United States
Department of
Agriculture

Forest Service

May 2007

Environmental Assessment

Siuslaw Thinning and Underplanting for Diversity Study—Phase II

Central Coast and Hebo Ranger Districts
Siuslaw National Forest
Lane, Tillamook, and Lincoln Counties, Oregon

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Comments received in response to this solicitation, including names and addresses of those who comment, will be considered part of the public record on this proposed action and will be available for public inspection. Comments submitted anonymously will be accepted and considered; however, those who only submit anonymous comments will not have standing to appeal the subsequent decision under 36 CFR part 215. Additionally, pursuant to 7 CFR 1.27 (d), any person may request the agency to withhold a submission from the public record by showing how the Freedom of Information Act (FOIA) permits such confidentiality. Person requesting such confidentiality should be aware that, under the FOIA, confidentiality may be granted in only very limited circumstances, such as to protect trade secrets.

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Chapter 1—Why is the Study Needed?

Introduction

Forest Supervisor Jose Linares proposed Phase II of the Stand Diversity Study (the Study) to learn more about increasing diversity (managing overstory trees; understory trees, shrubs, and forbs; and dead wood) in young, dense, even-age Douglas-fir stands of high site index in the Oregon Coast Range; and characterizing the effects of structural manipulation on structural and biological diversity. The Study is a cooperative effort between the Siuslaw National Forest, Pacific Northwest Research Station, and Oregon State University. Proposed Phase II treatments are in the previously established Cataract, Wildcat, and Yachats diversity study sites (map 1).

Phase I of the Diversity Study was undertaken in 1992 to form the scientific basis needed to demonstrate that stands can be partially harvested and managed to create important elements of habitat for old-growth or late-successional dependent wildlife species. To date, the Study has monitored the effects of a single thinning entry and understory planting over a fourteen-year period. Phase I of the Study was accomplished through the Cataract Thin (USDA 1990a), the Wildcat Thin (USDA 1993a), and the Yachats Thinning—Unit 3 (USDA 1993b) Projects (table 1). The initial treatment application has resulted in stands having various levels of structure and understory composition.

Table 1. Phase I—Acres Thinned and Underplanted

Thinning Prescription	Cataract Study Site (stand 607167)	Wildcat Study Site (302024)	Yachats Study Site (506112)	Acres Underplanted
Control (no treatment)	6.4	3.6	3.9	6.7
30 trees per acre (relative density = 8)	9	10.8	7	16.9
60 trees per acre (relative density = 16)	5.4	7	8	11.9
100 trees per acre (relative density = 37)	10.7	6	14	10.4
Total	31.5	27.4	32.9	45.9

The Proposed Project

The long-term Study objectives include: learning about effects to overstory trees from overstory density treatments, learning how overstory treatments affect understory trees, and learning how treatments affect understory species diversity. Within the context of the long-term objectives, the purpose of this proposal is to further evaluate the outcomes of the Phase I treatments, to prescribe and implement follow-up density management treatments in the areas with 60 and 100 trees per acre (Phase II), to add a dead wood component to Phase II, and to evaluate the outcomes of Phase II treatments. Density management treatments include reducing the areas with 60 trees per acre to about 17 trees per acre (relative density of 8), and reducing the areas with 100 trees per acre to about 40 trees per acre (relative density of 16) (table 2). Thinning and yarding impacts to overstory and understory components, dead wood decay rates, and artificial and natural recruitment rates of dead wood would also be measured. These treatments would serve to provide additional information on how to develop or maintain structural complexity.

No new temporary roads would be built at any site. Routine road maintenance, such as roadside brushing and surface grading, would be needed to make the roads suitable for log hauling. Existing landing sites and logging corridors would be used. Associated monitoring and analysis would also be a part of Phase II.

Pre-thin surveys would be accomplished in the summer of 2007; thinning treatments would be done during the summer or fall of 2008; and post-thin surveys would begin in the summer of 2009. No acres would receive additional underplanting.

Refer to chapter 2 for a description of Alternative 1 (no action) and a quantified list of actions proposed by Alternative 2.

This assessment is tiered to the Final Environmental Impact Statement for the Siuslaw National Forest Land and Resource Management Plan (Siuslaw Forest Plan; USDA 1990), as amended by the Northwest Forest Plan (the Plan; USDA, USDI 1994, 2001, 2004). The Siuslaw Forest Plan, as amended by the Plan, establishes the management direction, desired conditions, and standards and guidelines under which lands administered by the Siuslaw National Forest are managed. These plans are intended to provide for healthy forest ecosystems, including protecting riparian areas and waters.

The Planning Area

The Cataract study site is located in Lane County—Township 17 South, Range 10 West, section 18; the Wildcat site is in Tillamook County—Township 3 South, Range 9 West, sections 9 and 10; and the Yachats site is in Lincoln County—Township 15 South, Range 11 West, section 1. Lands affected by the Study are allocated by the Northwest Forest Plan as late-successional reserve and riparian reserve, with the Wildcat site also in an Adaptive Management Area.

The Problems (Issues) To Be Addressed

The Siuslaw National Forest has over 200,000 acres of plantations. The primary management objective in these plantations is to develop large trees and increase structural and biological diversity. This study focuses on providing information on the response of overstory and understory trees, shrubs and forbs to different treatment pathways for meeting these primary objectives. Continued long-term research through this study would assist managers in making plantation management decisions, including the management of snags and down wood. This research project is also a component of a network of similar studies in western Oregon and in Washington.

Based on available information, including the direction from the Siuslaw Forest Plan, as amended by the Northwest Forest Plan (the Plan); the recommendations from the Late-Successional Reserve Assessment, Oregon Coast Province—Southern Portion (USDA, USDI 1997); and the recommendations from the North Fork of the Siuslaw River Watershed Analysis (USDA 1994b), Nestucca Watershed Analysis (USDA 1994a), and the Yachats-Blodgett Watershed Analysis (USDA 1997), Forest Supervisor, Jose Linares identified the following problems and the need to address them:

- Not enough is known about how best to meet the goals of the Northwest Forest Plan. Phase I of the Stand Diversity Study has provided managers with information about how plantation overstories and understories respond to different thinning treatments. Phase II of the Study would continue this learning process and provide managers with additional information on overstory and understory response to second-entry treatments. Thus, he saw a need to continue the Study to learn more about these responses.
- The shortage of late-successional forest habitat in the Pacific Northwest limits recovery of old-growth-dependent species, such as the northern spotted owl and the marbled murrelet. Thus, he saw a need to continue the Study to learn more about how to speed the development of late-successional habitat in late-successional and riparian reserves.
- The decline of grass, forb, and shrub habitats may limit local populations of species that use these habitats, including Region 6 sensitive species and management-indicator species. Thus, he saw a need to learn more about how to maintain these components in plantations.
- Not enough is known about how best to manage for dead wood (snags and down wood) in plantations. Thus, he saw a need to incorporate the dead wood component into the Study Plan.

Evidence Used by the Forest Supervisor in Deciding to Address These Problems

The record of decision (USDA, USDI 1994b) for the Northwest Forest Plan—based on physical, biological, and societal evidence provided in the Forest Ecosystem Management Assessment Team report (USDA, USDI, et al. 1993) and described in the Plan's environmental impact statement (USDA, USDI 1994a)—is intended to provide for:

- Adaptive management—described as a process of action-based planning, monitoring, researching, evaluating, and adjusting—to improve future land management decisions;
- Healthy forest ecosystems, including protecting riparian areas and waters; and
- A suitable supply of timber and other forest products to help maintain local and regional economies predictably over the long term.

The Plan identified concern for northern spotted owls, marbled murrelets, and anadromous fish in the Oregon Coast Range Province (which includes the Siuslaw National Forest) because of its isolation and harvest history (chapters 3 & 4; page 21). The 1994 record of decision, which amended the Siuslaw Forest Plan, allocated federal lands in the Study into one or more of the following:

Late-successional reserve (pages C-9 to C-20); or
Riparian reserve (pages C-30 to C-38), or
Adaptive Management Area (D-15).

