.

The Northwest Forest Plan

The NWFP was developed in a process that begin with a scientific and policy analysis (Forest Ecosystem Management Assessment Team 1993) followed by a NEPA-based process involving draft and final environmental impact statements, ultimately culminating in the adopted NWFP. There was significant tension during the development of the NWFP between a focus on ecosystems (e.g., old-growth forests and streams) and on individual organisms (e.g., NSO and Marbled Murrelet). Related to this was also a major tension between a coarse-scale approaches involving large-scale habitat protection and fine-scale approaches focused on habitat for individual species. Ultimately the plan attempted to embrace both approaches, which created many difficulties in its implementation, including on BLM lands in southwest Oregon. *Some of the major issues related to resolution of management of BLM lands in southwestern Oregon appear to be related to this same tension between species- and ecosystem-oriented approaches to conservation of the federal lands.*

Many of the key elements of the NWFP are embedded in four major land allocations: 1) Late Successional Reserves; 2) Riparian Reserves; 3) Matrix; and 4) Adaptive Management Areas.

Late Successional Reserves (LSRs)

These large reserves were ultimately intended to provide large contiguous habitat blocks that could support meta-populations of NSO, with reserves at sufficiently close spacing for effective owl dispersal among reserves (Thomas et al. 2007) (Figure 2). Additional NSO activity centers were protected by smaller (100 acre) reserves scattered through the Matrix. The LSRs were laid out to incorporate concentrations of high-quality mature and old forest, but also included substantial intervening acreages of younger forest on previously logged lands. This reserve network, which totaled 7.4 million acres, was designed (i.e., over-designed) to remain functional in the face of large disturbances, as exemplified by the eruption of Mount St. Helens and the Biscuit Fire.

Management strategies prescribed for the LSRs were based, in part, on historical fire regimes. In Moist Forests, thinning (pre-commercial and commercial) was allowed in LSRs to accelerate development of complex structural conditions in younger forests -- stands that were less than 80 years old in 1993. Thinning in LSRs became an important part of the forest management programs of the federal agencies. Thus, management of the LSRs on Moist Forest sites attempts to develop large contiguous blocks of Late Successional/Old Growth (LS/OG) forests by preserving existing LS/OG forests and thinning younger stands within the LSRs. Of course, in the checkerboard BLM landscape, this is done within an ownership patchwork in which alternate sections of private lands are typically managed for intensive wood production.

Management direction for Dry Forests within LSRs permitted silvicultural treatments to reduce fuel loadings and restore characteristic forest structure where fire suppression had allowed stand densities and fuel loadings to increase unnaturally. However, Dry Forest restoration treatments have rarely been carried out in LSRs during the 17 years of the NWFP's existence.

The LSRs were designated as part of Critical Habitat for the Northern Spotted Owl in 1992. A revised and slightly smaller version of the LSRs was designated as Critical Habitat for NSO in 2008. It is unclear whether the upcoming (2012) NSO Critical Habitat designation will use the LSRs as a foundational element.

In addition to the large LSRs, smaller LSRs were established in the Matrix to protect every owl activity center in existence in 1994 and as well as nesting sites for Marbled Murrelet along the coast.

Populations of the NSO have continued to decline despite the habitat protection provided by the NWFP (Forsman et al. 2011). Forsman et al. (2011) recommended that the USFWS address this downward demographic trend by protecting the habitat of all known NSO sites in addition to retaining structurally-complex forest habitat throughout the federal forests. The USFWS has embraced those recommendations in its revised recovery plan as additions to the NWFP (USFWS 2011). These new findings and recommendations will undoubtedly limit management activity on suitable NSO habitat within the Matrix and elsewhere, as we discuss later in this document.

The LSRs were designed primarily for conservation of Moist Forests but also did incorporate Dry Forests on the eastern and southern margins of the NSO range. The need for active management of Dry Forests in LSRs to restore historic conditions was recognized and provided for in the NWFP (Forest Ecosystem Management Assessment Team 1993), as described above, but has rarely been undertaken (Thomas et al. 2007). Subsequent events, such as large wildfires and outbreaks of Western Spruce Budworm are indicative of the difficulty of sustaining large contiguous blocks of multi-layered forests in Dry Forest landscapes under current climatic conditions, let alone the longer, hotter, and droughtier summers predicted under climate change (e.g., Dello and Mote 2010).

To provide a more sustainable conservation strategy for Dry Forests, we proposed adoption of a landscape-level approach in which the denser patches of forest required by NSO and other dense-forest dependent species are embedded in a restored landscape (Johnson and Franklin 2009). A portion of the forest, perhaps 1/3, would be would be retained in denser patches of multi-layered forest (Courtney et al. 2008), although we view this level as a starting point for analysis. The dense forest patches function as preferred nesting, roosting and foraging habitat for NSO and provide protection from predators (USDI Fish and Wildlife Service 2011). Patches might be approximately 300 to 500 acres in size, located preferentially in sites where denser

forests were probably more common, such as cool north-facing slopes and riparian zones and in defensive areas such as adjacent to natural barriers.

The risk of loss of these patches from severe wildfires would be reduced by restoration treatments in the landscape matrix in which they are embedded. Some losses of denser forest patches are expected over time, but replacement habitat could be re-created in the surrounding forest, which retains significant old and large tree populations.[3]

Aquatic Conservation Strategy

The Aquatic Conservation Strategy (ACS) within the area of the NWFP is a comprehensive conservation and restoration strategy for aquatic systems with four components 1) a temporary system of Riparian Reserves (RRs) defined by a distance equal to one to two site-potential tree heights on each side of perennial and intermittent streams intended as to provide interim protection (Figure 7) until site specific analyses could be completed; 2) key watersheds that would be a priority for restoration; 3) watershed analysis that would identify major issues and restoration opportunities and adjust the interim riparian reserve boundaries; and 4) a restoration program, including modification of the existing road system (Reeves et al. 2006). RRs cover approximately 40 percent of the landscape outside of the LSRs, with more extensive representation in Moist than Dry Forests. Thinning is allowed within RRs under the NWFP but only to assist in aquatic ecosystem restoration.

Matrix

While both LSRs and RRs have ecological objectives, *production of timber and other commodities was intended to be an important objective on Matrix lands* (Figure 2). Also, it was an objective on Adaptive Management Areas, which were established to allow development and testing of innovative approaches for achieving the goals of the NWFP[4]. *As stated in the Standards and Guidelines for the Northwest Forest Plan* "Most timber harvest and other silvicultural activities would be conducted in that portion of the Matrix with suitable forest lands, according to standards and guidelines. Most scheduled timber harvest (contributing to the probable sale quantity [PSQ] not taking place in Adaptive Management Areas) takes place in the Matrix (USDA and USDI 1994, page C-39)." Thus, the Matrix and Adaptive Management Areas were to be the major source of regularly scheduled timber harvest under the NWFP. Much of the volume over time was intended to come from "regeneration harvests" in which the majority of the stand would be removed to provide for a new stand. To help achieve the ecological goals of the Matrix, clearcutting was not allowed and a portion of the stand needed to be retained as a legacy, in the form of individual structures and forest patches or "aggregates."

Forests in the Matrix were also intended to function as connectivity between LSRs and provide habitat for a variety of organisms associated with both late successional and younger forests. Standards and guidelines for the Matrix were designed to provide for important ecological functions, such as dispersal of organisms, carryover of some species from one stand to the next (retention), and maintenance of ecologically valuable structural components such as down logs, snags, and large trees. The Matrix was also expected to add ecological diversity by providing early-successional habitat (USDA and USDI 1994, page B-1).

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[3] We implement this alternative approach to Northern Spotted Owl conservation in the Medford Pilot as described below.

[4] Note: to simplify the discussion below, both Matrix and Adaptive Management Areas will be referred to as "Matrix."

NSO activity centers that occurred within the Matrix or Adaptive Management Areas as of the date of the NWFP (1994) were protected by retention of the best 100 acres around each activity center. Otherwise, stands within NSO home ranges in the Matrix or Adaptive Management Areas were intended to be available for harvest.

Northern Spotted Owl Recovery Plan

The Revised Recovery Plan for the Northern Spotted Owl was released in June 2011 (USDI FWS 2011). We summarize its major conclusions and recommendations below.

Many populations of NSO continue to decline, especially in the northern parts of the subspecies' range, even with extensive maintenance and restoration of NSO habitat in recent years. Despite the habitat protections of the NWFP, the most recent demographic analysis (Forsman et al. 2011) indicates that NSO populations are declining on 7 of the 11 active demographic study areas at about 3 percent annually range-wide. Scientific peer reviewers and Forsman et al. (2011) recommended that the USFWS address this downward demographic trend by protecting known NSO sites in addition to retention of structurally-complex forest habitat. As stated in Forsman, et al. (2011) *maintaining and restoring sufficient habitat is important to address the threats the NSO faces from a loss of habitat due to harvest, loss or alteration of habitat from stand replacing fire, loss of genetic diversity, and Barred Owls* (Forsman et al. 2011).

The USFWS recommends conserving occupied NSO sites throughout the range, especially those containing the habitat conditions to support successful reproduction. Thus, as a general rule, the USFWS discourages forest management activities that are likely to diminish a home range's capability to support NSO occupancy, survival and reproduction in the long-term, but recognizes that active forest management may be necessary to maintain or improve ecological conditions (USDI FWS 2011). The USFWS supports projects whose intent is to provide long-term benefits to forest resiliency and restore natural forest dynamic process, when this management is implemented in a landscape context and with carefully applied prescriptions to promote long term forest health. Examples of active management projects include forest stand restoration, fire risk reduction, treatment of insect infestations and disease and the restoration of high quality early successional habitat as described by Swanson et al. (2011). The USFWS recognizes that these projects may have both short and/or long-term effects to spotted owls and treatments will be designed to minimize impacts as much as possible in keeping with project's intent.

The USFWS emphasizes that the Recovery Plan contains recommendations not regulations and that it realizes land management agencies have multiple goals. Still, given the affirmative responsibility of federal agencies to recover threatened species as their highest priority, we draw a number of conclusions from this summary about future federal habitat conservation and management within the range of the NSO:

General

1) The Recovery Plan endorses use of the Standards and Guides of the NWFP.

2) Pilot projects to test forest management approaches should be done in the Matrix or Adaptive Management Areas.

For Moist Forests

3) Most mature and old growth forest in the Matrix will be ineligible for regeneration harvest, either though addition to the reserve system through Critical Habitat determinations or through application of Recovery Action 10 (protect habitat within NSO sites)

and Recovery Action 32 (protect high-quality NSO habitat). In general, these determinations and recommendations make it difficult to conduct regeneration or early successional harvests in stands that have not been previously harvested and are over 80 years of age. Timber harvests in these older stands in the Matrix were difficult even before these new recommendations due to "Survey-and-Manage" provisions; these new recommendations will add to those difficulties. These issues will be described further under the pilot project discussion.

4) Previously harvested stands less than 80 years of age with remnant structure may also not be available for regeneration or early successional harvest under these determinations and recommendations. Clearcutting sometimes left trees of low economic value but high wildlife value standing in the harvest unit. Such stands might be identified as "suitable habitat" in the range-wide habitat mapping provided by Davis et al. (2011) and utilized in the recovery plan to estimate the amount of habitat. Examples of this habitat identification will be shown later in the pilot project discussion; a more comprehensive analysis is shown in Appendix A.

5) The strategy of designating areas (such as LSRs) large enough to support self-sustaining populations of owls remains intact as does the goal of growing young forest within them into NSO habitat in the future.

6) Consistent with these points for Moist Forests, the USFWS endorses an ecological forestry approach to forest management, including plantation thinning to increase diversity and creation of diverse early successional ecosystems.

For Dry Forests

7) The USFWS recognizes the need for actively managing habitat to meet the overlapping goals of NSO recovery, restoration of dry forest structure, composition and process including fire, insects and disease.

8) Actions should emphasize vegetation management treatments outside of NSO core areas or high value habitat where consistent with overall landscape project goals. Where actions occur within core areas, monitoring of effects should be done.

9) Consistent with the preceding two points for Dry Forests, the USFWS endorses an ecological forestry approach to forest management.

The O&C Act of 1937

Under the O&C Act of 1937, the BLM Western Oregon forests (revested Oregon and California Railroad and re-conveyed Coos Bay Wagon Road grant lands) "… shall be managed… for permanent forest production, and the timber thereon shall be sold, cut, and removed in conformity with the principal of sustained yield for the purpose of providing a permanent source of timber supply, protecting watersheds, regulating stream flow, and contributing to the economic stability of local communities and industries, and providing recreational facilities."

Since this Act, many more laws have been passed by Congress that give the BLM direction in management of the western Oregon lands, especially environmental laws of the 1990s including the Endangered Species Act and the National Environmental Policy Act. Still the 1937 Act makes clear that permanent timber production under the principles of sustained yield is an im-

portant goal of management. We assess the sustained yield associated with different land bases and prescriptions in Part IV for a starting point in discussion about options.

IV. The Secretarial Pilot Projects

The general goals for our involvement in the pilots are to 1) Demonstrate the Franklin/Johnson restoration principles for Moist Forests and Dry Forests in three pilots in southwest Oregon, in the context of the NWFP, NSO recovery plans, and current administrative authorities; 2) Focus on actions that will contribute simultaneously to achieving desirable ecological and social outcomes; 3) Utilize stands that, consistent with goals #1 and #2, are less controversial; and 4) Produce viable timber sales within 12-18 months.

Specific Pilot Demonstration Goals

In the Secretarial Pilots, we chose to demonstrate important aspects of our restoration proposal that are not currently being implemented on BLM's Western Oregon lands.

In Moist Forests--our goal is to demonstrate early successional harvests in younger forests in the Matrix land allocation of the Northwest Forest Plan, using variable retention prescriptions. Currently no regeneration harvesting is taking place or proposed on Moist Forest sites on federal lands in the PNW even though such harvests are necessary for creation of early successional ecosystems and for long-term sustained timber yields. The proposed harvest prescription would be an initial silvicultural treatment in a comprehensive silvicultural system that would include creation and management of multi-aged, mixed-species stands on long (100-160 year) rotations. Key elements in the demonstration include:

- Implementing variable retention early successional harvests (Franklin et al. 1997, Beese et al. 2003, Franklin et al. 2007) in younger forests located within land allocations that have timber production as one of their goals (e.g., the Matrix and Adaptive Management Areas within the NWFP area). Elements retained during harvest include individual trees, snags, and logs and small intact forest patches ("aggregates" with goals of the retention including sustaining ("lifeboating") biota and structurally enriching the post-harvest stand; and

- Allowing for development of early successional ecosystems following harvest, partially by using less intensive approaches to site preparation and tree regeneration. These pre-forest ecosystems have high levels of biodiversity, including many species that are habitat specialists and have unique functional roles (Swanson et al. 2011). Natural re-establishment of trees is emphasized although some tree planting will be done to ensure that adequate tree regeneration does occur on harvested sites. Occurrence of invasive species may also require flexibility in the intensity of post-harvest treatments.

Active management is needed to provide complex early successional ecosystems well distributed in time and space, although medium to large-sized natural disturbances do occur and should be part of any overall plan to provide for these ecosystems. Initially, we intended to do early successional harvests in the less controversial previously harvested stands (60-80 years of age). Ultimately we also applied it in a natural older stand (90-110 years of age) that had experienced no past timber harvest, in part to stimulate the dialogue regarding harvests in such forests. All early successional harvests in the pilot projects are located in the Matrix allocation, where long-term timber production was a goal under the NWFP (Figure 2).

Variable retention early successional harvests are the focus in the Roseburg and the Coos Bay Pilots, exemplifying the Cascade and Coast Range conditions, respectively. These two locations

contrast significantly in Moist Forest composition and growth and, therefore, in appropriate silvicultural prescriptions and expected responses.

In Dry Forests--our goal is to demonstrate how silvicultural treatments can begin to reverse the stand and landscape simplification that has occurred over the last 150 years and restore their biological diversity, heterogeneity, and resilience. The vision is forward looking toward desired future conditions in this landscape and potential threats to it, including effects of climate change, while recognizing the useful knowledge that can be derived from historical studies.

Many Dry Forest areas need restoration to more resistant and resilient conditions using silvicultural treatments; prescriptions must be keyed to specific on-site management objectives, plant associations, stand conditions, and landscape contexts. Some general principles guide Dry Forest restoration silviculture:

- Protect and improve survivability of older trees (trees >150 years of age) and other desirable trees (e.g., large hardwoods) and structures (e.g., large snags) by reducing adjacent fuels and competing vegetation;

- Conduct thinning treatments that 1) move basal areas toward more sustainable levels, 2) increase mean stand diameters, 3) shift composition toward more fire- and drought-tolerant species, such as ponderosa and sugar pine, and away from less fire- and drought-tolerant species, such as white fir; and 4) manage tree populations so as to provide candidate replacements for maintenance and restoration of old-growth trees;

- Move toward levels of within-stand spatial heterogeneity characteristic of Dry Forests using variable density thinning prescriptions that include un-thinned ("skips") and heavily thinned ("gaps") areas. Gaps are intended to provide opportunities for regeneration of shade-intolerant tree species, such as ponderosa pine and oaks;

- Restore appropriate levels of ground fuels and understory vegetation, using prescribed fire where possible, with particular attention to activity fuels; and

- Plan and implement restoration activities at landscape levels, incorporating appropriate heterogeneity (e.g., retention of some denser forest patches) and addressing restoration needs in non-forest ecosystems (e.g., meadows, riparian habitats, and hardwood groves).

The high potential for significant losses of resource values in Dry Forests on federal lands makes aggressive large-scale implementation of restorative treatments a high priority. Many treatments involve removal of significant quantities of merchantable wood and more than pay for themselves; however, these treatments are appropriately integrated with others that will not pay for themselves, such as mechanical removal of small stems and prescribed burning.

Landscape and stand conditions both need to be considered when implementing a pilot project in a Dry Forest watershed. Designing a landscape-level plan for a network of dense forest patches needed as critical habitat for NSO and its prey is the first step. Prioritizing and prescribing restoration treatments in the forest land base or matrix--within which the denser forest patches are embedded – is the second step and are planned in a way that will increase the resilience of the dense forest patches and decrease risks from fire and insects to the entire landscape.

Dry Forest restoration is the focus of the Medford Pilot. Although we propose that this strategy be applied across Dry Forest landscapes, regardless of NWFP land allocations, we located our Dry Forest pilot in the Matrix land allocation (Figure 2) to maximize the chance for successful implementation.

Opportunities for Professional and Public Engagement and Collaboration

We involved a broad range of professionals and stakeholders in the pilot planning efforts from the beginning by: 1) working with local agency professionals (BLM, USFWS, NOAA-F) and those of the Coquille Tribe to help them understand our approach and to learn from them about effective implementation; and 2) engaging interested groups and citizens to demonstrate our approach to them and to better understand their interests and concerns.

We collaborated with professionals and the public during 2011 demonstrate and discuss our approach and show sample marks in selected stands. A broad spectrum of interested groups and citizens took part. Congressman Defazio and Senator Merkley attended some field trips as did a number of Congressional and Senate aides. In general, we utilized the same steps in each pilot (Table 1). A detailed timeline of interactions is included (Table 2). In the timeline, we have also included preliminary work in Roseburg and Medford in 2010 that led, in part, to the pilots.

Table 1. General process for working with professionals and the public on the Pilots.

Task	Purpose	Interaction with local professionals	Interaction with the public
1. Landscape assessment/ development of stand selection criteria	Set the context for selecting stands in which to demonstrate our restoration principles	Work back-and-forth developing and implementing a landscape assessment	Review the landscape assessment/stand selection criteria and make suggestions
2. Stand selection	Identify stands in which principles will be demonstrated	Work jointly to identify stand pool for treatment	Discuss key criteria for stand selection, explain why particular stands used or rejected considering landscape assessment/stand selection criteria and hear suggestions for change (both in office and in the field)
3. Undertake a sample mark and seek review of it	Demonstrate mark by Franklin/Johnson of candidate stands	Visit marked stands to discuss our approach (usually done before a public tour)	Have field trip to explain our approach and the marking choices within it; hear suggestions for improving the mark
4. BLM professionals mark remaining stands selected for treatment	Review success of mark in applying the Franklin/Johnson restoration principles in the field	Field tour with BLM staff of the stands they marked (usually done before the field tour)	Field trip to assess the mark; hear suggestions for change

Table 2. Detailed Pilot timeline

Pilot Development (task)	Date (2011)	Attendance at public meeting
Plan development of Pilots with BLM/Coquille Tribe (Salem)	January 21	
Workshop on Moist Forests and the importance and creation of diverse early successional ecosystems (Roseburg)	Febroary 17	100
Plan development of Pilots with BLM/Coquille Tribe (Roseburg)	February 3	
Continue planning Pilots with BLM/USFWS/NOAA-F (Roseburg	February 24	
Roseburg Pilot		
Initial meeting with BLM/USFWS/NMFS (Roseburg)	Febroary 16	
Initial meeting with public on Roseburg Pilot	February 16 (evening)	70
Develop criteria for stand selection with BLM/USFWS/USFS/NOAA-F	February 24	
Public meeting on stand selection criteria	March 3	30
Public meeting on finalizing stand selection	March 8	30
Meet with BLM in Roseburg	April 11	
Visit/mark sample stands (on snowshoes!) with BLM	April 15, 17	
Continue visiting/marking sample stands with USFWS	April 24, 25	
Lead public field tour to see proposed Pilot stands	May 1	50
Lead public field tour to see proposed Pilot stands	May 2	50
Review proposed approach to early successional harvest with BLM professionals to assess conformance of Pilot project with restoration principles	August 9	
Participate in public tour of Pilot projects	September 13	
Medford Pilot		
Work with the BLM to develop landscape analysis to guide stand selection in the context of recovery of the northern spotted owl, find demonstration stands, mark demonstration stands	March 13-18	
Lead public field tour of landscape plan/tree selection	March 19	70
Review proposed landscape plan with BLM/USFWS	March 24	
Review finished project in field with BLM professionals to assess conformance of Pilot project with restoration principles	May 4	
Lead public field tour of Pilot stands and tree selection	May 5	60
Coos Bay Pilot		
Lead field tour with Coquille Tribal professionals to explain approach	December 27, 2010	
Examination of candidate stands with Coquille Tribe	March 9	
Examination of candidate demonstration stands with BLM and Coquille Tribe/ mark sample stand with assistance of BLM and Coquille Tribe	March 21-23	
Help lead public meeting on Pilot	May 31 (evening)	50
Lead public field tour of proposed Pilot stands	June 1	70
Review proposed Pilot project in field with BLM professionals and public	September 14	

Note: the public tours generally included professionals from BLM, USFWS, and NOAA-F

Roseburg Pilot: Moist Forest Harvest to Create Diverse Early Successional Ecosystems on Moderate Productivity Sites

Roseburg BLM personnel asked us to utilize the Myrtle Creek Watershed for the pilot project on their district (Figure 12). Their reasons included: 1) general location of this drainage within the Matrix land allocation, except for Riparian Reserves (Figure 7); and 2) few potential conflicts with timber sales (thinning) planned by the district. This watershed includes both Dry Forests at lower elevations and Moist Forests at higher elevations (Figure 3). We focused the pilot on Moist Forests as a complement to the Moist Forest project on Coos Bay and because of the policy complexities inherent in management of Dry Forests within checkerboard landscapes.

Goal: Demonstrate an ecological forestry approach to harvesting and subsequent stand management, including provision for early successional ecosystem development, in a variety of existing younger forest stands on Moist Forest sites on Matrix lands of the Roseburg District.

We began by developing a population of potential stands for the demonstration during a series of public meetings, where participants were asked to provide landscape and stand criteria to guide stand selection.

- Key criteria in selecting the stand population included stand age and stand origin. After much discussion, we tabulated the characteristics of all Moist Forest stands in the Matrix land allocation between 50 and 100 years of age in the Myrtle Creek Watershed (Figure 12).

    - We initially planned to use previously harvested stands between 60 and 80 years of age, given our intent of using stands that were less controversial. However, Myrtle Creek Watershed contains relatively few acres of such stands. In addition, while some stakeholders wanted us to restrict our demonstration to 60-80 year stands, others wanted us to use only stands >80 years of age.

    - Ultimately, we settled on stands between 50 and 100 years of age (as defined by the BLM Operations Inventory) that were readily accessable as our potential population (Figure 13).[5] This age range included some previously harvested stands as well as natural stands that had not been previously harvested. This age range is broadly inclusive of the ages that BLM currently uses as desired rotation ages in the Matrix. While 50 years of age seems young for an early successional harvest, there is a substantial acreage of 50-year-old stands, which greatly broadens the population of stands available to demonstrate the strategy. Also, some "50-year-old stands" are actually include older trees.

    - Using criteria that focus more on overstory age, even if that overstory is a remnant of a previous stand, yields somewhat different results (Figure 14). In addition, older patches and trees can occur in stands labeled as much younger (Figure 15). Thus, there is a need for caution in using age maps to delineate areas of interest to the Northern Spotted Owl.

[5]Upon field inspection, we found that one stand contained components older than 100 years of age and might equally been described as a "110 year old stand with older components."

Another much-discussed criterion was the potential habitat suitability of any candidate stands for the NSO. Some stakeholders wanted the pilot to avoid any "suitable" stands, especially those with a history of use. Others did not want owl suitability to be a major consideration since these stands are all in the Matrix land allocation, which would have timber production as one of their goals under the NWFP.

Ultimately, we decided to apply our restoration principles to the broader age range of Moist Forest stands, even if the range-wide analysis indicated the stand contained suitable NSO habitat; otherwise our choices would have been very limited (Figure 16). Nest patches in historical home ranges (the best 100 acres around the nest) were to be avoided as well as patches of complex forest designated by USFWS and BLM as having special value as NSO habitat (Recovery Action 32 (USDI USFWS 2011). It should be noted that any home ranges where we considered harvesting suitable habitat were home ranges with habitat levels above the thresholds of concern generally utilized by USFWS during consultation; after harvest they would still be above the thresholds.

After visiting a few selected stands with BLM and USFWS professionals and evaluating retention goals and issues, we turned the selection and marking of retention patches or aggregates (30% of the stand including interwoven Riparian Reserves) over to the BLM (Figure 17). Generally, there was only minor problems in identifying retention patches. However, in the natural, previously unharvested stand 100-120 years of age, BLM professionals encountered problems that make it difficult to undertake early successional harvests in these types of stands (Figure 17) including numerous active Red Tree Vole nests, which can result in a tree height buffer around nest sites under NWFP Standards and Guides and subsequent legal settlements.

Some of these considerations were dealt with by incorporating locations of these structures or species into retention patches within the proposed harvest unit. However, the withdrawals within the stand can become so extensive that the goal of creating openings for early seral species is compromised. Withdrawals can also make it difficult to logically locate temporary roads needed to log the harvest unit.

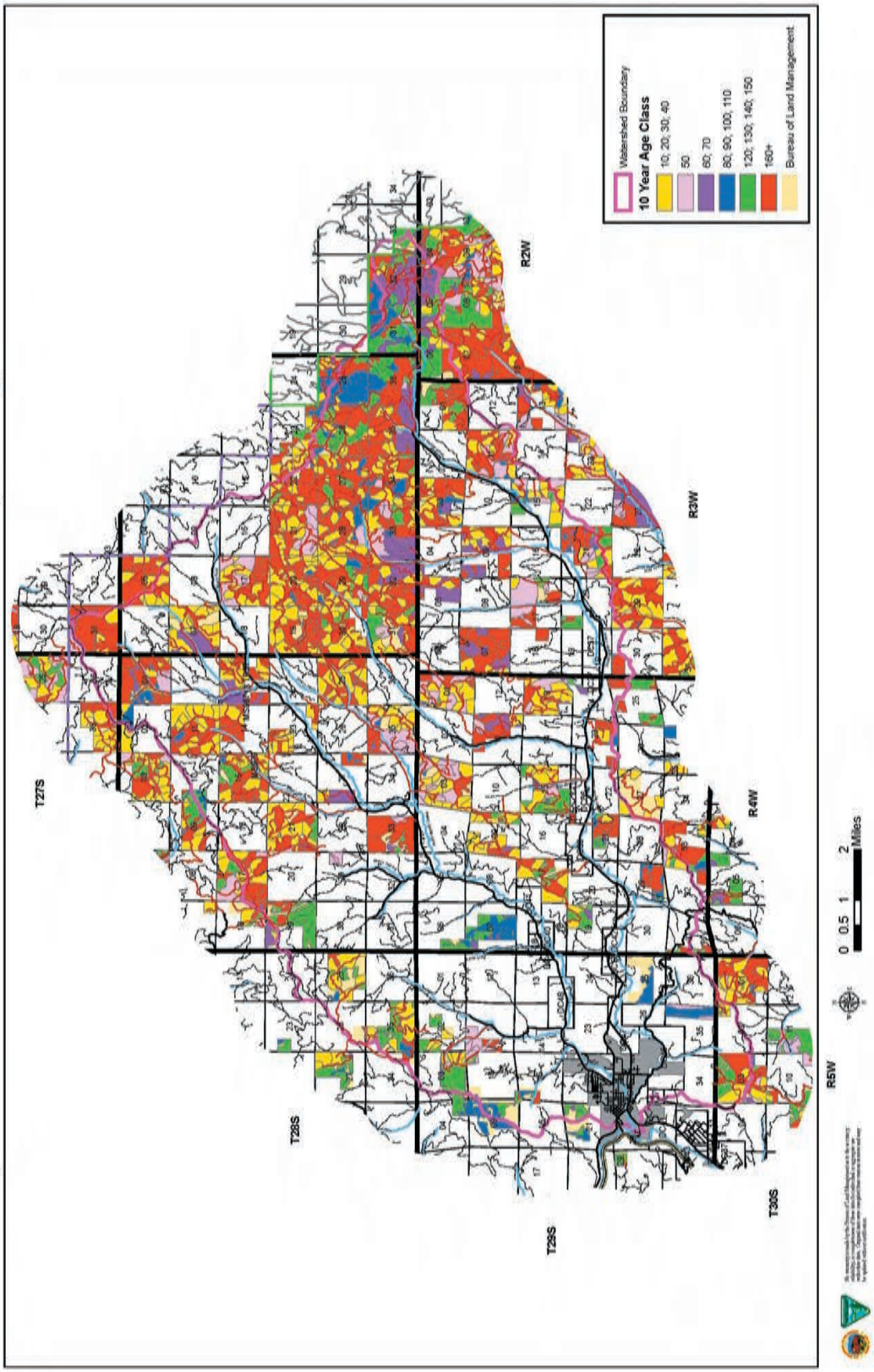


Figure 12. Age classes of BLM ownership in Myrtle Creek Watershed of the Roseburg District. This drainage is in the "Matrix" land allocation, with interspersed Riparian Reserves along streams.

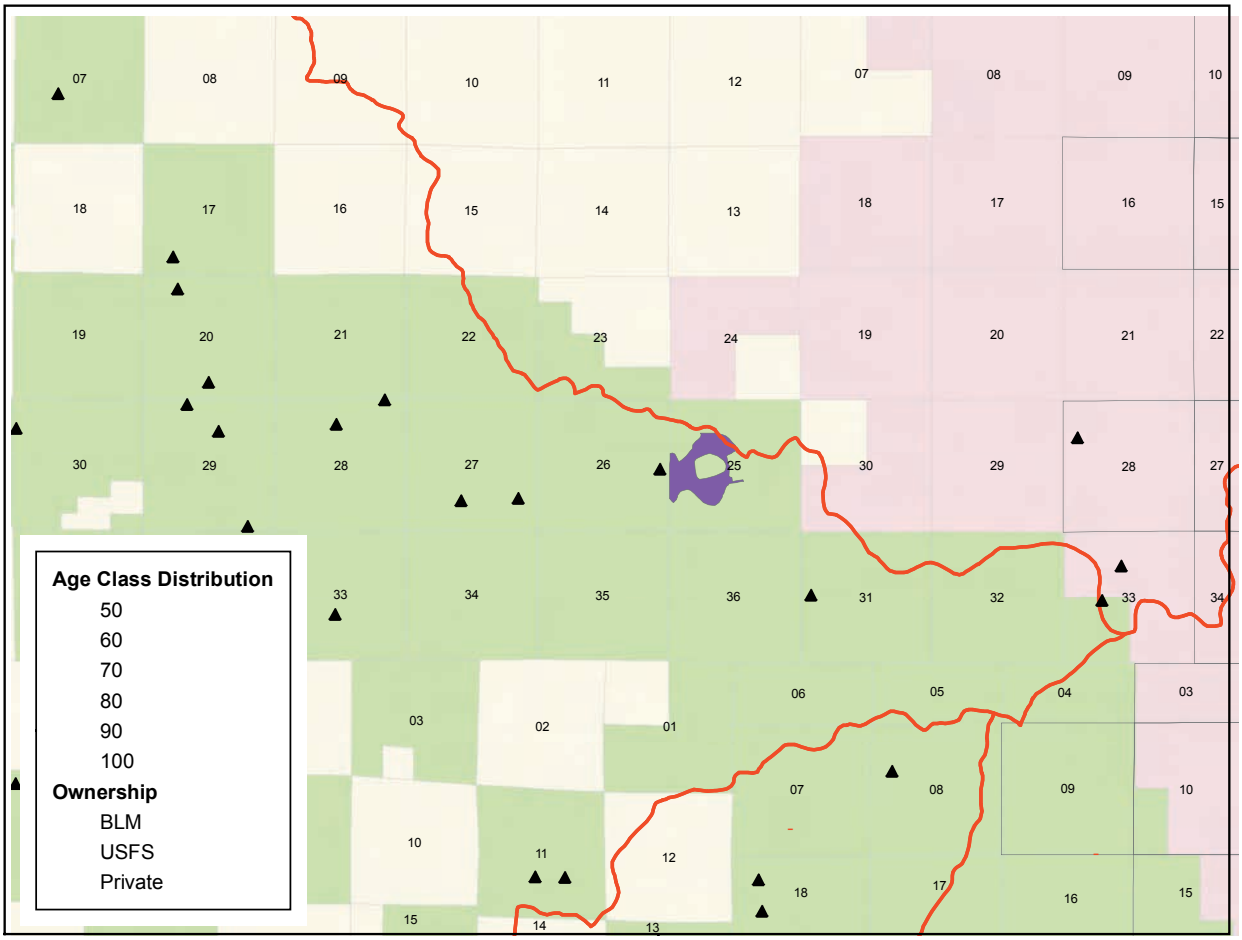


Figure 13. Moist Forest stands in Matrix land allocation classified as between 50 and 100 years of age by the BLM Operations Inventory in the Myrtle Creek Watershed.