The Assessment Report for Federal Lands in and adjacent to the Oregon Coast Province (USDA 1995) indicates that the mature conifer stands in the Province have been extensively clearcut, and few patches of large, functional late-successional forest remain. The Report recommends managing to accelerate late-successional forest development and to aggregate small patches into larger ones.

The Report describes the in-stream fish habitat on federal lands throughout the Province as being in marginal to poor condition. It recommends specific actions to improve fish habitat on federal land by reestablishing natural riparian areas through actions such as thinning plantations to speed the development of large wood.

For needing to learn

The need to learn, for individuals and society as a whole, is strongest when uncertainty exists about how events will unfold. The current extent and intensity of debate among managers, scientists, and citizens over outcomes of land-management strategies provide strong evidence that sufficient uncertainty exists among knowledgeable and concerned people to warrant investing in learning. The following five examples contribute to this evidence supporting the proposed action:

- Debate surrounds the question of whether the plantations will ever reach old-growth conditions, with or without thinning and underplanting.
- Where there may be consensus that thinning and underplanting plantations speed their development towards old-growth conditions, debate continues about how best to accomplish thinning and underplanting to achieve these conditions.
- Some concern continues about managing solely for old-growth conditions at the expense of maintaining some level of early seral habitat in watersheds.
- Debate continues about whether to create dead wood (snags and down wood) in plantations.
- Where there may be consensus on the need for dead wood in plantations, debate continues about the quantities or methodology of creation.

The diversity of views held by the debaters can be represented in this study to illuminate the debate and lead to improved practices.

Useful information from Phase I of this study

The Siuslaw National Forest commonly uses information from Phase I of this study to guide planning and implementation of habitat restoration efforts for old growth forest and other habitats.

Over the past few years, the Forest has reduced the amount of residual trees in our commercially thinned plantations, because Phase I of the Study quantified the effects to diameter growth and crown development. These quantified effects indicate that the best prescription for restoring large trees is retaining fewer trees than we had been leaving. For example, information from the Study has influenced our residual tree prescriptions by reducing the trees per acre in older plantations from the 80 to 120 range to the 40 to 70 range.

We also learned from this study the response of understory trees (planted and natural) to various treatments, and have adjusted our prescriptions accordingly. For example, we can now better predict the potential for successfully growing western hemlock, Sitka spruce, Douglas-fir, western red cedar, red alder, and big leaf maple in the understory of thinned plantations. We know hemlock, spruce, and Douglas-fir grow well initially after thinning, but Douglas-fir needs more light to continue growing well.

We gained information about the response of other understory vegetation, which we can use to better predict our ability to produce habitat in forest under-stories for wildlife species that use grasses, forbs, or shrubs.

Potentially useful information from Phase II of this study

Information from Phase II should help us understand how long it takes to develop very large trees, which can become large snags or down wood as well as develop large cavities. Large trees with cavities are the primary structures used by spotted owls for nesting and large trees with large limbs are the primary structures used by marbled murrelets for nesting.

Information from Phase II should help us understand how long it takes to develop limbs large enough to support marbled murrelet nests, because treatment areas that reduce the overstory to about 17 trees per acre from 60 trees per acre would maximize growth of these trees. The overstory trees in the 60 trees-per-acre areas have relatively full crowns and many have limbs half-way down the bole (50 percent crown ratio). Since limb size is a function of diameter, the lower limbs are where potential nesting structures could develop first for marbled murrelets. The 100 trees-per-acre areas would be reduced to about 40 trees per acre and the existing 30 trees-per-acre areas (which would not be treated) would provide valuable information regarding limb development in relation to stocking levels.

Information from Phase II should also help us understand how long it takes to develop a middle-story and how long under-story plants, such as brush species, persist with different thinning prescriptions. Phase II information should also help us better understand the impacts to understory plants from second-entry harvest operations.

Help From Other Agencies and the Public

After identifying the actions that the proposed project would implement to address the problems on page 2, the Forest Supervisor sought public comment on them. Letters describing the actions considered in the proposed project were mailed to about 200 parties on May 5, 2006. The letters served as both a scoping notice (40 CFR 1501.7) and an opportunity to comment on the proposed action (36 CFR 215.6). Public comment was also solicited through a legal notice in the Corvallis Gazette-Times in Corvallis, Oregon, published May 5, 2006. Comments on the proposed action were requested by June 5, 2006. No comments were received as a result of these notifications.

Decision Framework

The Responsible Official for the Study is the Forest Supervisor for the Siuslaw National Forest. The environmental assessment (EA) for the Study—to be completed after public comment on the preliminary analysis—will disclose the predicted environmental effects of implementing the different alternatives the Forest Supervisor directed the Team to analyze. Based on this EA, a decision will be made by the Forest Supervisor. The Forest Supervisor will determine through a Decision Notice:

> To what extent, if any, will actions called for in the proposed study be implemented?
>
> What management requirements and mitigation measures (project design criteria) will be applied to these actions?

The primary factors that will influence the Forest Supervisor’s decision are based on how well the problems on page 2 are addressed. The Decision Notice will document this decision and describe what actions will be implemented to address the problems. The decision will be consistent with the Siuslaw Forest Plan, as amended by the Northwest Forest Plan, and will incorporate the associated project design criteria (appendix A), including the management requirements and mitigation measures.

Chapter 2—What Alternatives Were Developed?

Alternatives were developed to meet the identified needs and associated problems, and to be consistent with the standard and guidelines associated with the Siuslaw Forest Plan, as amended by the Northwest Forest Plan. The range of alternatives considered, including those that were considered but eliminated from detailed study, reflects the problems identified in chapter 1; public involvement with recent Forest projects, such as the Five Rivers Landscape Management Project (USDA 2002), and the Yachats Terrestrial Restoration Project (USDA 2005a); and concerns raised during monitoring of past commercial thinning projects.

Alternatives Considered But Eliminated from Detailed Study

The following alternative was considered by the Forest Supervisor, but was eliminated from detailed study. This alternative represents the initial phase II study proposal.

No incorporation of snags and down wood into the Study

To maintain consistency with Phase I of the Study, it was initially determined that Phase II would include the same parameters as Phase I. However, through encouragement by the Forest and District Wildlife Biologists, as well as the Forest Silviculturist, researchers agreed to include dead wood as an additional component to be monitored under Phase II, because it an important aspect of structural diversity. Dead wood would be added in a manner that avoids adverse effects to the ongoing Study objectives.

Alternatives Considered in Detail

Alternatives 1 and 2—Two alternatives, including Alternative 1 (No Action) and Alternative 2 (Proposed Study), were fully developed and are described in this section. The analyses of their effects are disclosed in chapter 3. Actions included for Alternative 2 are designed to address the problems identified by the Forest Supervisor and incorporate the standards and guides established by the Siuslaw Forest Plan, as amended by the Northwest Forest Plan (USDA, USDI 1994b; ROD, page B-11).

Management requirements, mitigation measures, and monitoring—Design criteria (appendix A) outline the practices to be used and their timing and duration when planned activities under Alternative 2 are implemented. Measures to avoid or minimize impacts associated with implementing these alternatives have been included in the design criteria. Therefore, we believe that management requirements and mitigation measures for all proposed actions are covered by the design criteria. For the proposed actions, Appendix A identifies implementation monitoring (determines if actions are implemented as designed) and effectiveness monitoring (determines the effectiveness of the design criteria). Monitoring and observations of past, similar actions indicate that the design criteria are effective in protecting natural resources.

Alternative 1: No action

The no-action alternative is required by Council of Environmental Quality regulations (40CFR 1502.14(d)). The no-action alternative forms the basis for a comparison between meeting the Study needs and not meeting the Study needs. This alternative provides baseline information for understanding changes associated with the action alternative and expected environmental responses as a result of past management actions. Selecting this alternative would result in the following actions:

> No plantations would undergo second-entry thinning treatment, with the plantations relying on natural processes to further develop late-successional habitat; and
>
> No additional information would be gathered by researchers to help managers improve future land management decisions that affect dense, even-age Douglas-fir stands.

Because the existing environment is not static, environmental consequences from selecting this alternative are expected. Depending on the kind and frequency of disturbances and gradual changes in vegetation and animal populations, these lands would move toward old-growth conditions.