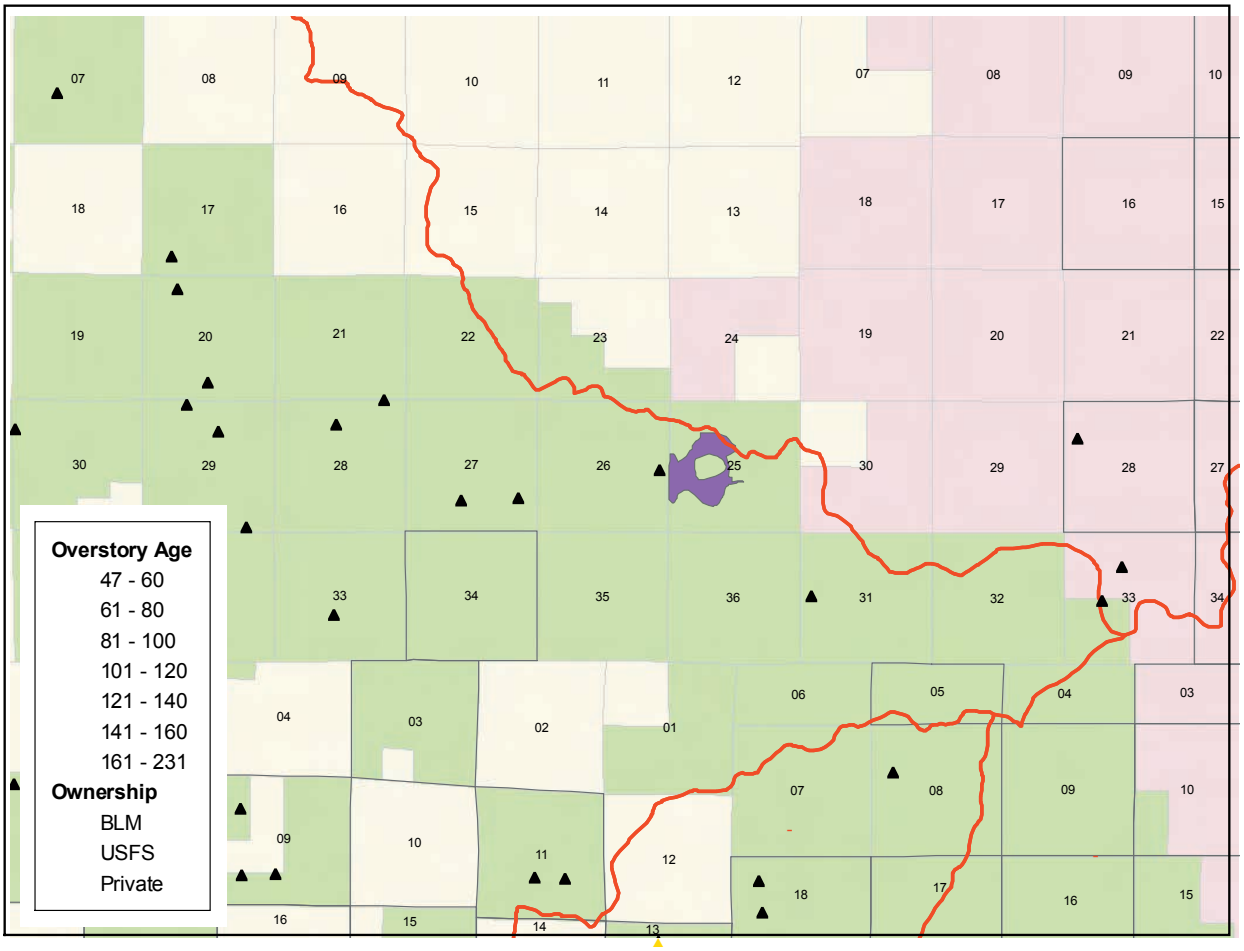


Figure 14. Overstory age of Moist Forest stands in Matrix land allocation classified as between 50 and 100 years of age by the BLM Operations Inventory in the Myrtle Creek Watershed

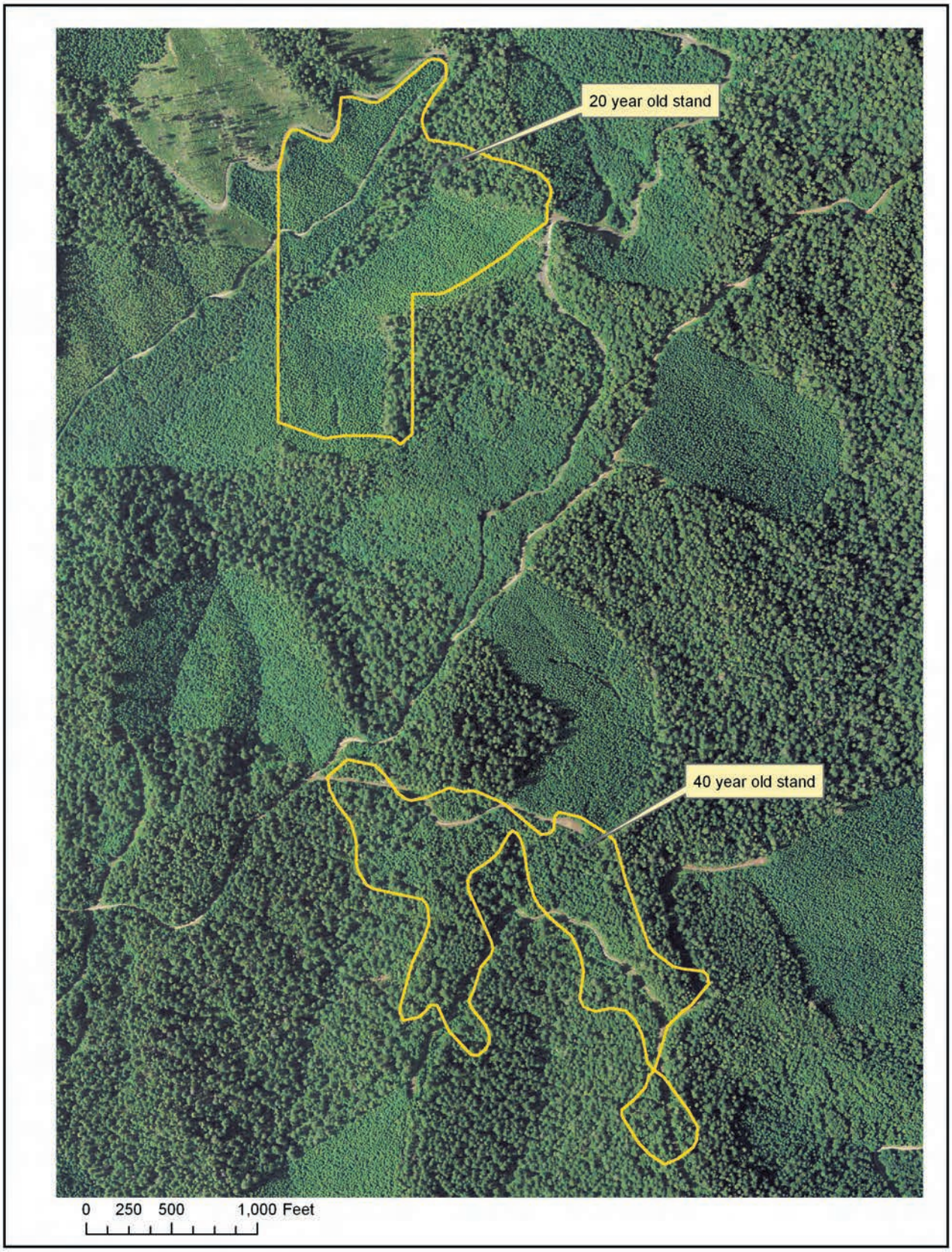


Figure 15. A portion of the BLM forests in the Myrtle Creek drainage showing the spatial pattern of young (small crowns less than 40 years) and old (large crowns greater than 160 years), with ages coming from BLM Operations Inventory. Also, some of the stands described as 40 years old or less have remnant old trees (lower stand outlined in yellow with scattered old trees mixed in a young stand) or have patches of old trees (such as upper stand outlined in yellow with the corridor of old trees running through it).

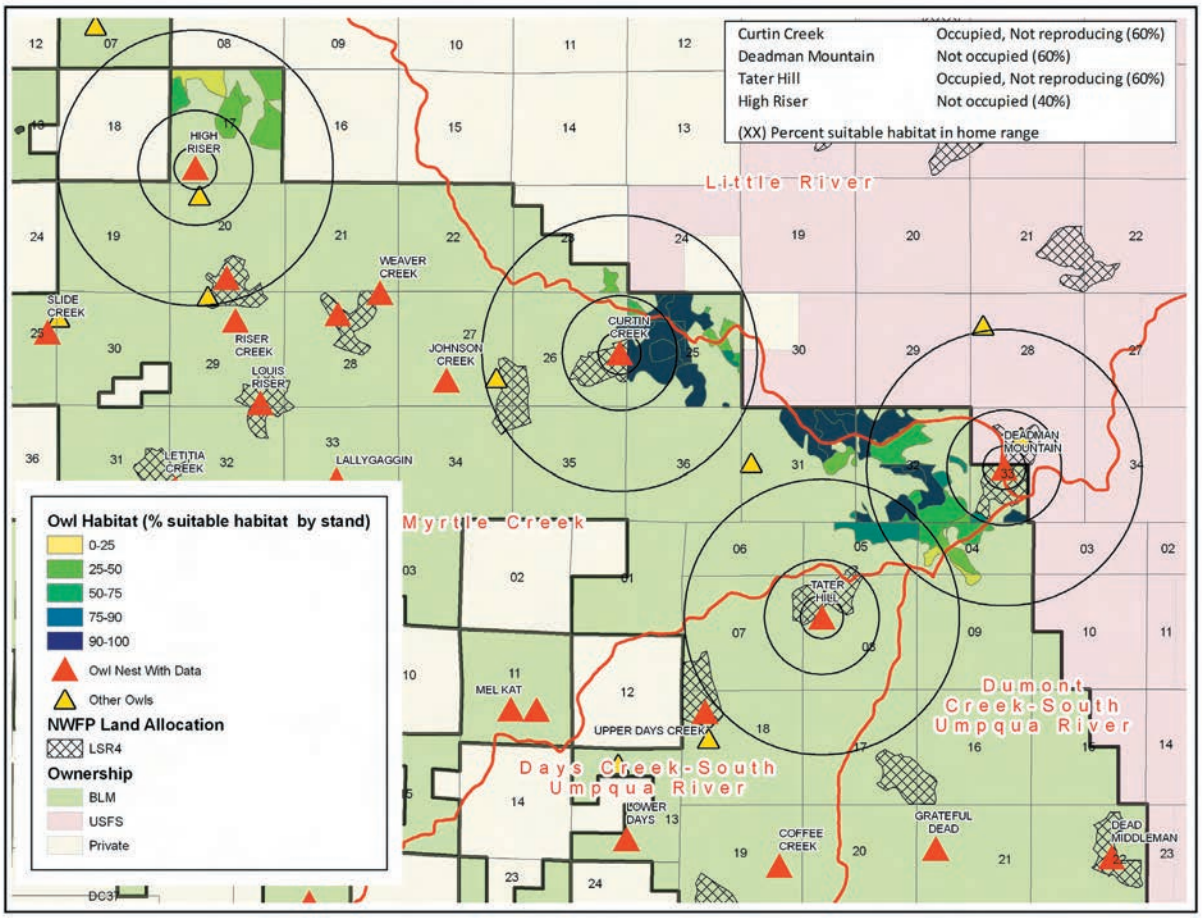


Figure 16. Percentage of suitable Northern Spotted Owl habitat in Moist Forest stands in Matrix land allocation of the Myrtle Creek Watershed classified as between 50 and 100 years of age by the BLM Operations Inventory. (Source: Region-wide analysis of Northern Spotted Owl habitat by Davis et al. 2011). Field analysis would further identify which portions of the stands contain suitable habitat. Also, historical owl occupancy sites and home ranges are shown.

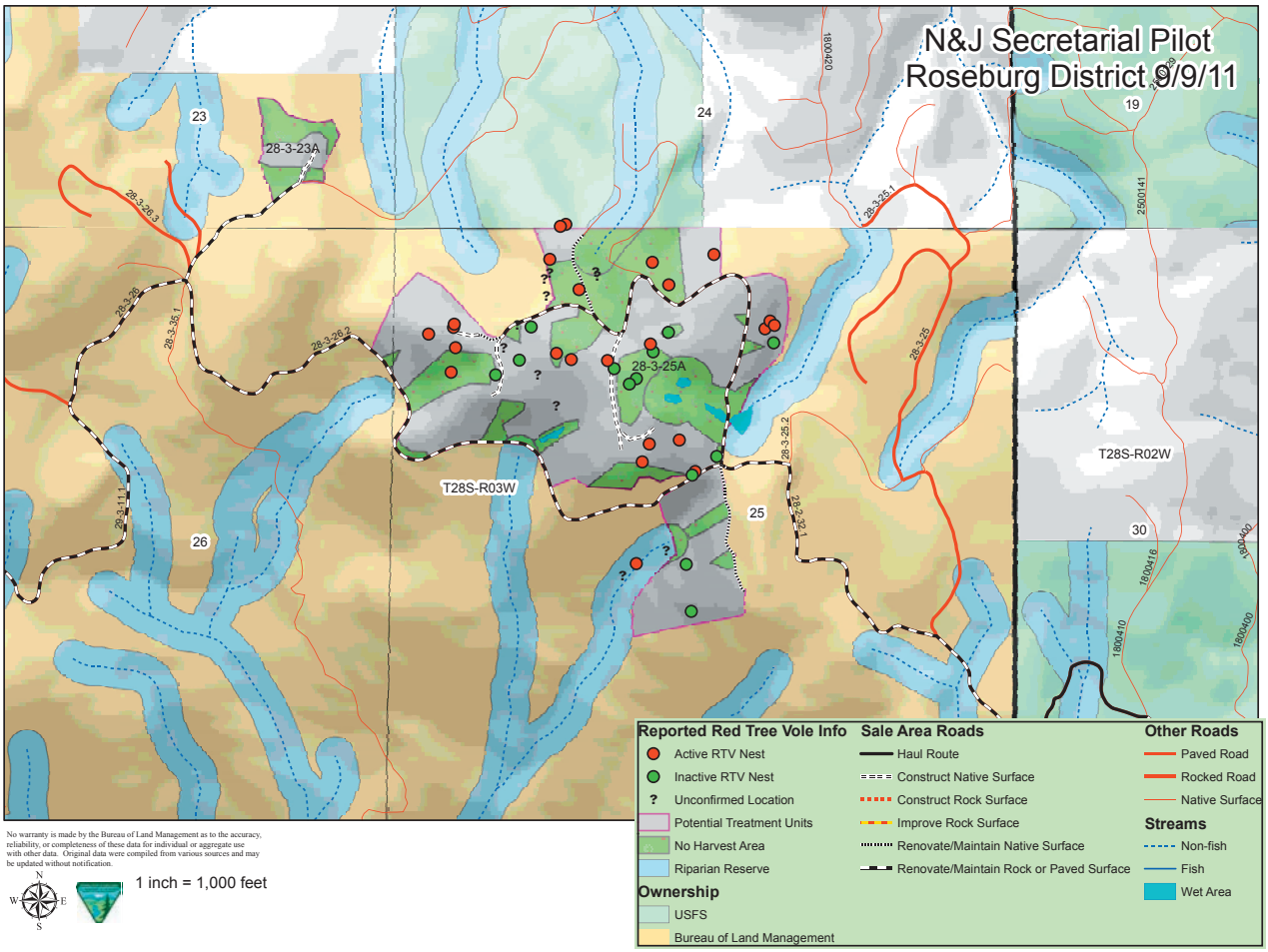


Figure 17. Map of two of variable retention early successional harvest units in the Roseburg Pilot Project showing the location of retention patches, planned harvest areas and Riparian Reserves. Locations of active and inactive Red Tree Vole nests are also shown; note that some, but not all, of the nests have been captured within retention patches.

Coos Bay Pilot: Moist Forest Harvest to Create Diverse Early Successional Ecosystems on High Productivity Sites

The Coquille Tribe and the Coos Bay BLM asked us to utilize the Coos Bay Wagon Roads for the pilot in the Coos Bay District (Figure 18). These lands are of special interest to the Coquille Tribe and also the Confederated Tribes of the Coos, Lower Umpqua, and Siuslaw Indians.

Goal: Demonstrate an ecological forestry approach to variable retention harvest and subsequent stand management, including provision for early successional ecosystem development, on a variety of existing younger forest conditions in the Moist Forests on Matrix lands of the Coos Bay Wagon Roads.

We wanted to demonstrate our restoration principles in a number of previously harvested stands in the Matrix between 60 and 80 years of age (Figure 18). These stands are relatively abundant on the Coos Bay Wagon Road lands and are highly suitable for demonstrating our principles, partially because structural development is rapid in these highly productive forests.

We discovered that many 60- to 80-year-old stands were scheduled for thinning and were not available for demonstrating an early successional harvest. Also, stands in the western portion of the pilot area were of special interest to the Coos Tribe. Ultimately we accepted a single stand (Figure 19 and Figure 20) just south of a large LSR, which had previously been clearcut but contained old legacy trees and abundant large down wood. This unit is located at the intersection of two NSO home ranges, has small Marbled Murrelet LSRs along the edges, incorporates significant areas of Riparian Reserves, and was designated as NSO Critical Habitat in 1992 but subsequently left out of 2008 Critical Habitat.

We visited the selected stand (referred to as “Section 17”) with the BLM District and Coquille Tribal professionals and, again, with the public and the professionals. It was clear from discussions and sample marks that the professionals understood our principles and how to apply them.

- BLM and Coquille Tribal professionals had the goal of selecting 20-30 percent retention, primarily as aggregates. They initially focused on special features, such as areas of old legacy trees and logs, while attempting to distribute the retention patches over the harvest unit. Subsequently, the required buffers around active Red Tree Vole nest trees became a dominant consideration in placement of retention patches (Figure 19), with a local citizen group (“Nest”) providing data on nest locations.

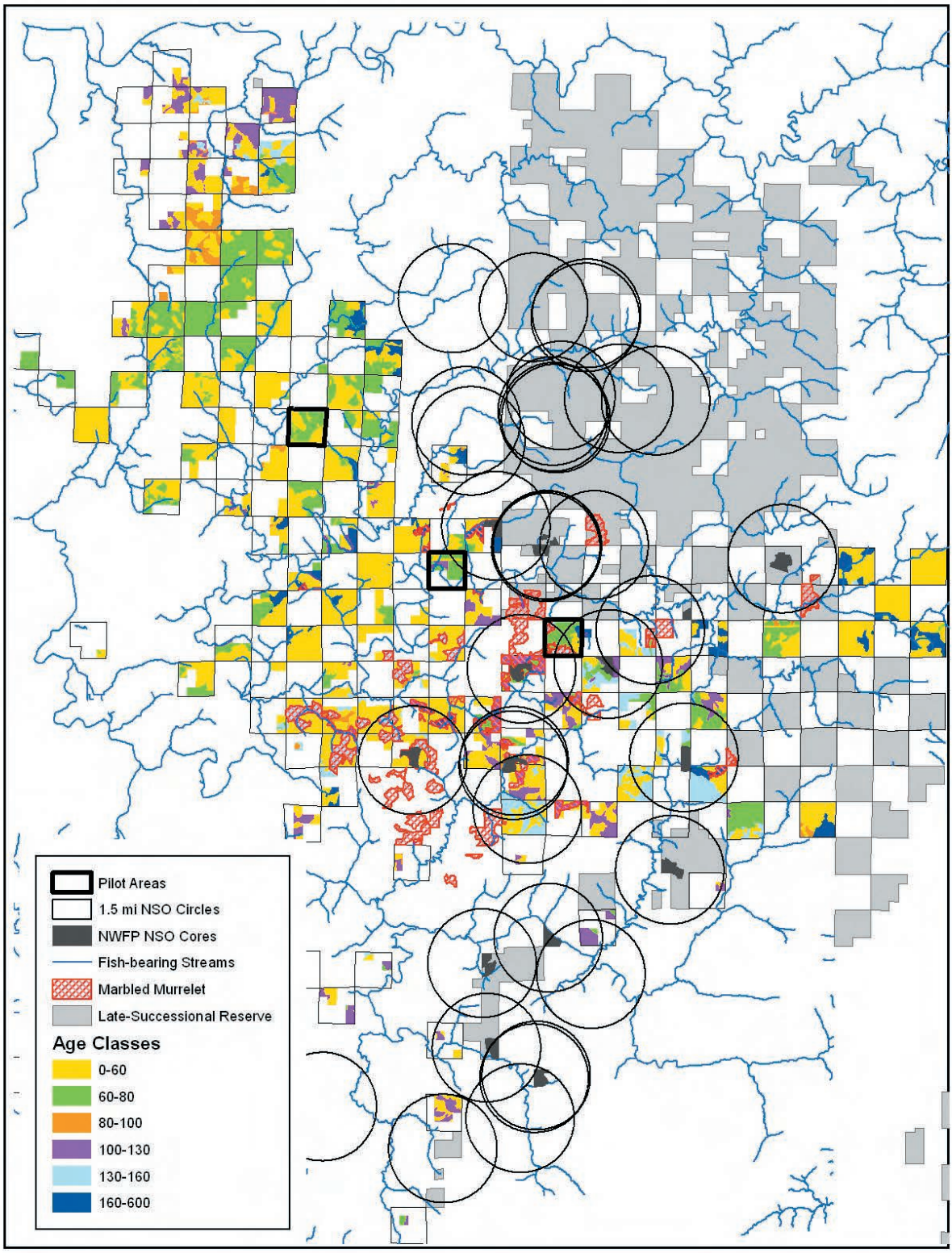


Figure 18. General location of Coos Bay Wagon Roads showing land allocations and location of the three stands considered for the Pilot.

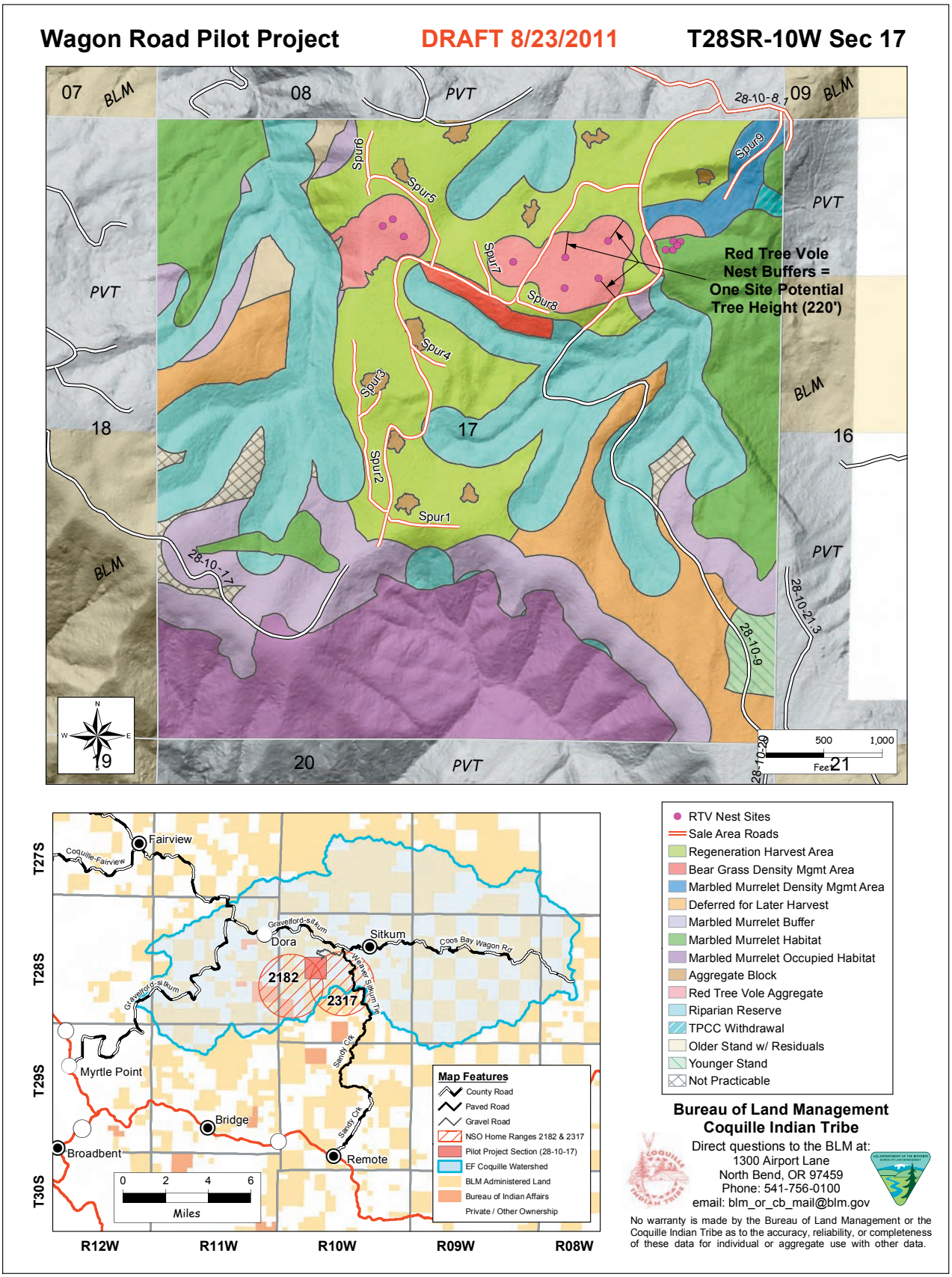


Figure 19. Detailed considerations in the stand selected in the Pilot for a variable retention early successional harvest including land allocations, draft retention patches, and active Red Tree Vole nests that were found.

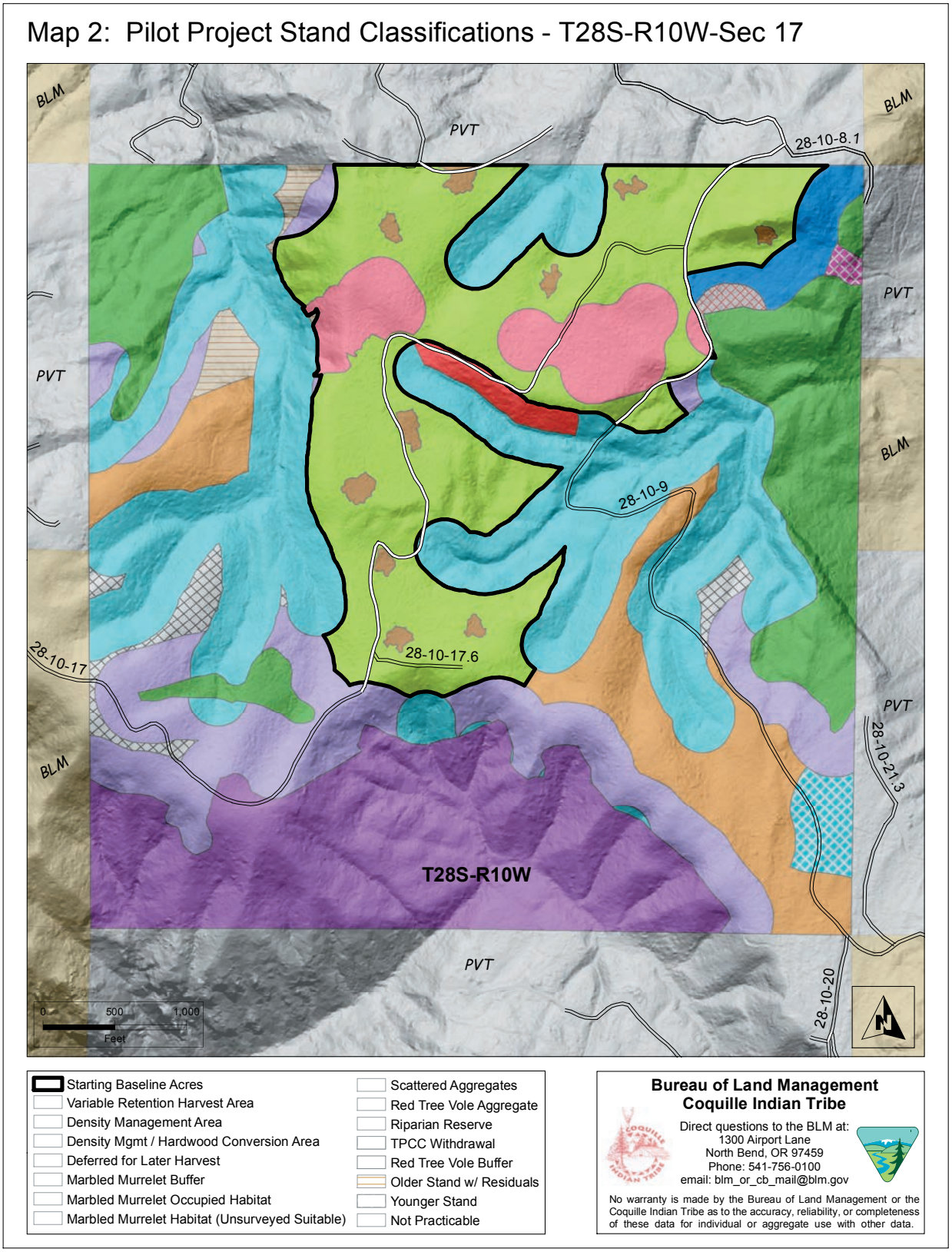


Figure 20. Detailed considerations in the stand selected in the Pilot for a variable retention early successional including harvest land allocations and final retention patches.

Medford Pilot: Increasing the Resilience of Dry Forest Landscapes to Future Threats while Contributing to Recovery of Northern Spotted Owls[6]

The Middle Applegate Watershed was the obvious selection for the Secretarial Pilot since it had been identified by the Southern Oregon Small Diameter Collaborative and the Applegate Watershed Council before we arrived (Figure 21) and was part of an Adaptive Management Area. It also had been the locale of a previously offered timber sale, which was not sold; however, extensive biological surveys had been carried out as part of the sale preparation and allowed an accelerated schedule for offering the pilot project.

Goal: The Medford Pilot Project demonstrates the nature and the feasibility of active management to reduce stand densities and increase heterogeneity in Dry Forests, thereby improving their ability to survive current and future threats from wildfire, drought, and insects, while retaining dense forest patches for the Northern Spotted Owl within the Dry Forest landscape.

We were asked to apply restoration treatments to the Dry Forest stands south of the Applegate River (Figure 21). The forests are primarily relatively dense stands of maturing Douglas-fir with a mid-story of hardwoods (oaks and madrones) (Figure 22). Ponderosa and sugar pines are present in small numbers. Generally hardwoods are overtopped and in declining vigor, with many dead or dying. The forest floor is relatively sparse due to shading by the Douglas-fir overstory.