Alternative 2: Implement Phase II of the Study

To address the problems and meet the identified needs in chapter 1, this alternative would implement the following management actions (table 1, maps 2, 3, and 4).

Within the context of the long-term objectives, the purpose of this proposal is to further evaluate the outcomes of the Phase I treatments and to prescribe and implement follow-up density management treatments in the areas with 60 and 100 trees per acre. Density management treatments include reducing the areas with 60 trees per acre to about 17 trees per acre (relative density of 8), and reducing the areas with 100 trees per acre to about 40 trees per acre (relative density of 16) (table 2). Snags and down wood would be created. These treatments would serve to develop or maintain structural complexity. Impacts to overstory and understory components would be measured, and associated monitoring and analysis would also be a part of Phase II.

Existing landing sites and logging corridors would be used during tree removal. No new temporary roads would be built at any site. Preparing roads for log hauling, such as roadside brushing and surface grading, would be needed to make the roads suitable for use. Although an existing 500-foot temporary road that enters the 30 trees-per-acre area of the Cataract site would not be used during Phase II of the Study, the road would be stabilized and closed with an earthen berm after thinning operations are completed. Associated monitoring and analysis would also be a part of Phase II.

Pre-thin surveys would be accomplished in the summer of 2007; thinning treatments would be done during the summer or fall of 2008; and post-thin surveys would begin in the summer of 2009. No acres would receive additional underplanting.

Appendix A, design criteria for actions; and Appendix B, the Study design, provide additional information.

Comparison of Phases I and II of the Study

Key quantitative differences—based on our estimates—of Phases I and II of the Study are compared in table 2.

Table 2. Comparing Phase I and Phase II Treatments

Initial Thinning Prescription Under Phase I	Phase I Acres Treated	Phase II Proposed Residual Trees Per Acre/Acres to be Treated			
	Cataract, Wildcat, and Yachats	Cataract study site (stand 607167)	Wildcat study site (stand 302024)	Yachats study site (stand 506112)	Total acres to be treated
Control—no treatment areas (relative density = 57)	13.9	N/A	N/A	N/A	N/A
30 trees per acre areas (relative density = 8)	26.8	N/A	N/A	N/A	N/A
60 trees per acre areas (relative density = 16)	20.4	17/5.4	17/7	17/8	20.4
100 trees per acre areas (relative density = 37)	30.7	40/10.7	40/6	40/14	30.7
Total Acres	91.8	16.1	13	22	51.1
Percent of 6th field watersheds affected		0.07 percent of 22,800 acres	0.07 percent of 18,700 acres	0.12 percent of 17,500 acres	0.09 percent of 59,000 acres
Percent of 5th field watersheds affected		0.04 percent of 41,000 acres	0.008 percent of 163,100 acres	0.06 percent of 38,600 acres	0.02 percent of 242,700 acres

What alternatives were developed?

Alternative 2, map 2

Alternative 2, map 2

Alternative 2, map 3

Alternative 2, map 3

Map 4

Map 4

Chapter 3—What are the Environmental Effects?

Predicted Effects of Actions to Implement the Study

Forest Stand Conditions

Plantation Treatments and Associated Actions

The desired future condition objectives for the plantations (stands) involved in the Study include trees that are generally healthy and vigorous, variable spacing between trees, a mix of different understory tree, forb, and shrub species, and a deadwood (snags and down wood) component. The knowledge gained by the Study in monitoring these stand components would help managers make more informed decisions in the future, regarding stand management.

These stands were treated in the early 1990's as part of Phase I of the Study. Before treatment, the stands consisted of dense, single-story Douglas-fir that ranged from 30 to 35 years old. The trees in these stands have responded well to the treatment, especially in the 30 to 60 trees-per-acre (TPA) areas, where tree crowns and diameters are largest. A few trees, mostly in the 30 TPA areas, have blown down. Where trees were planted in the understory—especially in the 30 to 60 TPA areas—most species, especially western hemlock, are growing well. Understory trees in the 100 TPA areas are growing at a slower rate and have slightly higher mortality due primarily to the higher degree of shade, compared to the 30 and 60 TPA areas. The forb and shrub layer has responded well to thinning treatments, with the greatest response in the 30 to 60 TPA areas. None of the trees planted in the control areas survived. The responses from forbs and shrubs have remained low in the control areas, but these species are responding to crown recession.

The Study Plan for Phase II (appendix B, table 1) illustrates the response variables for each treatment unit, including overstory trees and snags, saplings, tree seedlings, shrubs, forbs and grasses, substrate (litter, rock, mineral soil, etc.), and down wood; and associated sampling units for each treatment unit, including size of response variable, measurement plot size, number of plots per treatment unit, and measurements to be accomplished. Information gathered from these surveys would be factored into the design of future plantation treatments on the Forest.

Alternative 1, no action

None of the stands would receive additional treatment (Phase II) under this alternative. The stands would be left to develop at their present rate. Trees in the control areas would continue to compete for limited resources, especially light. Trees in treated areas, mostly in the 100 TPA areas, would eventually compete for these same resources. Trees would grow taller as they strive to obtain sufficient sunlight, but diameter growth would continue to slow in response to loss of crown. As tree crowns close, the reduced light would reduce the growth and development of understory trees and ground vegetation. Most importantly, the knowledge that would have been gained under Phase II would be forgone.

Commercial thinning under Alternative 2

Under Alternative 2, portions of each stand would be commercially thinned to reduce existing residual tree densities in the 60 TPA areas to about 17 TPA (relative density of 8), and in the 100 TPA areas to about 40 TPA (relative density of 16). With these treatments, overstory trees and understory trees and other vegetation would receive more light, and for a longer period of time. Consequently, based on the results of Phase I, the rate of development of overstory trees, understory trees, and shrubs, forbs, and grasses would increase, and for a longer period of time. Phase II thinning treatments may increase the windthrow potential for residual trees, although the these trees have developed greater resistance to windthrow since the Phase I treatments, and windthrow rates are not expected to exceed those experienced in the post-Phase I 30 TPA areas. Any trees that may blow down would be counted towards the down-wood component for the Study.

Although commercial thinning operations would cause some damage to residual vegetation, especially the understory, the Study would indirectly quantify these impacts. Information gained through the Study would help managers better determine the likely impacts to residual vegetation from second-entry treatments. This information would also help influence the development of more effective project design criteria for future, similar projects on the Forest.

Additional stand structure (snags and down wood) would be created about four years after Phase II thinning treatments to improve the quantity of this important wildlife habitat component (see the wildlife habitat and species section in this chapter). Older decay classes of down wood also provide opportunities for some trees to become established in the understories, especially western hemlock and Sitka spruce.

Harvest Plan (Resource Planner)

Skyline Operations

To facilitate skyline yarding of stands proposed for commercial thinning, Alternative 2 would use existing roads to access landing sites. No new roads or landings would be needed. Existing yarding corridors that resulted from the previous treatments would be reused as much as possible to minimize impacts to existing trees.

Timber-sale Economics

Under Alternative 2, about 756.5 thousand board feet (MBF) or 1,717 hundred cubic feet (CCF) would be produced. A MBF to CCF conversion factor of 2.27 was used for this analysis.

Based on a recent average market rate for small-wood timber sales in Oregon and Washington, the advertised rates for the sale of timber would be about $220 per MBF. The advertised rate is the current market rate and includes the minimum amount needed to cover Forest Service expenses associated with planning, sale preparation, and sale administration; logging and associated costs; and the required minimum collection for the National Forest Fund (NFF).

Table 4 summarizes the timber-sale values and collections for Alternative 1 and 2, based on MBF dollars. The total sale value reflects the estimated advertised rate shown above. Collections and payments to counties, roads and trails are deducted from the total sale value to obtain the remaining sale value. The remaining sale value, minus collections for Knutson-Vandeberg projects such as slash and noxious weed treatments, is sent to the National Treasury.