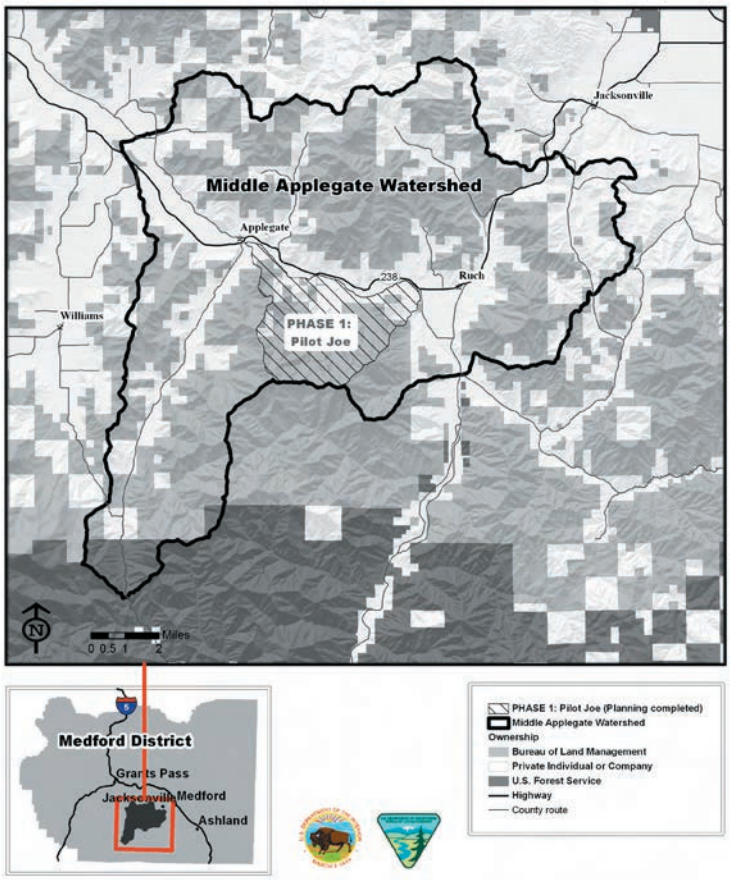
The first step in applying our Dry Forest restoration principles required that we identify approximately one-third of the drainage that would be retained as untreated, dense forest patches. These landscape-level areas are intended to provide nesting, roosting and foraging habitat for the NSO, some of its prey species, and other species and processes dependent upon dense forests. Fortunately, BLM professionals were able to carry out this first step and identified and delineated an appropriate set of dense patches, which they call Late Successional Emphasis Areas (LSEAs), based on maps of NSO habitat quality and historical use (Figure 23).

Following delineation of the dense forest patches, areas for restorative treatment were selected that would contribute most to reducing potential threats to the Late Successional Emphasis Areas. These proved to be areas located between the Applegate River and the LSEAs, since these sites have higher fire probability and also are located between concentrated ignition sources (the settled valley bottomlands) and the LSEAs (Figure 22)

Some of the areas selected for treatment are commercial units (i.e., they will more than pay for their treatment through removal of commercial wood products) and some are non-commercial units (Figure 24).

We marked a few stands to demonstrate our approach to selection of the trees for retention as well as selection of areas for “skips” (small areas left untreated) and “gaps” (areas heavily thinned to allow for development of understory vegetation and tree reproduction). We then participated with the BLM staff in working through a few stands before turning the remaining areas over to them for marking, including the designation of skips (Figure 25).

Preliminary cruises of the sample stands we marked showed that treatments would reduce overall stand basal area by about 40%, with harvest focused on Douglas-fir less than 25” dbh. ~~All trees over 30” were retained as were all l~~arger hardwoods.



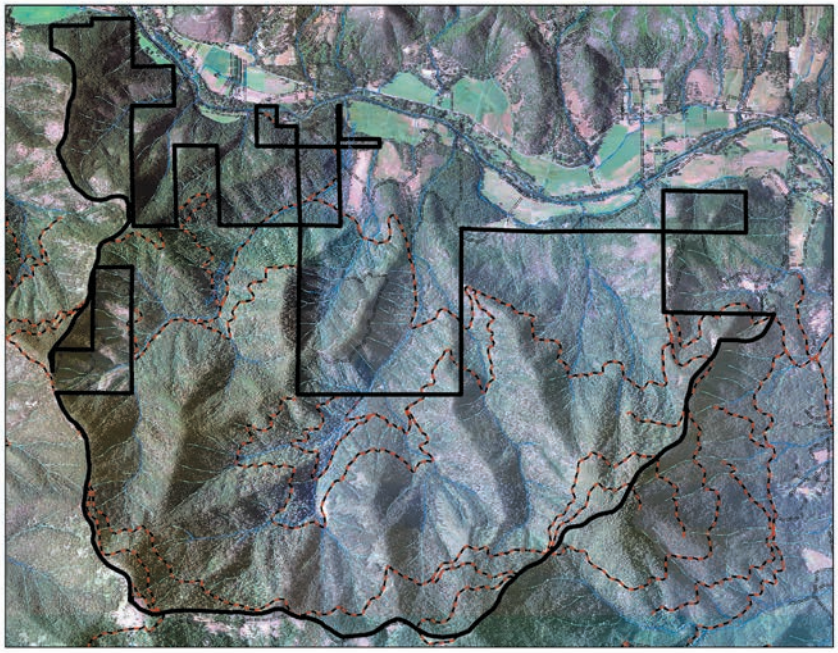


Figure 21. General location of the Pilot Project (Pilot Joe) within the Middle Applegate Drainage (top); Topography, streams (in blue), and roads (in red) of Pilot Joe (bottom).

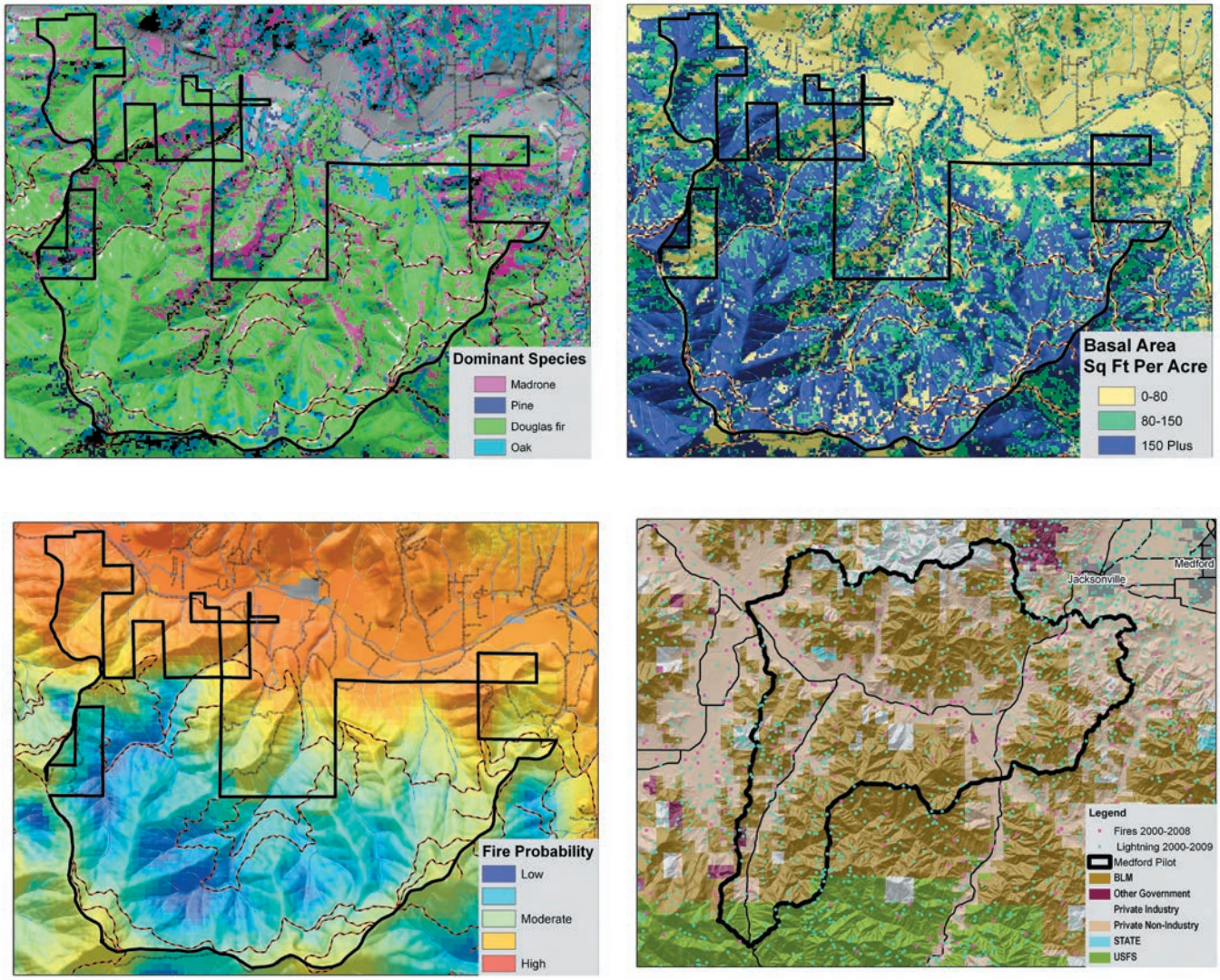


Figure 22. Characteristics of the Pilot Joe Area. Douglas-fir is the dominant species in Pilot Joe (top left) and most stands have basal area greater than 80 square feet (top right) although both species type and basal area varies with aspect, microsite, and land use history. Fire probability In Pilot Joe varies from relatively high in the valley bottom to relatively low in higher elevations (lower left). The Pilot Joe area regularly experiences both lightning strikes and wildfire (bottom right) with most of the fires starting in the valley bottom.

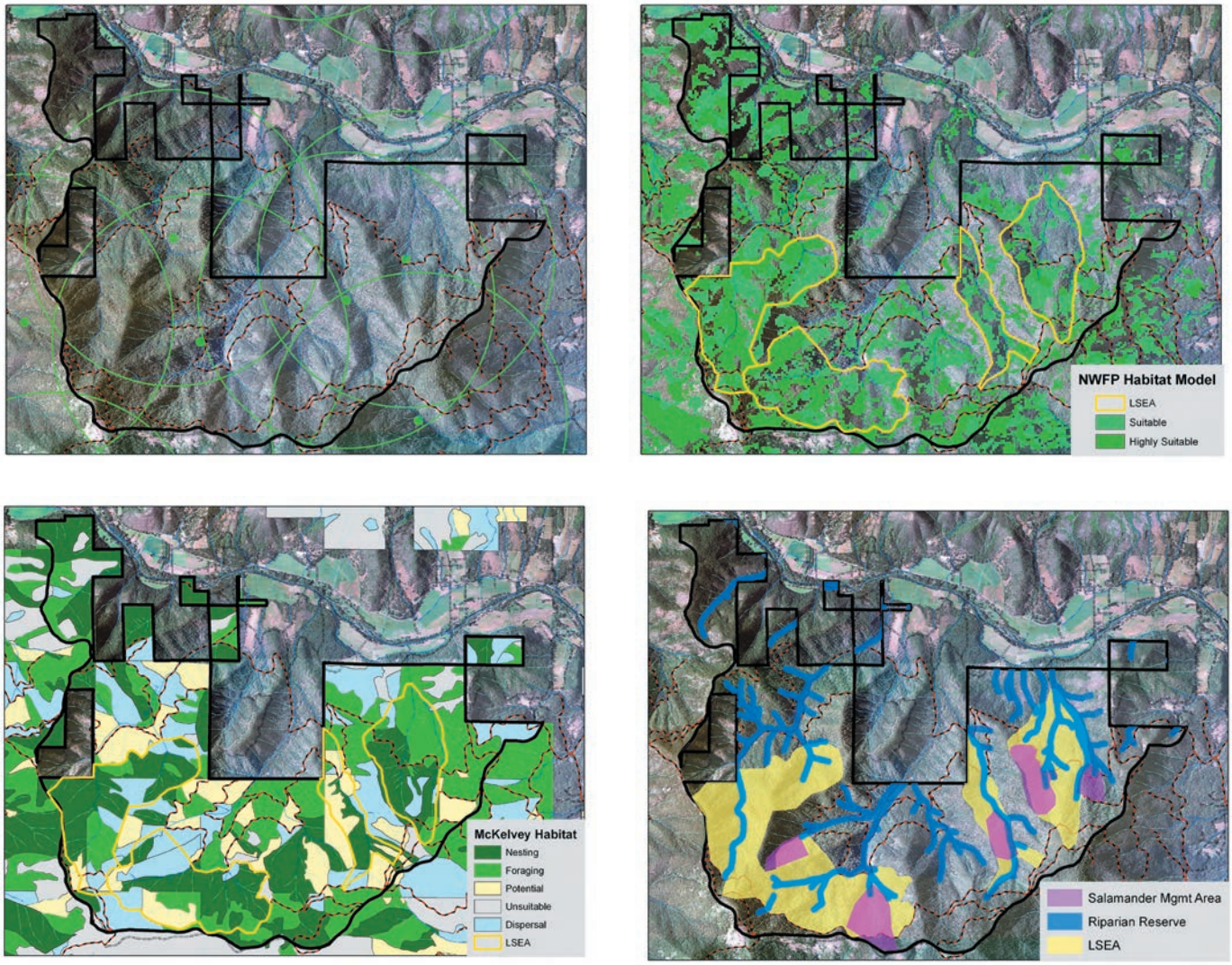


Figure 23. Consideration of the Northern Spotted Owl. Spotted owls have historically occupied the Pilot Joe area (top left–home range circles and sightings (green dots), but few have been found lately. Two sources of information on preferred habitat for the Northern Spotted Owl are the range-wide analysis of Davis et al. (2011) (top right), and work by McKelvey (lower left). Areas of Late Successional Emphasis (LSEA) were placed to capture suitable habitat, using both sources of information, and reflect past owl use. In aggregate, LSEAs, Riparian Reserves, and Salamander Management Areas cover approximately 50% of Pilot Joe (lower right). Pilot harvest activities were not considered with those areas.

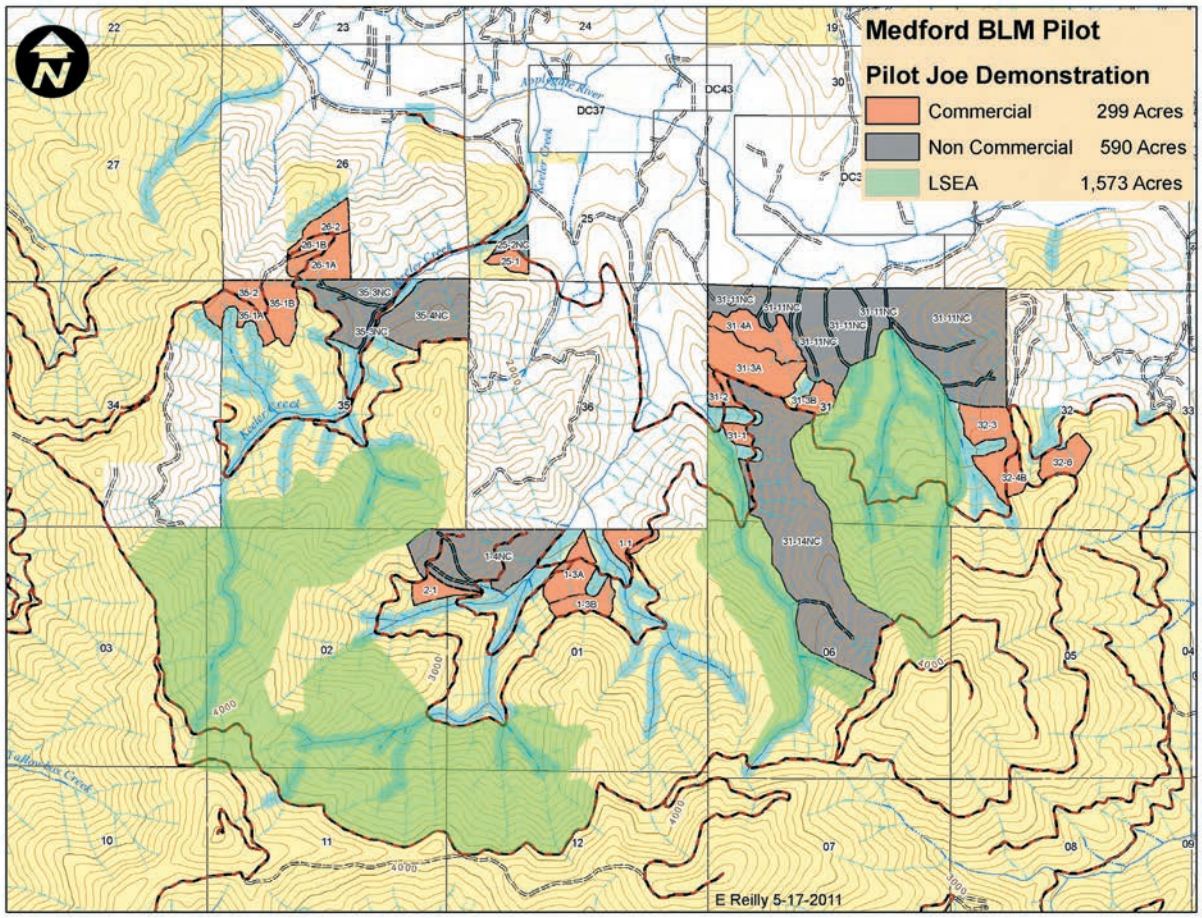


Figure 24. Example of integration of forest restoration with conservation of the Northern Spotted Owl in Dry Forests of the Applegate River drainage southeast of Grants Pass, Oregon. Colored areas are BLM lands; white areas are private lands. Blue linear features are Riparian Reserves. LSEA = Late Successional Emphasis Areas located around nest sites of the Northern Spotted Owl. Commercial = restoration treatments that will provide economically viable timber sales. Non-commercial = restorations treatments that will require investment.

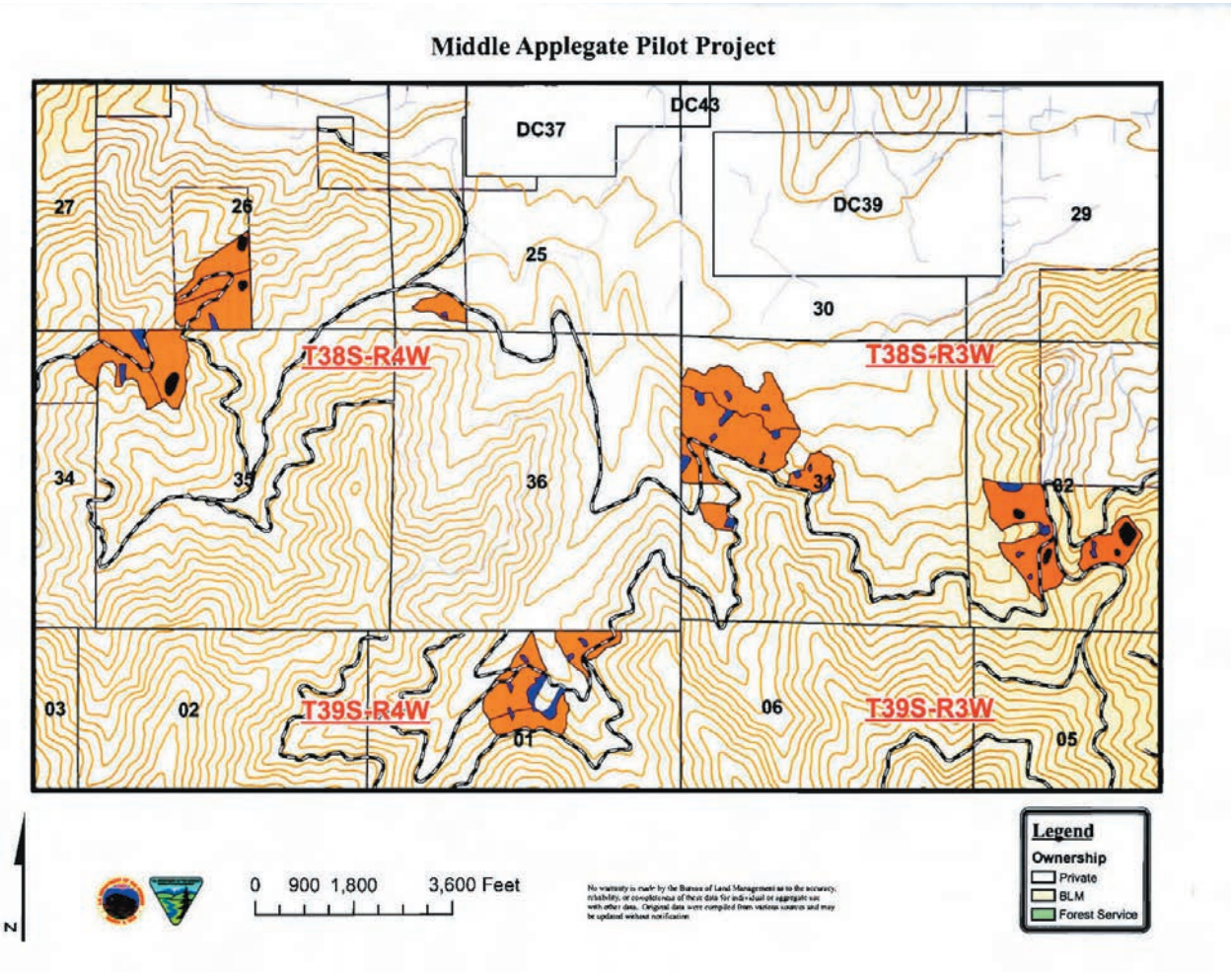


Figure 25. "Skips" in commercial treatment units of Pilot Joe.

V. Observations about Moist Forest and Dry Forest Restoration

Moist Forests

Moist Forest regeneration harvests designed to create diverse early successional conditions ("early successional harvests") are a critical, albeit controversial, component of Moist Forest restoration

- Pilot landscapes lack significant areas of diverse early successional ecosystems; recent regeneration harvests by private landowners provide little representation of this developmental stage. Most recent regeneration harvests in the pilot landscapes are on forest industry land and employ clearcutting followed by intense site preparation, dense conifer planting, and suppression of competing hardwoods and shrubs. These practices grow conifers rapidly but do not allow for development of diverse early successional ecosystems.

- Moist Forest landscapes generally are deficient in representation of both diverse early successional and late successional (old growth) ecosystems, whether in reference to historical conditions or to provision of sufficient habitat for the species and ecosystem processes associated with these ecosystems (Table 3). Simultaneously increasing the representation of both ecosystems requires careful landscape planning and stand selection. In setting priorities, it is logical to retain older stands, since they are farther along their successional trajectory to old growth. Thus, younger stands are generally the most suitable candidates for regeneration harvests intended to create diverse early successional conditions, especially if they have been previously-harvested.

Table 3. Historical ranges of variability in diverse early successional forests and old growth forests from 250 simulated landscapes, based on fire regimes characteristic of the Oregon Coast Range over the 1000 years prior to Euro-American settlement (Wimberly et al. 2002) and current levels (1996) of these two forest structural stages (Spies et al. 2007) in the Oregon Coast Range.

Forest Structural Stages	Historical Range of Variability			Current Level
	Low	Median	High	
	——Percent of Oregon Coastal Forest——			
Diverse early successional	12	17	29	3
Old growth	29	42	52	3/11*

*The higher number for the current level of old growth includes mature forest.

- Wildfires create some of the best diverse early successional habitat, but using a "let-burn" strategy to provide early successional ecosystems is not a useful approach for systematically creating early successional habitat in the landscapes managed by BLM.

  - Allowing wildfires to flourish in Moist Forest landscapes, rather suppressing them (the current policy) is inappropriate because: 1) risks to human life and property from uncontrolled wildfires are unacceptable in the landscapes managed by BLM; and 2) there is potential for significant losses of scarce late-successional forests, since wildfires in Moist Forest landscapes are highly unpredictable and risky.

- When wildfires do occur on federal lands they create an opportunity for development of high-quality early successional ecosystems. Intensive salvage operations and associated site preparation and tree planting are not appropriate if a management goal is to utilize such events to provide for early successional ecosystems. Salvage and related activities can greatly reduce the potential for full development of early successional ecosystems by removing important legacies, eliminating important constituent species, and abridging the duration of early successional development. In general, post-wildfire activities should be guided by the management emphases for the area prior to the event. Under our restoration strategy, if salvage and related activities are considered on burned sites, they would follow the same principles utilized in harvesting green forests on such sites.

Variable retention harvests followed by actions that will nurture diverse early successional communities are the first steps in an ecologically-based comprehensive silvicultural strategy under our restoration strategy:

- Layout and selection of retention patches in Moist Forest variable retention regeneration harvests can protect many special features.

- Both the Coos Bay and Roseburg Pilots demonstrate the biological complexity that can be conserved during harvests in younger forests, including previously harvested stands.

- Careful field work and design are needed to capture the structural (e.g., old trees, snags, and logs) and compositional legacies (e.g., hardwoods) present in existing stands and maximize their effectiveness in creating diversity in the post-harvest ecosystems.

Survey and Manage requirements for areas planned for variable retention, early successional harvest create uncertainty about sale feasibility and can significantly diminish the Matrix area available for regeneration harvests.

- The search for active Red Tree Vole nests and their protection with tree-height buffers in both the Coos Bay and Roseburg Pilots created uncertainties about where regeneration harvests could occur.

- The requirement to do fungal surveys for two years in areas of likely habitat reduced the sale area, since a two-year assessment was not possible within the pilot timeline.

- The target of 20-30% retention combined with the desire to use this retention to meet Survey-and-Manage requirements limited the potential to incorporate other special features of the stand in the retention.

Natural regeneration can play a dominant role following variable retention early-successional harvests, but allowing for low to modest levels of planting can reassure stakeholders and managers that adequate numbers of trees of appropriate species will be re-established in a reasonable time. Planting can also be used to add species that lack local seed sources.

- One specific goal in the restoration strategy is to allow for a period in which early successional ecosystems can develop (e.g., 25 to 30 years) before complete tree canopy closure occurs. Aggressive efforts at reforesting by intensive planting and control of competition are inconsistent with this goal.

- Decisions on whether and how much planting is needed require an analysis of site conditions, including the potential presence and aggressiveness of competing herbs and shrubs.

- Relying on a combination of natural regeneration and planting will, by itself, help increase the heterogeneity and structural complexity of these forests.

- Learning and adaptive management will be needed, as happened with the advent of staggered-setting clearcutting after World War II and "high yield" forestry in the 1970s.

- A limited number of good examples of diverse early successional ecosystems exist on Moist Forest sites on federal lands. They can provide insights.

Harvesting utilizing variable retention prescriptions will result in creation of multiple-aged stands (at least two age-classes) as a younger generation of trees becomes established among the retained islands of the pre-harvest stand.

- Retained aggregates need to be viewed as integral elements of the harvest management unit--i.e., they are part of rather apart from the post-harvest stand, providing biologically richer and older elements. The structures and patches selected for retention are retained through at least the next rotation, at which time a decision can be made about their further retention or replacement.

Variable retention harvests in younger Moist Forests to create diverse early successional ecosystems are only a part of a comprehensive long-term silvicultural strategy that includes:

- Pre-commercial thinning of the young stands, as needed, with goals that include retaining and enhancing compositional and structural diversity;

- Commercial thinning, as needed, that also retains and enhances compositional and structural diversity. Thinning prescriptions would differ significantly from those utilized in forests intensely managed for wood production – e.g., they would utilize variable-density thinning prescriptions that will enhance heterogeneity; and

- Long rotations (e.g., 100-150 years) that allow for development of mixed-age, mixed-species forests that will protect watersheds and provide rich habitat for biodiversity, and produce diverse wood and other forest products.

Dry Forests

Restoration of Dry Forests in southwest Oregon is needed to increase their functional capabilities and resilience.

- Restoration prescriptions need to vary with the plant association: The Douglas-fir plant series is probably the most extensive of the Dry Forest plant series on BLM lands in southwest Oregon but several other plant series (most notably Oregon White Oak and Ponderosa Pine) are also included within the Dry Forest category. Other important considerations in development of restoration prescriptions include existing stand conditions and landscape context.

- Historical analyses suggest that a complex and heterogeneous landscape existed in the mid-19th century--a landscape with a mixture of oaks, pines, madrone, and Douglas-fir as well as significant shrub and grassland communities. Information comes from historical data, historical observations (GLO survey notes), and scientific studies using historical data (McKinley and Frank 1996, Baker 2011).[6]

    - Oregon white oak and California black oak were among the most abundant tree species on the landscape—species associated with open savannas.
    - Although patches of dense conifer forest existed there were extensive areas lacking conifer forest or with open forest canopies.
    - Old ponderosa pine, Douglas-fir, and sugar pine were generally the largest trees in the landscape followed by the oaks.
    - Pine abundance was equal to or greater than that of Douglas-fir in some areas.
    - Where forest structure was open, the understory was often dominated by shrubs and small hardwoods.

- Current forest conditions on sites belonging to the Dry Douglas-fir plant series contrast significantly with the historical ecosystems. We now have:

    - Unharvested stands: Predominantly dense mature stands dominated by Douglas-fir, in which surviving oaks and madrones are being suppressed and pines are suffering intensive competition with the Douglas-fir. Many of these stands appear to be the "first generation" of closed conifer forests on these sites, in that there are few to no legacies from previous generations. Historically, these lands were occupied by diverse communities ranging from open grassland and shrub fields through oak savannas and mixed hardwood and conifer woodlands to dense forests. Savannas were typically dominated by Oregon white oak, often with ponderosa pine (McKinley and Frank 1996). These Dry Forest sites occupy the drier, warmer segments of major watersheds and are predominantly characterized by Douglas-fir plant associations; moister portions of these watersheds are occupied by Moist Forest sites (often characterized by moist Grand Fir and White Fir plant associations). Both conditions (Dry and Moist Forest sites) form complex local mosaics reflecting elevation, exposure, landform, and soil variability in this topographically and geologically complex region (Whittaker 1960; Waring 1969; Atzet et al. 1992).

    - Diversifying these stands by thinning--allowing pines, incense-cedars, oaks, and madrones to reproduce and thrive--is an important part of our restoration strategy as is increasing the growth and resilience of the residual Douglas-firs. In addition, over 40% of the forests in this landscape will remain untreated in order to provide the dense forest patches needed by NSO and some of their prey species and to maintain a heterogeneous landscape.

    - Harvested stands: Clearcutting occurred from the 1960s to 1980s followed by planting resulting in sites that are occupied largely by dense plantations. Increas-

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[6] GLO survey information is the major source of quantitative data for most of these studies. That information should be used with caution due to potential biases, such as the instructions to avoid mature trees or defective trees do to fear that would not last. Also, those surveys were done after the major transformation of the Applegate landscape resulting from the discovery of gold in 1851 and the associated destruction of Tribal communities.

ing the heterogeneity and complexity of these plantations is an essential part of any restoration effort. In addition, existing shaded fuel breaks need to be maintained along some ridge tops.

- Arguments among scientists over Dry Forest restoration in southwest Oregon centers on interpretation of changes that have occurred. We interpret the observed changes as forest simplification following western human disruption of historic disturbance processes (wildfire); others appear to interpret this change as natural succession in a landscape that periodically experienced high-severity disturbances. Current research in the Applegate and Ashland watersheds should help resolve this debate.

- Overall, our restoration strategy for sites belonging to the Dry Douglas-fir plant series attempts to reverse the simplification of this landscape that has occurred over the last 150 years by restoring its historic biological diversity, heterogeneity, and resilience. The strategy is directed toward a desired future state of this landscape that includes increased resistance and resilience in the face of potential disturbances, including those associated with climate change. The vision is forward--not backward--even while recognizing the important knowledge derived from historical studies.

Restoration prescriptions for Dry Forests in southwestern Oregon need to be tailored to the diverse stand conditions and complex mosaic of plant associations that are present in the field. The Dry Forests of southwestern Oregon form complex mosaic of plant associations as a function of aspect, slope, elevation, and soil conditions.

- Due to the complex topography, diverse soil conditions, and complex disturbance history, extensive uniform forest ecosystems are exceptional. Silvicultural prescriptions must respond to this local and landscape-level complexity.

- Evaluations at both the landscape and site level are needed to guide management decisions and prescriptions--aggregated maps of historical conditions, existing conditions, productivity, desired future conditions, or proposed treatment are often misleading. Section wide-maps of averaged conditions are highly suspect.

The most important elements in restoring forests growing on sites characterized by the Douglas-fir plant series in southwestern Oregon is active management that reduces stand densities and increases tree species diversity, mean stand diameters, and spatial heterogeneity, while retaining significant portions of the landscape as denser forest patches in order to provide essential habitat for the NSO and some of its prey species. The ultimate goal is a landscape in which closed canopy, complex stands are embedded in a matrix of restored open, more resilient forest.

- Historically resilient natural stands and landscapes in Dry Forest regions of southwest and eastern Oregon provide models for restoration approaches in current dense, fire- and insect-prone stands and landscapes. Resilient stands are typically dominated by small populations of older, large diameter trees of fire- and drought-tolerant species and are spatially heterogeneous, incorporating a diversity of structural conditions, including both open areas and dense patches of younger trees. Denser forests--wildfire refugia--typically occupy less fire-prone areas within the Dry Forest landscape.