Table 3. Summary of total sale value and costs for Alternatives 1 and 2

Alternative	Total sale value	Minimum NFF collection	Payment to counties, and roads and trails	Salvage-Sale Fund collection	Remaining sale value	Collections for K-V projects
Alt. 1	0	0	0	0	0	0
Alt. 2	$166,430	$380	$58,250	$9,800	$98,000	$4,450*

*$1,450 for slash treatments, $500 to close the non-system road at Cataract, $2,500 for noxious weed control and monitoring.

About 35 to 40 percent of the sales on the Siuslaw Central Coast Ranger District are sold at the advertised rate. However, there are many variables that influence the value of timber at the time of sale, including market conditions, competition during bids for timber sales, and flexibility in the seasons of operations—any of these could cause bids for the timber-sale contract to rise above advertised rates.

Wildlife Habitat and Species (District Wildlife Biologist, USDA 2007)

Effects to wildlife are based on the assumption that treatments are consistent with “Standards Common to All Actions” identified through consultation with USDI Fish and Wildlife Service (USDI 2006, reference number 1-7-06-I-0190, p. 11).

Analysis of potential project effects is required for species identified as Threatened or Endangered, Survey and Manage, Sensitive, Management Indicators, and certain landbirds. The effects analysis includes this group of animals, identified as “species analyzed.” Species analyzed were identified from the following sources:

- Threatened, Endangered, and Sensitive species from section 2670 of the Forest Service Manual;
- Annual Species Review of Survey and Manage species from the Northwest Forest Plan (USDA, USDI 2004a);
- Management-Indicator Species from Land and Resource Management Plan Siuslaw National Forest (USDA 1990); and
- Landbirds from Partners in Flight (PIF 2005).

Evaluation of effects to these species is used to determine the effects to the Forest Service goals and desired conditions for wildlife, based on Forest Service Manual 2602. Effects to these species are based primarily on effects to important habitats these animals need; and secondarily, on potential disturbance effects to individuals from project implementation during the breeding season.

Species analyzed use the following habitats: grass-forb, shrub, sapling/pole forest (1 to 10 inches DBH), small forest (11 to 20 inches DBH), mature forest (21 to 32 inches DBH), old growth forest (>32 inches DBH), caves/burrows, cliffs and rims, talus, down wood, snag, and riparian (Brown 1985; Johnson and O'Neil 2001).

This analysis, using information from landscape-scale assessments, identified habitat conditions well below their historic levels, and an emphasis of management is to maintain or restore these habitats of concern. These deficit habitats are late-successional forest, grass-forb, shrub, and large dead-wood habitats. The habitat with greatest restoration emphasis is late successional forest, because two threatened species depend on this habitat, and late-successional forest (LSR) is the dominant land allocation in and surrounding each of the Study sites.

Potential effects to habitats of concern are emphasized in this analysis, but all the habitats needed by the species analyzed were considered. Proposed activities would have negligible effects to any habitats, because activities would occur in a very small area of each affected LSR (table 2).

Habitat Effects

- Fifty one (51) acres of grass-forb, shrub, and sapling-pole habitats would increase, because thinning would increase the amount of light available to plants that make up these habitats.

- Twenty (20) acres of small-forest habitat would be removed where 16 to 20 trees per acre (TPA) are retained. Thinning should hasten restoration of small-forest habitat in understories of thinned stands.

- No acres of mature or old growth forest habitat would be directly affected; however, thinning and dead wood creation should hasten restoration of mature and old growth forest habitat.

- No acres of caves-burrows, cliffs-rims, or talus would be affected.

- Fifty one (51) acres of deadwood habitat would be created (snags and down wood).

- Riparian habitat includes the habitats described above where these habitats are near water, and it includes water quality and other in-stream factors. The majority of the study area is in riparian reserve (about 75 percent); therefore, the effects described above apply to riparian habitats. Water quality would be maintained and other in-stream habitat elements would not be affected, because of project design criteria, such as maintaining the original (Phase I) stream buffers (appendix A).

Effects to Species Analyzed

Threatened or endangered species

Because there is no suitable or designated critical habitat in or adjacent to the project area for any of the following species, the proposed action will have **no effect** on:

Brown Pelican	E	*Pelicanus occidentalis*
Northern Bald Eagle	T	*Haliaeetus leucocephalus*
Oregon Silverspot Butterfly	T	*Speyeria zerene hippolyta*
Western Snowy Plover	T	*Charadrius alexandrinus nivosus*
Western Lily	T	*Lilium occidentale*
Nelson's Checker-mallow	T	*Sidalcea nelsoniana*

The effects to the northern spotted owl, marbled murrelet, and critical habitat for the northern spotted owl and marbled murrelet are described below:

- The project area contains suitable dispersal habitat for the northern spotted owl. Northern spotted owl dispersal habitat is comprised of conifer and mixed mature conifer-hardwood habitats with a canopy cover greater than or equal to 40 percent and conifer trees greater than or equal to 11 inches average diameter-at-breast height (DBH).

- The proposed action would remove dispersal habitat in the following areas:

  - Cataract: about 5 acres removed from North Fork of Siuslaw watershed, where 70% of federal lands will contain dispersal habitat after treatment.

  - Wildcat: about 7 acres removed from the Nestucca River watershed, where 50% of federal lands will contain dispersal habitat after treatment.

  - Yachats: about 8 acres removed from the Yachats River watershed, where 62% of federal lands will contain dispersal habitat after treatment.

- The proposed thinning to a residual density of about 17 trees per acre, which equates to regeneration harvest, **may affect but is not likely to adversely affect** habitat for the northern spotted owl, because adequate amounts of dispersal (at least 50%) habitat will remain in the fifth-field watersheds containing the sites where dispersal habitat would be removed.

- The project is adjacent to suitable habitat for spotted owls, but only has a low likelihood that a pair would be nesting within the disruption foot print of the project. This is based on several factors: no spotted owl activity centers are within the project's disruption distance, density estimate for spotted owls in the north coast is 1 pair per 11,840 acres (Forsman et al. 2005), and this project will have a disruption foot print of 160 acres, based on 65 yards from the source of noise—chainsaws and heavy equipment. Additionally, non-nesting spotted owls, if within the area, would be able to relocate without substantial impacts to their behavior patterns. Therefore, disturbance from the project **may affect, but is not likely to adversely** affect northern spotted owls.

- The project is adjacent to suitable habitat for marbled murrelets, but only has a low likelihood that a nesting pair would be within the disruption foot print of the project, because no stands are known to be occupied by murrelets, the density of murrelets in the Recovery Zone 3 is 1 pair per 257 suitable acres (FWS ref. #1-7-05-F-0664), and this project will have a disruption foot print of 22 acres of suitable murrelet habitat, based on 100 yards from the source of noise—chainsaws and heavy equipment. Additionally, non- nesting murrelets, if within the area, would be able to relocate without substantial impacts to their behavior patterns. Therefore, disturbance from the project **may affect, but is not likely to adversely affect** marbled murrelets.

- The above assessment of impacts addresses the proposed action in concert with other ongoing activities. There are no other planned future activities within the project area that would remove dispersal habitat. Therefore, there are **no cumulative effects** anticipated for any listed species in the project area.

- The proposed action will have **no effect** on critical habitat for the northern spotted owl, because the project area does not contain designated critical habitat for this species.

- Proposed activities would have **no effect** on critical habitat for the marbled murrelet, because the project area does not contain suitable habitat for the marbled murrelet.

The US Fish and Wildlife Service has concurred with these findings of effects through their Letter of Concurrence for this project (USDI 2007, FWS reference number 13420-2007-I-0077). The Study is consistent because implementation would assure no suitable nesting or roosting habitat would be removed, the amount of spotted owl dispersal habitat removed is within established limits, and potential effects to spotted owl or marbled murrelet from study-related disturbance would be within the limits consulted for this type of action on the Siuslaw National Forest.

Indirectly, treatment activities, especially areas retaining 16 to 20 trees per acre (TPA), may increase the restoration rate of suitable spotted owl and marbled murrelet nesting habitat, because these open-grown trees should develop larger diameter boles and limbs faster than trees in other growing conditions.