- The Dry Forest restoration strategy uses this model of resistant and resilient Dry Forest stands and landscapes as a general guide that is than adapted to specific local conditions and management objectives, including the mosaic of environmental and existing stand conditions. Landscape-level considerations include retention of some forested areas in an untreated, dense state and identification of areas having high priority for treatment. Stand level considerations included reductions in stand density, shifts in species composition to more fire- and drought-tolerant species, increases in mean stand diameter, and incorporation of spatial heterogeneity (patchiness). Re-introduction of fire for treatment of activity fuels and to help restore and maintain desired understory and fuel conditions is a part of the restoration.

- Even though many of the Dry Forest stands in southwest Oregon are hypothesized to be first generation forests on sites that were non-forested in pre-western settlement times, we consider this general restoration approach to be the appropriate starting point in restoration--i.e., creation of resistant and resilient Dry Forest forests and landscapes in southwest Oregon.

- Areas selected for retention as dense forest patches at the landscape level should be located so as to benefit the NSO based on: 1) evidence of NSO use; 2) existence of complex forest structure; 3) presence of abiotic factors, such as aspect and landform indicative of the moister, cooler areas where dense patches would have persisted historically; and 4) the degree to which the risk to these patches from wildfire and other threat can be reduced.

- Locating and shaping forest restoration activities so as to increase the persistence or "hang time" for the retained dense forest patches is a crucial management goal. Thus, selecting and treating stands that will help reduce threats to these denser patches, such as from probable paths of wildfire, is a high priority. The Medford Pilot exemplifies such a goal as treated areas were select to reduce the potential for crown fire to carry into the retained dense forest patches. The potential for a significant hardwood/shrub response exists in some environments; hence, a long-term maintenance plan is needed for treated stands.

- Stand conditions in restored forest stands--e.g., the composition and density of retained live trees--generally should be of a nature that they can be regrown into denser suitable NSO habitat when replacement habitat is needed. For example, restored stands should retain old conifers and hardwoods, which provide nesting habitat for NSO and its prey.

- Although there are continuing debates about the historic state of many southwest Oregon Dry Forest stands, treatment of these forests so as to reduce the potential for stand-replacement wildfires and insect epidemics is consistent with current management objectives, which include reducing risks to critical habitat for NSO and their prey. The Medford Pilot provides for retention of about half of the BLM landscape in denser forest patches when the areas selected for NSO (30-35 % of the area) are combined with remaining Riparian Reserves and other set-asides, such as for Survey-and-Manage species, which total about 15% of the landscape.

- We estimate that total area of Dry Forest sites on BLM's southwest Oregon lands is approximately 800,000 acres. Perhaps 700,000 acres of the Dry Forest is on sites belonging to the Douglas-fir plant series with the Ponderosa pine, Jeffrey pine, and Oregon white oak plant series providing the remainder of the area that we think should be

considered for Dry Forest restoration. Relatively few Dry Forest acres fall into LSRs on the BLM lands in southwest Oregon and those that do often have been administratively withdrawn or are in various allocations that preclude timber.

- A high priority need is for a comprehensive landscape-level analysis for BLM's Dry Forest lands in southwest Oregon to design the network of dense patches needed for the NSO. The challenge in designing this network will be greatest where BLM's Dry Forest lands are part of a checkerboard with intensively managed private forest lands, because of remaining short-term concerns for retention of NSO habitat on BLM lands.

Integrated project planning and implementation

Our experience in development of the pilot projects does suggest that strong efforts are needed to insure that there is adequate coordination among BLM staff specialists in implementing restoration activities of the type proposed in the Franklin/Johnson restoration strategy.

- Close coordination is needed between silvicultural, engineering, and contracting staff in bringing such projects from planning through sale to be sure that the goals initially outlined are ultimately realized. Subsequently, it is important that sale administrators have a thorough understanding of the ecological, economic, and cultural elements of the project and, finally, that there is collaboration in the post-harvest activities between relevant staff specialties, such as in silviculture, fuels, and wildlife, to be sure that goals are not compromised during the "finish work" on the project.

- Our experience on other projects showed that goals initially established for projects can be significantly compromised by decisions made at various steps in the initial planning, detailed development, and implementation of the projects. Allowing sufficient staff time for communication and collaborative field assessments and strong support from district managers are important elements in assuring successful implementation of restoration projects.

- Integrated project planning should include the USFWS and NOAA-F in project identification and layout. Early upfront involvement and collaboration will streamline the regulatory process and enable both better conservation of species and speedy project completion.

VI. Potential Land Bases, Harvest Levels and Revenues

Our goal has been to demonstrate how the Franklin/Johnson forest restoration principles can be used to provide both ecological and economic benefits on BLM's western Oregon forests, as we stated at the beginning of this report. Earlier we discussed some of the ecological benefits from application of these principles. In this section, we consider economic implications of the strategy by focusing on potential timber harvest volumes and associated revenue.

Dry Forest Harvests

Dry Forests provide less than 25% of the productivity of BLM Western Oregon forests. Potential harvests from these forests are inherently difficult to estimate since they key off of evolving threats to forest sustainability. In addition, estimates of harvest levels for Dry Forests are problematic until more experience is gained in implementing a restoration strategy. Still, timber harvest can be a tool to achieve and then maintain desired densities in both the short-run and long-run.

Our strategy assumes that most of the landscape outside of the LSEAs will be considered for treatment over time. In general outline, our strategy is similar to the "uneven-aged" strategy in the Preferred Resource Management Plan (PRMP) of the WOPR (USDI BLM 2008). On a per acre basis, though, our restoration strategy would probably have slightly lower yields than the "uneven-aged" strategy under the PRMP of the WOPR, because no old-growth trees would be cut under our approach but some would have been cut under the PRMP.

BLM estimated that a sustained yield of approximately 25 million bd ft/year would be produced from approximately 180,000 acres. Our Dry Forest strategy is proposed for approximately twice that acreage but would leave the larger, older trees. In addition, we urge that initial treatments be accelerated because of the threats from wildfire and insects. Finally, we see timber harvest as having a long-term role in maintaining desired forest conditions. Given all these considerations, we estimate a harvest of 50 million bd ft/year for the next 15 years followed by a lower harvest of 30 million feet/year in the long term.

The exact level of the expected modest harvests from Dry Forests under our restoration strategy does not significantly affect the conclusions regarding harvest volume and revenue from BLM's western Oregon lands.

Moist Forest Harvests

Our analysis of harvest levels for Moist Forests is more detailed because of their central significance in BLM's overall western Oregon harvest levels as well as because our proposed restoration strategy differs significantly from what was proposed in WOPR. We will examine an array of different land bases that might be utilized using our strategy.

Moist Forest Long-term Sustained Yield (LTSY)

Calculation of harvest levels for Moist Forests is more straightforward than for the Dry Forests. We start by calculating long-term sustainable yield (LTSY) per year from Moist Forest sites. LTSY for Moist Forests depends on the average harvestable yield/acre/year that will be produced in the long run and the acreage available for timber production (unreserved acres). Thus LTSY (forest/year) = Acres*LTSY/acre/year). The harvestable yield, in turn, depends on the selected silvicultural regime, site quality, rotation age, and amount and distribution (dispersed

or aggregated) of retention at harvest. Yields of existing natural forest stands provide an approximation of the LTSY from Moist Forests using the Franklin/Johnson restoration strategy. For comparison, we estimate the LTSY for Moist Forests for two other silvicultural strategies: 1) NWFP as it was originally written, and 2) the Preferred Resource Management Plan (PRMP) of WOPR (USDI BLM 2008) (Table 4).

We estimate that, in the long run, the Franklin/Johnson Moist Forest restoration strategy would produce about 2/3 of the per-acre timber yields of the NWFP and about half of the per-acre "full yield" of the PRMP in WOPR (Table 4). Consequently, the Franklin/Johnson restoration strategy would require a larger land base to achieve the same total timber harvest levels (LTSY) as were proposed under the PRMP or NWFP.

Table 4. Three alternative long-term silvicultural strategies for Moist Forests in BLM Western Oregon Forests and associated long-term sustained yield (LTSY) per acre per year

Long-term silvicultural strategy	LTSY/acre/year bd.ft. (short log)
1. Franklin/Johnson restoration–harvest with retention generally in aggregates followed modest planting, nurturing early successional stage, and thinning as needed to enhance structural complexity	400
2. Northwest Forest Plan (as written)–regeneration harvest with moderate dispersed retention followed by planting, mechanical suppression of competing vegetation, pre-commercial thinning as needed to support wood production	650
3. Preferred Management Resource Plan in Western Oregon Plan Revision–clearcutting followed by planting, mechanical suppression of competing vegetation, pre-commercial thinning as needed to support wood production.	780

Note: Under the Northwest Forest Plan in Moist Forests (as currently implemented)–thinning for a limited period, then cessation of activities–LTSY = 0.

Some comments about the LTSY calculations:

- These yields are approximations for comparative purposes.

- Estimating the yield of a silvicultural regime 100-120 year rotation for the Franklin/Johnson restoration strategy for Moist Forests is difficult and can be endlessly debated. Since this strategy is modeled on the development of natural (wild) stands, the yield of existing natural stands from three Moist Forest districts (Salem, Eugene, Coos Bay), modified by the amount of retention, provides a good approximation of yield. The exact effects of retention on growth of the new stand are unknown, especially since it has both positive and negative components. The modest level of planting that is planned should give the new stand a small boost. Most of the retention will be in aggregates or forest patches, which should have less effect on growth than the current practice on BLM lands of dispersed retention. Also, some of the historical stands that are the basis of the yield calculation contained a legacy from the disturbance that created them so this is already partially factored into the yields. We have not considered effects of climate change, which could arguably be either increase or decrease yields. Based on the above, we conclude that an average LTSY/acre/year of 400 board feet (short log) is a reasonable approximation for comparing the Franklin/Johnson strategy with alternatives.

- Estimates of yields for the silvicultural strategy associated with the WOPR PRMP or with the NWFP come from the analysis of the same three Moist Forest districts done for the

WOPR. As with all simulations, these estimates incorporate both science findings and expert opinion.

- All yield estimates were then reduced to account for lower yields in the Moist Forests of the Roseburg and Medford Districts.

We have estimated Moist Forest LTSY from our restoration strategy under a number of alternative land bases (Table 5). The first land base is Matrix acres under 80 years of age (the previously harvested stands). This initial land base is then incrementally increased by adding Matrix acres representing increasing age class increments until the entire Matrix is included. Finally, the harvest effect of doubling the Matrix acreage is included.

Table 5. Long-term sustained yield levels and short-term harvest levels under our restoration strategy with alternative acreage bases. Estimated stumpage revenue with each harvest level is also shown.

Moist Forest Alternative	Moist Forest Matrix Acres	Moist Forest	Moist + Dry	Moist + Dry	Stumpage Revenue First 15 years		Stumpage Revenue	
		LTSY	LTSY	First 15 years	(Low price)	(High price)	(Low price)	(High price)
	Thousands	——Millions of Bd Ft/year——			——Millions of Dollars/year——			
Matrix < 80 years	229	92	122	217	32	64	24	49
Matrix < 120	273	109	139	259	38	76	28	56
Matrix < 160	302	121	151	271	40	80	30	60
Matrix < 200	312	125	155	275	41	82	31	62
Matrix	340	136	166	286	43	86	33	66
Double Matrix with stands < 120	680	272	302	422	70	141	60	121

(Note: LTSY for Moist Forests under current policy implementation = 0 MMBF/year and total LTSY for Moist and Dry under current policy implementation is perhaps 20 MMBF/year. Under the assumptions used to construct this table, Moist + Dry harvest over the next 15 years about be about 120 MMBF/year)

Total Harvests (Moist and Dry)

Total Long-term Sustained Yield (Moist and Dry)

We can add estimates of Dry Forest LTSY to those of Moist Forest LTSY to get the total LTSY (Table 5). Note: these are rough, first estimates for land base comparisons. More analysis would be needed to refine and test them.

Short-term Harvest Levels (Moist and Dry)

The BLM recently has harvested slightly more than 150 million board feet a year, almost entirely from thinning plantations in previously clear-cut stands, a level that is above their projected volume from thinning under the NWFP (USDI BLM 2008). In addition, BLM is currently attempting to increase that thinning level to 200 million board feet a year. A majority of this thinning will come from Matrix lands; the rest will come from Late Successional and Riparian Reserves.

Our previous analysis of thinning under the NWFP (Johnson and Franklin 2009) suggested that approximately 110 million board feet might be harvested from Moist Forests over the 20 year -period 2006-2026, with the majority of that from reserves. Thinning volume would drop significantly after that period. We estimate that the BLM may have only 10-15 years of thinning left at their current and projected future thinning levels, which are higher than those we analyzed earlier.

Thinning was designed to augment regeneration harvesting in the NWFP but it has become the sole source of harvest, putting pressure on stands suitable for that type of treatment. Grave concern has been voiced by BLM staff in many forums that, at the current rate, they will quickly run through available stands in 10 to 15 years and then be faced with either prematurely thinning very young stands or rapidly dropping the harvest level.

If regeneration or early successional harvesting was resumed at the levels suggested by our LTSY calculations, we assume that thinning would return to the more moderate level of approximately 100 million board feet/year. To a significant degree the short-term thinning harvest volumes are additive to the LTSY estimates, particularly in the case of reserves. However, stands currently being thinned in the Matrix could be shifted to a regeneration or early successional harvest treatment complicating the arithmetic. The interaction of thinning and early successional harvest is particularly notable when the stands available for early successional harvest are limited to those currently less than 80 years. Thus, it might be difficult to achieve the harvest volume assumed in the LTSY calculations during the first 15 years if the land base is limited to stands currently less than 80 years of age. In total, we assumed a net thinning increment of 75 million bd ft/year for the first 15 years for the land base restricted to stands less than 80 years of age, and 100 million bd ft/year for the other land bases (Table 5).

Revenue

Stumpage revenue from BLM harvests has been historically important to western Oregon counties. In theory, we can convert these harvests into potential stumpage revenue by projecting likely stumpage prices through time and multiplying by projected harvest. Unfortunately, stumpage prices have been extremely volatile over the last 20 years. Thus, we will discuss future revenue from harvest as a range of possible outcomes.

For this analysis we calculated stumpage revenue under “low prices” ($100/thousand board feet for short-term plantation thinning; $200/thousand board feet for the remaining volume, most of which will come from regeneration harvest) and “high prices” ($200/thousand board feet for short-term plantation thinning; $400/thousand board feet for the remaining volume). Currently 50% of this revenue goes to the O&C counties, although this could be changed by an act of Congress.

Potential revenues are especially sensitive to the size of the Moist Forest land base (Table 5). In addition, this analysis suggests that the short-term revenue will be higher than the long-term revenue, given the bump that thinning in the near future will provide.

Observations About Potential Land Bases, Harvests, and Revenues

Under the current “thinning-only” policy, recent harvest levels (150 million bd ft/year) can be sustained for only a limited time and these harvests will produce relatively small logs and low levels of financial return. Subsequently, harvests will decline substantially over the next few decades to only maintenance harvests in Dry Forests in the long-run.

Under the current land allocations, adopting the restoration strategy--which includes early successional harvests--would provide a short-run increase in timber harvests from recent levels under all land bases (Table 5). Following an initial burst of thinning, the harvest would decline. How much it would decline depends on the land base for long-term timber production.

For discussion purposes, we examined the implications of doubling the total Moist Forest Matrix. Doubling the total Moist Forest Matrix acreage by moving some forests currently less than 120 years from Reserve to Matrix status might provide a short-term harvest of over 400 million board feet/year and a LTSY of over 300 million board feet/year.

- Doubling the Moist Forest Matrix acreage would require reclassifying almost 2/3 of the reserved Moist Forest that is less than 120 years old as Matrix while simultaneously reclassifying all Moist Forests within the Matrix that are over 120 years as Reserves. In terms of acreage shifts 410,000 acres of currently reserved Moist Forests that are less than 120 years old would be reclassified as Matrix while 75,000 acres of Moist Forests over 120 years currently in the Matrix would be placed in Reserves.

- In doubling the area of Moist Forest Matrix, approximately half of the Moist Forests would end up in Reserves (weighted toward older stands) and half would be in Matrix allocation (weighted toward the younger stands).

- Doubling the size of the Moist Forest Matrix and committing all to a harvest sequence that would produce diverse early seral ecosystems would still leave the amount of early successional ecosystems at relatively low levels, assuming limited creation by natural disturbances.

To achieve a given LTSY in Moist Forests under the Franklin/Johnson strategy, more forest land would have to be committed to the strategy, including early successional harvests, than under the approaches suggested in the NWFP or the WOPR. However, the conditions created on this managed forest land would be more supportive of many elements of biological diversity and key ecosystem services than those produced under the intensive management practices proposed in WOPR. The managed forest areas would have structurally complex forests of mixed age and species composition. This is a particularly important consideration if extensive forested areas are reclassified from Reserves to Matrix.

Highly integrated approaches of the sort proposed here, which involve juxtaposition of managed and reserved lands, contrast significantly with the black/white, large land allocation approach adopted in the NWFP. Forests harvested and grown using ecological forestry principles interspersed with reserves of older forests offer an alternative approach to sustaining critical habitat for NSO while providing for long-term wood production.

Sources of an Expanded Landbase for Timber Production

Achieving a major contribution to stable timber supply from Moist Forests, at the level of projected under the NWFP or proposed in the WOPR, would take an expanded Matrix, especially if harvests are limited to “younger stands. Most younger stands, even those previously harvested, are located in LSRs, Riparian Reserves or Survey and Manage Buffers and are allocated to ecological objectives under the NWFP. Shifting some of these reserved younger forests to Matrix, while still adhering to the goals of the NWFP, will take careful analysis.

Previously harvested stands in the LSRs are one potential source of an expanded land base for sustained timber management using the silvicultural system described earlier. The previously harvested stands incorporated into the LSRs were expect to grow into suitable NSO habitat over time, creating the large contiguous blocks of LS/OG forests required to sustain a meta-population of NSO. Hence, reallocating a substantial portion of these stands would require careful scientific analysis at both the landscape and stand scales, a new policy framework, and (possibly) increased responsibilities of other landowners, such as national forests and private landowners, for recovery of the NSO. Assuming that the majority of the currently unharvested forests in the Matrix end up being reserved for the NSO, re-evaluating the importance of previously harvested stands in LSRs to provision of NSO habitat and its potential contribution to other management goals, such as provision of early successional ecosystems and timber, seems appropriate.

Previously harvested stands in Riparian Reserves are another source of an expanded Matrix land base. Interim riparian widths for Riparian Reserves were set at two site-potential tree lengths or 300' (whichever was greater) for fish-bearing streams and one site-potential tree length or 150' (whichever was greater) for non-fish-bearing streams (USDA Forest Service and USDI Bureau of Land Management 1994) (Figure 7). The outer edge of this interim riparian buffer was meant to delineate the maximum limits for a functionally connected area that provides ecological functions and processes needed for maintenance of healthy aquatic habitat maintenance (Reeves et al. 2006). Also, the second tree height in the Riparian Reserves was an attempt to provide a corridor for movement of terrestrial species and to help protect the microclimate of the area close to the stream (Reeves et al. 2006). The NWFP called for subsequent development of more site-specific buffers following watershed analyses. However, few interim riparian buffers have been modified. Managers have been deterred from attempting changes in riparian buffers because a high burden of proof is necessary and adequate analytical tools, which could be used to analyze impacts of smaller buffer widths on riparian processes were lacking (Haynes 2006).

Re-evaluation of the riparian buffers could focus on actually determining the areas that are actually critical to functioning of aquatic ecosystems. Examples of this type of effort can be found in the "Blue River Strategy" developed for the Blue River AMA (Cissel et al. 1999) and a recent effort reported in the Journal of Forestry (Holmes and Gobel 2011). Methods and tools now exist to conduct such analyses (Benda et al. 2007).

An evaluation of riparian buffers (Riparian Reserves) at the landscape scale could refine their placement and size, shifting from the interim fixed-width buffers of the NWFP to a "final" set of buffers with the help of aquatic experts--contracting them in some places and expanding them in other. The goal of this effort could be to refocus the buffers on aquatic systems and de-emphasize their somewhat diffuse and vague role as corridors and habitats for terrestrial species, realizing that with 20-30% retention during early successional harvests connectivity in the managed landscape would be significantly facilitated elsewhere in the landscape.

Developing new protocols for management of the Red Tree Vole is also an important element in expanding the Matrix land base. Red Tree Voles can be relatively common in both older stands and in younger, previously harvested stands (Figures 17 and 19 from pilot discussion), with tree height buffers often placed around active nests. Much has been learned about the Red Tree Vole in the past 15 years by scientific studies and project surveys. It is time to rethink the conservation strategy for this species, especially if more mature and old forest is reserved. *More generally, the burden of proof in species protection could be rethought.* Species generally were not put under Survey and Manage because they were thought to be endangered. Rather,

they were put into that category because we did not know how the NWFP might influence their habitats or knew little about their life history. Thus the burden of proof was placed on the land manager to show that they were not harming them, i.e., by staying away from their nests wherever they were found. An alternative approach would be to require evidence that population levels and trends for the species indicated concerns. Where that was established, special protocols would apply. Limiting species-specific measures to species of concern (and Threatened and Endangered species) has been proposed by the Secretary of Agriculture in a new planning rule for the national forests (USDA 2012) to meet the objective of conserving the diversity of plant and animal communities. Such an approach could be taken here, utilizing ecosystem plans (like the NWFP) to conserve species except where evidence exists additional measures are required.

Again, more generally, the level of risk taken with species survival could be re-evaluated. In the scientific analysis underlying the NWFP (FEMAT), a risk analysis was done for each species or species group to assess the likelihood that habitat to support viable populations of each species or species group would persist for 100 years. A threshold of an 80% likelihood was informally adopted by scientists for certain key species such as the NSO. That threshold was adopted for all species by the land management agencies in development of the NWFP, including those for which information was inadequate (the Survey and Manage Species). Within limits, the "level of risk" taken with regards to management objectives--including risks to persistence of species--is a social decision; i.e., controlling laws or regulations do not stipulate a specific level of risk. As an example, the aquatic scientists in FEMAT used a set of Riparian Reserves that would have provided a 67% likelihood of sufficient habitat for salmonids for 100 years in their initial analysis. Their selection of a lower level was partially because so much of the habitat for salmonids is in private hands. In the final NWFP, that level was raised to 80% ("for consistency") by expanding the buffer on intermittent streams from ½ tree height to one tree height. Neither the 67% likelihood nor the 80% likelihood was solely a scientific decision. Others have called for a higher threshold for threatened species. Ultimately the level of risk that is chosen is a policy call and should be viewed as such, even while society and decision makers consider inputs from the scientific community.

In summary, the NWFP established a new policy framework for decision-making about federal forests within the range of the Northern Spotted Owl. Certainly, rethinking that framework will generate considerable controversy. And it can be argued that this framework has, to at least some degree, become established in social and legal precedent. Still, we felt it important to make that framework explicit, so that the contributions of policymakers, managers, and scientists can be put in context and conscious decisions can be made about whether to modify this framework.

VII. Postscript

Where we go from here? It is clear to us that the O&C lands managed by the BLM are about to undergo another major shift in policy. The management direction laid down for federal forest lands in the Northwest Forest Plan has not fully achieved either the ecological or economic goals originally envisioned in the plan, even while it dramatically altered our expectations for these lands. Many factors are responsible for this, some inherent in the plan and others involving changing circumstances, such as societal concerns about older forests and catastrophic declines in the Northern Spotted Owl. Whatever the reasons, requirements for significant change in the NWFP are driven by such needs as expanded critical habitat for the Northern Spotted Owl, restoration of degraded forest ecosystems and landscapes, and identification of a landbase for sustainable timber harvests.

The major choices facing society would seem to be between adopting a holistic and integrated management approach to the O&C (and other federal forest) lands or attempting to even more finely divide up the land into starkly different allocations. In the NWFP, we attempted to allocate lands to environmental (e.g. Late Successional Reserves) or economic (e.g. Matrix) goals, following a hundred year pattern of separating the federal estate into two parts--reserves and commodity lands. Unfortunately, the goals of the plan were not adequately served by this strategy; resource values are simply too pervasive and intermixed.

We believe that it is time to begin moving O&C management toward an integrated approach. It would build on areas of agreement and innovative ideas for conservation and management including: the broad consensus on conserving mature & old forests; USFWS' expected proposal for greatly expanded but more managerially flexible NSO critical habitat; expanded scientific knowledge of the forests, streams, and landscapes; the need for active management to create more resilient Dry Forest landscapes and to restore early successional ecosystems in Moist Forests landscapes; and recognition that timber harvest can contribute to ecological goals while providing jobs and income in local communities.

One major impediment to a holistic, integrated management approach on O&C and other federal forest lands is not science or technology but stakeholder trust in management agencies. This includes stakeholders from the entire spectrum of interests--environmentalists, community leaders, mill owners, scientists, policy makers, and ordinary citizens. Breaking through the barriers of distrust and cynicism will take new ideas and institutions. Collaborative groups, multi-party monitoring, and independent review of agency actions provide a start; much creative work is needed here.

Management approaches that truly integrate ecological, economic, and cultural values are elusive and difficult, but a goal that would benefit both the forest resource and society. We put forward our pilot experiences as one small effort to move us toward such a goal.

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Appendix A. Northern Spotted Owl Habitat Mapping

During Winter 2011, we learned that a new map of NSO habitat would soon be published (Davis et al. 2011). Highly sophisticated mapping combined forest attributes with owl use patterns to create the first range-wide spatial map of habitat using consistent quantitative data sources. We used these maps in our Pilot efforts as they became available.

The habitat definitions are as follows (Davis et al. 2011, p. 61):

- Unsuitable: This habitat class represents the lowest suitability class and owls will normally avoid using it for nesting and roosting.

- Marginal– Occasionally, these habitat characteristics are associated with nesting and roosting owls; however, this could be due to occurrence of legacy habitat features such as large trees, extreme rarity of suitable nesting/roosting habitat, or perhaps interspecific competition with barred owls.

- Suitable– This habitat class represents habitat conditions where the probability of owl presence is higher than expected by random chance and up to average conditions associated with nesting and roosting.

- Highly Suitable–habitat class represents the most suitable, or "above average", conditions used by nesting and roosting territorial owl pairs.

Note: the sum of Suitable Habitat and Highly Suitable Habitat are often combined into a single term "Suitable Habitat" in the NSO Recovery Plan. We will also use that approach here.

We have overlaid the new NSO habitat maps with age class maps of BLM Western Oregon Forests and our Moist/Dry Forest classification for use in discussing implications of the Recovery Plan (Figure A-1 and A-2). While there are errors in both habitat mapping and age class mapping and additional errors occur in overlaying them on each other, we still can draw some general conclusions from this analysis:[1]

Overall

- The older the age class the higher the proportion of Suitable Habitat.
- All age classes have all four habitat conditions
- Marginal Habitat is the most common habitat condition
- Moist Forests have a higher proportion of their older age classes in Suitable Habitat than do Dry Forests

Moist Forests

Approximately 2/3 of the stands over 80 years of age are Suitable Habitat
Over 4/5 of the stands over 40 years of age are at least Marginal Habitat

Dry Forests

Less than half the stands between 80 and 160 years of age are Suitable Habitat
Approximately 4/5 of the stands over 40 years of age are at least Marginal Habitat

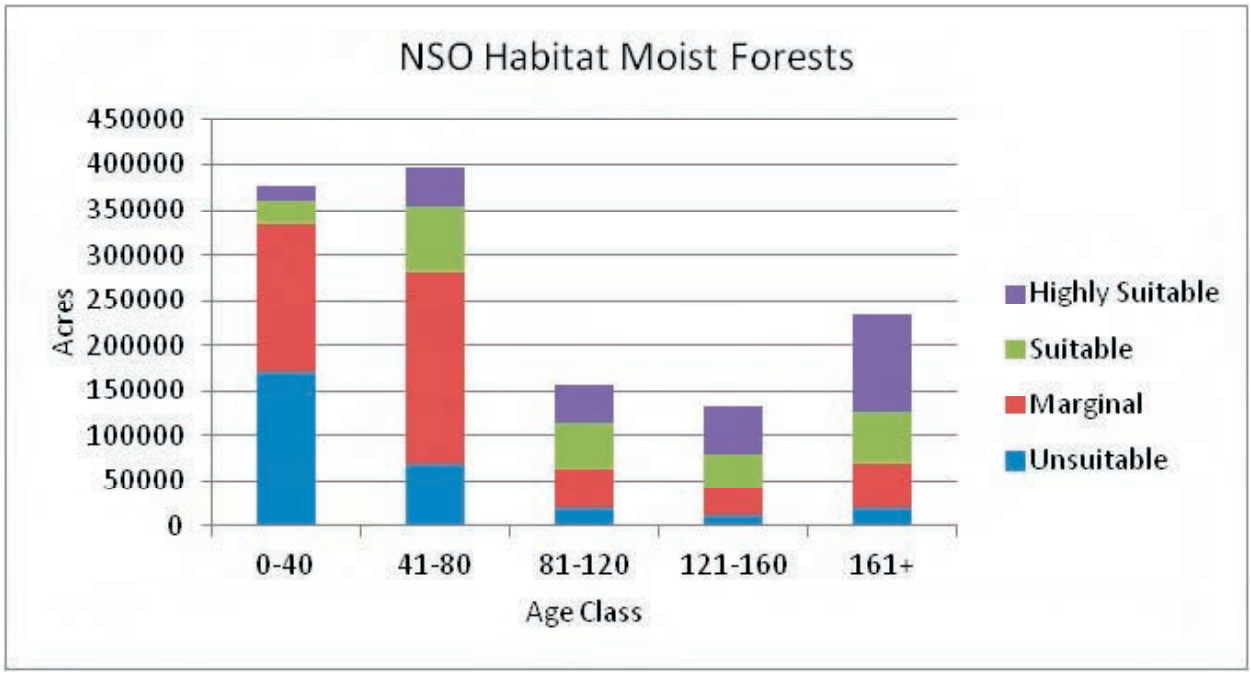

Figure A1.

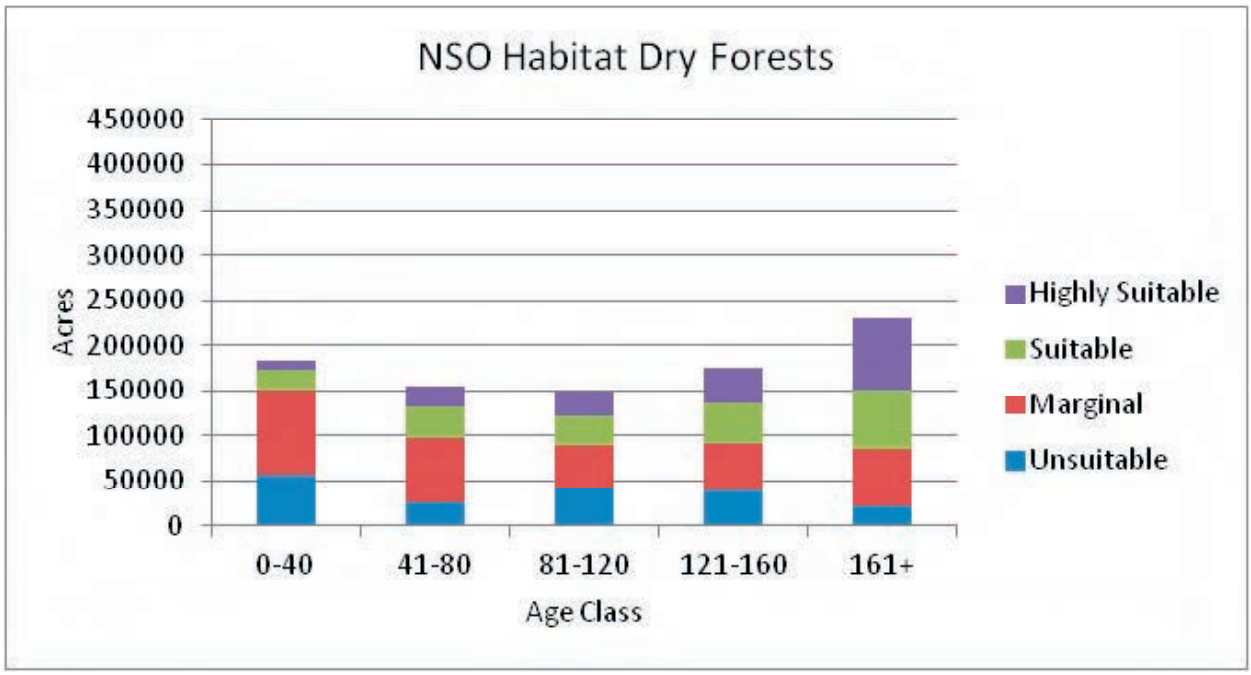

Figure A2.