Sensitive species

This project may impact individuals or habitat but would not lead to listing of any species identified as Sensitive by the Regional Forester, because activities would affect a very small amount of habitat and could disturb a few individuals.

Survey and manage species

On the Central Coast Ranger District, the Study would not affect any Survey and Manage species, because no species with current Survey and Manage status were identified that could be affected by the proposed activities at each study site.

Analysis identified the Pudget Oregonian snail, the evening field slug, and the red tree vole as currently having Survey and Manage status on the Siuslaw National Forest.; However, this status only applies to the Hebo Ranger District (USDA, USDI 2002; USDI, USDA 2003). The great gray owl has Survey and Manage status in the Oregon Coast physiographic province; however, this status only applies east of the crest of the Oregon Coast mountain range (USDA, USDI 2004c).

On the Hebo Ranger District, this project would not affect any Survey and Manage species, because no suitable habitat exists for wildlife species with Survey and Manage status in the treatment areas.

Protection Buffer, Management Indicator, and Neotropical migrant landbird species

The Study would have minimal effect on protection buffer, management indicator, or neotropical migrant landbird species, because of the small amount of habitat affected in the 6^{th} and 5^{th} field watersheds (table 2).

Conclusion

The proposed study is consistent with Forest Service goals for wildlife. These goals include supporting recovery of threatened or endangered species; maintaining species viability, and producing habitat capability levels to meet sustained yield objectives relative to demand for featured and management indicator species; and providing diverse opportunities for esthetic, consumptive, and scientific uses of wildlife.

The Study would have very minor direct effects to agency wildlife goals, because the scale of this project is very small, compared to the amount of habitat in each watershed where activities occur. Indirectly, this study could benefit agency wildlife goals at a much larger scale, if knowledge gained from this study is applied to future land management decisions.

Proposed, Endangered, Threatened and Sensitive Plants (Forest Botanist)

The alternatives were evaluated following Forest Service policy regarding proposed, endangered, threatened, and sensitive (PETS) species (Forest Service Manual 2671, USDA 2006b).

No documented sites of PETS botanical species are known to occur in or adjacent to each of the study sites. A pre-field review determined that there is potential for one vascular plant, one bryophyte, five lichen, and eleven fungi species to occur. Field surveys designed to detect the presence of the vascular plant, bryophyte and lichen species was conducted in the Study area on April 11 and September 1, 2006. No PETS species were detected. The surveys were not able to determine the presence or absence of the eleven fungi species with potential habitat because they do not reliably fruit every year. Therefore, it is assumed that these species are present in the Study area.

PETS fungi species identified as having potential habitat in the Study area are *Cordyceps capitata, Cortinarius barlowensis, Leucogaster citrinus, Otidea smithii, Phaeocollybia attenuata, Phaeocollybia californica, Phaeocollybia dissiliens, Phaeocollybia piceae, Phaeocollybia pseudofestiva, Phaeocollybia sipei,* and *Sowerbyella rhenana*. All are associated with conifers, either occurring on the roots as symbiotic mycorhizae or growing in soil under conifer trees. Threats to these species include the removal of host trees, and soil disturbance and compaction. Prescriptions for stand treatments include leaving an average of 17 to 40 trees per acre after treatments and associated actions are completed. Under Alternative 2, soil disturbance would be primarily limited to roads, landings, and areas adjacent to landings, resulting in a small percentage of the total study area being affected. Therefore, proposed actions under Alternative 2 are not expected to impact any of the ten fungi. Alternative 1 would have no impact on these species.

Northwest Forest Plan Survey and Manage Botanical Species (Forest Botanist)

The alternatives were evaluated for their effects to survey and manage species following The Record of Decision dated January 2001, entitled “Record of Decision and Standards and Guidelines for Amendments to the Survey and Manage, Protection Buffer, and other Mitigation Measure Standards and Guidelines” and includes any amendments or modifications to the 2001 ROD that were in effect as of March 21, 2004.

A record search did not find documentation of any known survey and manage species sites in or adjacent to the study area. Survey and manage standards and guidelines require that field surveys be conducted for species in Management Categories A and C, if potential habitat exists in or adjacent to the study area and this habitat could be impacted by project actions. Consequently, field surveys were conducted in the study area on April 11 and September 1, 2006 for three vascular plants, one bryophyte and five lichen species. The surveys did not locate the presence of any survey and manage Category A or C species (USDA 2006a). Therefore, Alternative 1 and the proposed actions under Alternative 2 would have no impact on any of these species.

Invasive Plant Species (Forest Botanist)

The study area was surveyed in the summer of 2006 for invasive plants (weeds). The Forest botanist evaluated the potential for weed colonization of disturbed sites, based on the actions proposed. It was determined that Alternative 2 has a weed-risk rating of high for introducing and spreading weeds (USDA 2006b).

Invasive plant species in the study area are limited to regionally abundant non-native species that frequently colonize road shoulders and other areas of soil disturbance where seeds and plants parts are distributed by vehicles, equipment, people, and animals. Examples of invasive plants found in the project area include Scot's broom (*Cytisus scoparius*), cut-leaf blackberry (*Rubus laciniata*), English holly (*Ilex aquifolium*) and foxglove (*Digitalis purpurea*). Scot's broom is classified as a List B Noxious Weed in Oregon. The other invasive species found are not classified as noxious weeds, but they are seen as undesirable on the Forest.

Ground-disturbing actions, that result in exposed mineral soil on sites, with moderate to full sunlight exposure, greatly increase the potential for noxious or undesirable weed colonization and establishment. Ground-disturbing actions, unique to Alternative 2, include maintaining roads and landings. Prescriptions for the sites include reducing residual trees to an average density of 17 trees per acre on 20 acres, and 40 trees per acre on 31 acres. These actions increase the potential for weed colonization and establishment of disturbed sites. Stands accessed by road systems that support weed populations are at greater risk of weed colonization and establishment.

Preventive measures identified in appendix A are expected to provide adequate resistance to the introduction of noxious weeds not currently established in the study area. These measures will also reduce the risk of spread of established weed species beyond their current boundaries. Remedial treatment to limit the potential for the spread of Scot's broom is prescribed for the stand that currently has an infestation on the road adjacent to it. The KV plan includes high-priority funding for controlling the spread of weeds in these areas because noxious weed control is deemed to be mitigation. An "early treatment" vegetation management strategy would be implemented in high-risk stands, using manual and mechanical treatment methods. The objective of these treatments is to try and deplete the amount of weed seed in disturbed sites, reduce the area occupied by the weed, and establish competitive desirable vegetation prior to project implementation.

In summary, by following preventive measures in appendix A and completing remedial treatments, the risk of noxious weed infestation on disturbed areas under Alternative 2 should be reduced to acceptable levels over most of the study area. By monitoring the effectiveness of preventive measures and including additional weed treatments where warranted, weed infestation levels are not expected to exceed current levels and may likely be reduced below current levels in the study area in the foreseeable future. Alternative 1 is expected to maintain current weed infestation levels in the foreseeable future.

Water Quality and Soils (District Hydrologist)

Water Quality

Temperature—No increases in water temperature are expected due to implementation of this study. Vegetated riparian buffers would be maintained to provide sufficient shade on all perennial streams in or adjacent to the three sites.

Sediment—Project design criteria (appendix A) such as yarding away from stream corridors in the Wildcat and Yachats sites, fully suspending logs over the stream in the Cataract site, maintaining vegetated riparian buffers, and implementing erosion control and road maintenance measures are expected to minimize or eliminate introduction of sediment to surface water during and after commercial thinning activities. Residual trees and measures to limit sedimentation and protect soil productivity are expected to minimize or eliminate introduction of sediment to surface water after the project is completed.

Domestic users with water rights—Four water rights exist in the vicinity of the Yachats site, and one water right exists about 1.5 miles downstream from the Cataract site. There are no water right holders below the Wildcat site. Introduction of fine sediment due to logging activity is the water quality parameter likely to be affected by implementing this study. Design criteria are expected to minimize or eliminate introduction of sediment, both during and after commercial thinning activities. In addition, the untreated control area west of the Yachats site would provide additional protection to water-rights systems in the vicinity.

Soil Productivity

Compaction—Existing landings and roads would be used for commercial thinning, therefore no increase in area of compacted soil is expected.

Displacement and erosion—Small areas of soil displacement are expected where one-end suspension of logs would occur. Based on field observations of these sites and other units, minor areas of displacement are not likely to meet the Siuslaw Forest Plan definition of displacement (removal of at least ½ of the A horizon over an area of at least 100 square feet; SFP FW-107). Erosion may displace soil in road corridors, though design criteria are expected to minimize the extent of erosion or eliminate it altogether.

The combined effects of compaction, displacement, and erosion are not expected to exceed 15 percent of land at each site (Siuslaw Forest Plan standard, FW-107).

Aquatic Habitat and Species (District Fish Biologist)

The effects to fish habitat and species are based primarily on the field visits to each of the three sites, GIS and USGS Topography Maps, any past relevant fisheries reports containing the study areas, and the project design criteria (appendix A). The effects to the Regional Forester’s sensitive species are described in this section.

Stream temperature

Although a few trees outside of buffers may be felled that currently provide minor amounts of shading, existing stream buffers would be maintained. Understory vegetation has developed substantially since phase I of the study and now provides additional shading to streams. The closest samonid habitat is more than 1,000 feet away from the Yachats study site, and further away in the other two study areas (3,000 feet from the Wildcat site and 5,000 feet from the Cataract site).

Alternative 1 would maintain existing stream temperatures in the short term. Thus, no effects on fish (including trout) and other aquatic species would be expected. In the long term, stream shading at the sites would continue to increase as tree crowns and understory vegetation continue to grow.

Based on the project design criteria (appendix A) that minimizes impacts to stream shade, and type and location of actions proposed, none of the plantation treatments and associated actions proposed by Alternative 2 are expected to measurably affect existing stream temperatures in the short term. In the long term, stream shading is expected to improve in affected areas as tree crowns grow and understories continue to develop.

Large wood production

The desired future condition for aquatic habitat in the planning area would include an abundance of large-sized (at least 24 inches in diameter and at least 200 feet in height) conifer in riparian areas, and an abundance of down wood on floodplains and in stream channels.

Large wood benefits salmonids as well as trout species, such as Oregon coastal cutthroat, by creating deep pools for cool-water refugia and rearing habitat in the summer; providing slack-water refugia in stream channels and on floodplains during winter high flows for fish and other aquatic species; and by collecting and storing nutrients and sediment, including gravel required for spawning habitat.

Alternative 1 would maintain the existing conifer density at the three study sites. The conifer would be left to develop, without additional thinning treatments to reduce inter-tree competition. Eventually, large trees would develop in these areas, but it would take longer to develop in the 60 and 100 TPA areas, compared to Alternative 2.

Commercial thinning, as proposed under Alternative 2, would result in trees obtaining an average stand diameter of at least 24-inch diameters sooner in the 60 TPA and 100 TPA areas, compared to Alternative 1. The existing buffers would be maintained and contain trees that may to be recruited to fish-bearing stream channels and floodplains. These buffers range from 30 to 100 feet on each side of the stream and include at least the first two rows of conifer on the streamside edge of each thinning unit (appendix A). Additional trees that could enter streams include the trees left after thinning the stands.

Because of the trees that would be left in existing buffers and the residual trees that would be retained at the three sites, Alternatives 2 is not expected to substantially reduce the quantities of small wood that could be recruited to aquatic habitat. In the long term, large wood would increase more rapidly after thinning, moving aquatic habitat towards the desired condition sooner than with no additional plantation treatments, and possibly improving salmonid and trout habitat downstream.

Sediment

Alternative 1 would continue maintaining roads that access the Cataract and Wildcat sites, because these roads are kept open for mixed use. The road that accesses the Yachats site would not be maintained for the project. Ongoing road maintenance activities, such as roadside brushing and surface grading, are not expected to cause measurable amounts of sediment to enter streams, based on past observations of previous road maintenance activities.

Alternative 2 would implement minor road maintenance, including roadside brushing and surface grading, on all roads that access the three sites. Because of the project design criteria (appendix A) that limit potential sedimentation of streams, any sediment that could enter streams and affect fish habitat would be minor and short term. In addition, most, if not all the log hauling would be conducted during the dry season, further reducing the potential for sediment to enter streams. By barricading the entrance of the road that enters the 30 trees-per-acre area of the Cataract site, the potential for road-caused sediment to enter streams would be reduced.

Sensitive Species

The project has been designed to minimize adverse effects to sensitive fish species, including Oregon coast coho and chinook salmon, Pacific coast chum salmon, Oregon coast steelhead and coastal cutthroat trout, and Umpqua dace. Oregon coastal cutthroat trout is the only sensitive fish species that is known to occur in the study areas. Because actions proposed for this study are governed by the project design criteria, adverse effects to Regional Forester Sensitive Species Oregon coastal cutthroat trout would be minor and short-term.

The Cataract site includes two treatment units that run along a 13 percent gradient, permanent stream channel (suitable for Oregon coastal cutthroat trout habitat) that is buffered. There is also a 25 percent gradient, permanent stream (non-fish bearing) running inside one of the treatment units. About 200 feet below that same treatment unit, the stream merges into a 3rd-order stream (8 percent gradient) that is suitable for Oregon coastal cutthroat trout. About 4,750 feet below the lowermost treatment unit, there is a short reach with a 50+ percent gradient that blocks any anadromous fish passage.

The Wildcat site has one stream (possibly permanent) that runs inside one of the treatment units. The gradient on the stream is over 30 percent, making it non-fish bearing. This same stream merges into a 3rd-order stream named Bear Creek, which has a 12 percent gradient and suitable for Oregon coastal cutthroat trout, 80 feet below the treatment unit.

The Yachats site does not contain any permanent stream that runs along the treatment units. There is potential Oregon coastal cutthroat habitat 100 feet below one of the treatment units (12 percent gradient). The intermittent streams running within the treatment units have steeper gradient (over 30 percent) and not suitable for any trout or salmonid fish species.

For all three sites, the existing buffers would be maintained (minimum of 30-foot no-cut buffers) on all permanent streams that run alongside the treatment units. Minimum 30-foot buffers would also be maintained (for the majority of the stream course) for any of the intermittent/permanent streams that run inside the treatment units to maintain bank stability and stream temperature. By implementing the design criteria, such as maintaining existing buffers and requiring full suspension of logs when yarding over streams, no significant effects to the Regional Forester Sensitive species would be expected.

Essential Fish Habitat

The Magnuson-Stevens Act of 1976, as amended, directed Regional Fishery Management Councils to identify Essential Fish Habitat (EFH) for commercial fish species of concern. For the study, these species include coho and chinook salmon.

Sediment and stream temperature

Under Alternative 1, ongoing road maintenance activities associated with the roads adjacent to the Cataract and Wildcat sites are not expected to affect EFH because of the distance between the roads and EFH habitat. Existing stream shading would be maintained.

Under Alternative 2, project design criteria—such as log-suspension requirements, road maintenance requirements, and maintaining existing buffers—and distance between activity areas and EFH habitat (1,000 feet from the Yachats site, 3,000 feet from the Wildcat site, and 5,000 feet from the Cataract site) would not adversely affect EFH in terms of sediment input and stream temperature.

Large wood

Alternative 1 (no action) would maintain the existing number of trees in riparian areas. Therefore no effects to EFH are expected.

In determining the large-wood component effects to EFH associated with Alternative 2, the Forest Service considered the design criteria, location of thinning units in relation to EFH, the average size of the trees in managed stands, the acres of treatment in each stand, the silvicultural prescription for each stand, recruitment mechanisms of large wood into streams, and the ecological function of trees proposed for removal may play in the hydrologic process. Although there may be some trees over 24 inches DBH that would be removed from the 60 and 100 TPA thinning areas, most would be under 24 inches DBH and located more than 80 to 100 feet from streams that are 2nd order or larger.

In addition, there is a very low potential for large wood to be transported to EFH by fluvial or debris torrents and processes, because the streams adjacent to the stands are 1,000 feet to 5,000 feet upstream of coho habitat. Debris torrents, if they occur in unit stream channels, would likely deposit upstream of EFH. There are few signs of slope instability. Furthermore, the control (no thinning) areas in each of the three sites would continue to provide adequate sources of small and large wood that could enter streams and potentially benefit EFH.

In summary, the Forest Service concludes that activities proposed by the Study would not adversely affect EFH.

Public and Management Access (Forest Transportation Planner)

The Siuslaw National Forest roads analysis (USDA 2003) designated two broad categories of National Forest System (NFS) roads: key roads and non-key roads. Key roads comprise a network of long-term-use roads forming connections between communities, roads considered vital for forest access and management, and roads connecting to State, Federal and County routes. Non-key roads are generally not considered vital to community connections or needed for constant access for forest management. The activities proposed by the study would use key and non-key roads but would not change public or management access.

The three study sites are accessed by existing NFS roads. Because no changes in the existing NFS roads are needed to access the study sites, and the roads would not be closed after commercial thinning operations, a roads analysis was not completed for this study. Current ongoing activities associated with the NFS roads include noxious weed control, public recreational use, forest products gathering for personal and commercial uses, and fire and fuels management. Activities proposed by the Study would maintain these uses.

Road work to facilitate commercial thinning involved with the study would consist of routine road maintenance activities. These activities include removing roadside vegetation, grading road surfaces, maintaining drainages, adding minor amounts of gravel surfacing (if needed), and removing any existing waterbars. If waterbars are removed, they would be replaced following commercial thinning operations. By limiting commercial log hauling to the dry season, it would avoid the higher costs associated with the greater rock quantities needed to facilitate log hauling during the wet-season.

Note: Non-key NFS roads 5491 and 5491-411 access the Yachats site. One culvert on road 5491 has failed and will be repaired by an unassociated project prior to implementation of the study activities.

Alternative 1 (no action) and Alternative 2 (implement phase II of the study) would not change current access.

Alternative 2 would temporarily improve road conditions through routine maintenance, and would potentially close roads—on a temporary basis—to facilitate commercial thinning operations and address public safety. A 500-foot existing temporary road that enters the 30 trees-per-acre area of the Cataract site would be closed with an earthen berm after thinning operations are completed.

Fire (Forest Fuels/Fire Planner)

Because the potential for fire ignition cannot be eliminated under Alternative 2, the team is obligated to disclose the potential for wildfire as a result of an ignition in a thinned plantation. The effects described here are those more associated with stands that would be commercially thinned.

Commercial thinning and creating down wood in each study site would increase fuels on the forest floor. Based on past fire studies and observations, effects to fuels are listed below:

- Fuels created from thinning slash in the three sites fall under the light-slash fuel model (fuel model 11) in the light-to-moderate thinning units and the medium-slash fuel model (fuel model 12) in moderate to heavy thinning units.
- The fuels are expected to decay over time, decreasing the risk of wildfires. Observations of past thinning have shown decomposition of the fine fuel component (needles and twigs) in 3 to 4 years. During this period, thinning slash could support a surface fire.
- Leaving 51 whole trees on the ground—16 for Cataract, 13 for Wildcat, and 22 for Yachats—as down wood increases resistance to control by fire suppression resources beyond that for fine fuels. Down wood would not contribute much to the fire hazard because it is mainly the fine fuels that contribute to rapid rates of fire spread. With the addition of down wood, fire hazard is expected to remain low due to the limited number trees felled, climate, and location of the wood within each site (less risk in lower slopes away from roads).

Under Alternative 2, the Cataract and Wildcat sites lie adjacent to forest roads that are currently open for mixed use. The Yachats site is located at the end of a dead-end road that is seldom used. Because 95 percent of the wildfires on the Siuslaw are human-caused, fuels adjacent to the roads at the Cataract and Wildcat sites would be treated to reduce the volume of fuels. Fuel treatments, such as burning hand-piled slash (about 1.7 acres total) may be done adjacent to and within 25 feet of these roads. Landings at all three sites (about 12 landings, affecting 0.7 acres) may be machine piled and burned to reduce fuel loading. These treatments would be done after thinning operations are completed and after one or more inches of precipitation have occurred to reduce the potential for fire spread and mortality to residual trees. In lieu of handpile and burning slash, trees could be felled in such a manner as to keep limbs and tops at least 25 feet from road edges. This would avoid the need for burning the piles, thereby lessening the risk of fire affecting residual trees.

Only the Yachats site is located in a wildland-urban interface (WUI). Proposed fuel treatments, proximity of commercial thinning units to private property structures, and the generally northerly aspect of the site would result in a low risk of fire starting and spreading in the WUI. Therefore, no additional fuel treatments would be needed specifically to reduce the fuel loading in the WUI.

All prescribed burning would be designed to be consistent with the requirements of the Oregon Smoke Management Plan (ODF 2005) and the Department of Environmental Quality's Air Quality and Visibility Protection Plan (DEQ 2003). Because slash volumes are relatively small or treatment areas are scattered, adverse effects to air quality from burning are expected to be short-term and localized.

Human Uses and Influences

Domestic water sources (District Hydrologist)

The Siuslaw National Forest Plan states that "Best Management Practices are designed largely to protect fish and water for domestic use" (USDA 1990; D-10). The desired future condition is to maintain or improve water quality for downstream water users by reducing the potential for sudden pulses of increased turbidity due to mass movement, or chronic increased turbidity due to chronic fine-sediment sources.

Only the Yachats site has water rights in its vicinity. The water right downstream from the Cataract site is several miles away. Currently, there are four water rights just west of the site: two are solely for irrigation use, one is for domestic use, and one is for human consumption. The water quality parameter of concern for the waters users near the Yachats site is fine sediment, as detected by turbidity.

Under Alternative 2, commercial thinning and related actions are not expected to produce sediment that could impact downstream water users because:

- The thinning actions are distant from water diversion sites;
- Existing streamside buffers would be maintained;
- Roads proposed for use do not cross source streams and are distant from these streams; and
- Creation of snags and down wood cause little soil disturbance and locations would be distant from water-diversion sites.

In summary, based on project design criteria and distance between action sites and water diversion sites, Alternative 2 is not expected to increase turbidity for domestic water users. The no-action would maintain existing conditions for water users.

Heritage resources (Forest Archaeologist)

A thorough literature search was conducted to determine if heritage resources (prehistoric or archaeological sites) are known to exist in the planning area, or have the potential to be adversely effected by the proposed study. Included in the literature search were district site files and environmental assessments that were accomplished for the three sites (USDA 1990a, USDA 1993a and b), homestead records, land and cultural resource surveys, maps, land status atlas and local historical publications. The literature search indicated that no known sites will be impacted by proposed activities described for Alternative 2. These findings are consistent with known cultural landscape patterns across the steep-sloped uplands of western Oregon, where cultural activities were focused near major watercourses with limited, transient cultural activities in upland forest areas. No treaty resources are in the Study planning area. Activities will be consistent with our programmatic agreement with the State Historic Preservation Office and will meet the requirements of the National Historic Preservation Act (USDA 2005b).

Proposed activities such as commercial thinning or reopening temporary roads and landings are on previously disturbed sites and will not require field inventories, based on our 2004 Programmatic Agreement with the State Historic Preservation Office (appendix A).

Should heritage resources be discovered as a result of any project actions, work would be stopped in that area and the Forest Archaeologist would be consulted. The sites would be avoided, protected, preserved, and treated in accordance with the National Historic Preservation Act. Based on field reviews and past experiences with similar projects, no effects to heritage resources are expected from implementing Alternatives 1 and 2. Therefore, proposed activities would meet the requirements of the National Historic Preservation Act.

Recreation (Recreation Planner)

The Study would not alter the existing plans for road management. Therefore, existing dispersed recreation opportunities, such as hunting and wildlife viewing would be maintained. Existing recreational fishing opportunities would be maintained, as access to fishing sites would not be changed.

No developed recreation sites or established Forest Service trails exist in the planning area; therefore, no effects to such facilities will occur.

Scenery (Forest Landscape Architect)

The Cataract site is out of view from county roads. This site is within a mile of the North Fork of the Siuslaw Campground, part of or adjacent to the North Fork Siuslaw River Corridor. The view from the river and highway to the site is separated by topography. The eastern 3.5- and 7.2-acre units have shapes that respond to the creek tributaries and ridgelines and therefore appear more consistent with natural patterns. The eastern 5.4-acre unit boundaries do not respond to creek or topography and create a contrast with natural vegetation patterns. Treatments are expected to meet the scenic quality objectives of modification or moderate scenic integrity.

The Wildcat site is out of view from county roads. The site is within a mile of Beaver Creek Forest Camp, but is not visible from that campsite. The viewing distances are short in this area because of the many ridgelines and drainages which seem to go in all directions. The northern and outer east and west thinning unit boundaries of the Wildcat units do not respond to natural topography or drainage systems and so would create a contrast with the natural landscape. Treatments are expected to meet the scenic quality objectives of modification or moderate scenic integrity.

The Yachats site is in the vicinity of county road 804. Because of the visual screening provided by the control portion of the site to the west, private land timber to the north and east, stand buffers to the east, and the light thinning proposed all contribute to making the view along this corridor unlikely to be affected, particularly by the proposed western thinning. Treatments are expected to meet the scenic quality objective of modification.

Special forest products (Small Sales Specialist)

To maintain the integrity of the Study, including Phases I and II, harvesting of special forest products would not be permitted in the area encompassed by each of the three sites (about 92 acres).

Other Predicted Effects

Cumulative Effects (The Team)

The Council on Environmental Quality defines cumulative effects on the environment as those that result from the incremental actions of a proposal added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes them (40 CFR 1508.7).

For purposes of analyzing cumulative effects, the geographic area potentially affected by the alternatives is the 6^{th}-field watershed of each study site because of the small areas that would be impacted and the minor impacts associated with proposed actions. Only the Yachats site is in the vicinity of residences and County roads. The Cataract and Wildcat sites more isolated and surrounded by US Forest Service lands.

Current forest conditions—primarily influenced by past timber harvesting on federal and non-federal lands—lack late-successional forest habitat to support species such as the northern spotted owl and the marbled murrelet. According to the watershed analyses, past timber harvesting has also reduced the suitability of late-successional forest habitat by reducing the amount of interior forest habitat.

Beginning in 1976 and ending the 1990’s, harvest practices on federal land during this time were improved by the requirements of the 1976 National Forest Management Act. Consequently, skyline yarding (one-end or full suspension of logs during yarding) replaced highlead yarding, reducing soil disturbance; trees were retained in units to buffer at least the larger streams to reduce sedimentation of streams and provide shade; and excess excavated soil from road building was hauled to and deposited on stable sites instead of using the sidecast method, reducing the potential for road failure and stream sedimentation. Culvert size and placement improved, but size and number used for streams and ditch drainage was still inadequate. Beginning in the late 1980’s, some trees were left in units to provide snag and down wood habitat for various wildlife species.

Within the past 10 years on federal lands, commercial thinning has occurred in the Cataract and Bear-Wildcat 6^{th}-field watersheds that encompass the Cataract and Wildcat sites, respectively. About 1,160 acres have been commercially thinned in the Cataract watershed over the last 10 years, with little to no thinning occurring over the last three years. Within the Bear-Wildcat watershed, about 340 acres have been commercially thinned over the last 10 years, with some thinning occurring this past year. No commercial thinning has occurred within the last 10 years in the 6th-field watershed that encompasses the Yachats site.

In this document, the analysis provided for each alternative and resource area reflects the sum of most planning actions on federal lands in the foreseeable future. Future actions on federal lands in the Study areas are likely to include changes in the transportation system for Forest users; actions associated with ongoing road maintenance and repair of key forest roads; and harvesting of special forest products, such as firewood, salal, swordfern, and moss. No additional commercial thinning is planned for areas surrounding the Cataract and Wildcat sites. Based on the Yachats Terrestrial Restoration Project EA (USDA 2005a), about 500 acres in the 6th-field Yachats watershed are planned for commercial thinning over the next several years. About 1,500 additional acres in the larger Yachats 5th-field watershed are planned for commercial thinning over the next several years.

County road departments that maintain roads in the vicinity of the study sites include only Lincoln County. This County is expected to continue maintaining roads in the planning area. Maintenance work generally includes roadside brushing, repair of road surfaces, ditch cleaning and drainage maintenance, and replacement of some culverts, especially those that are known to hinder fish passage.

Most of the acres on nearby private lands have been clear-cut harvested, beginning about 50 years ago. The Team expects landowners to continue current practices and uses of their land, following current county and state land-use regulations. Current uses include farming, rural-residence living, livestock grazing, industrial timber harvesting, and limited non-industrial timber harvesting. Based on local industrial timber management objectives and practices, most industrial lands have been harvested in the last 15 years. Considering current national-development trends in similar rural areas, an increase in the quantity of rural residences in the watershed is expected.

Cumulative effects are measured relative to the baseline conditions described in chapter 1. Where specific effects are not described for a particular resource, cumulative effects are not expected to be measurably different from those under baseline conditions. Actions under Alternatives 1 and 2 are expected to have the following cumulative effects:

Alternative 1 (no action)

No additional information would be gathered by researchers to help managers improve future land management decisions that affect dense, even-age Douglas-fir stands.

Habitat preferred by species dependant on late-successional forest will take longer to develop, mid-seral species habitat will remain longer, and habitat preferred by early seral species will gradually decline as tree crowns merge.

Alternative 2

Forest stand conditions—Thinning the three plantations under Alternative 2 would speed the development of late-successional forest on about 51 acres. These small-scale changes would reduce fragmentation and accelerate development of late-successional forest characteristics on federal land, creating minor beneficial cumulative effects in the long term.

Terrestrial species (federally listed, sensitive, survey-and-manage, management-indicator, and land birds)—In the short term, disturbances from noise associated with treating the plantations are likely to have minor adverse effects on all terrestrial species to some degree. The dispersal in timing and distribution, and small scale of these actions across each watershed, however, are such that impacts are expected to be localized and not lead to adverse cumulative effects.

In the long term, the cumulative effects to wildlife would be beneficial, both from a learning and resource impact standpoint: the Study would provide managers with additional knowledge about how to manage for late-successional, early seral, and dead wood habitats; and it would accelerate restoration of late-successional forest, improve diversity of young/small forest, maintain or restore grass/forb/shrub habitat, and improve dead wood habitats on lands administered by the US Forest Service. Considering past, present, and reasonably foreseeable actions on other land ownerships in the affected watersheds, the cumulative effects of this study would not change; they would remain beneficial to wildlife.

Listed, sensitive, and survey-and-manage plants—Based on field surveys and protection measures, no adverse cumulative effects on these species are expected. Thinning the plantations would accelerate the development of late-successional forest habitat as well as result in greater tree and shrub species diversity in affected watersheds. In the long term, this would be beneficial to survey and manage species associated with late-successional forest.

Noxious and undesirable weeds—Current weed infestation levels would not be exacerbated by actions under Alternative 2 and are likely to be reduced due to remedial treatments and prevention measures.

Sediment production—No measurable cumulative additions of fine sediment are expected to enter streams from stand treatments. Using roads may increase fine sediment in the short term. Potential pulses of sediment associated with harvesting timber on private land, along with chronic sources of sediment from rural residences and livestock grazing are expected to continue. Overall, Alternative 2 is expected to cumulatively reduce sedimentation in the Study areas in the long term.

Soil productivity— Considering past and proposed logging operations, the detrimental soil condition (i.e., soil compaction and displacement) for each commercially treated plantation is expected to be less than 10 percent. Therefore, each plantation will be under the 15-percent threshold established by the Siuslaw Forest Plan for National Forest system lands.

Stream flow— Thinning the plantations would not measurably affect stream flows. Other actions on federal land, such as road decommissioning, would reduce peak and storm flows resulting in a net cumulative decrease over the long term. Continued development of rural residences in the upper Yachats watershed is likely to require minor increases in water withdrawal for domestic and agricultural use.

Stream temperature— Based on project design, plantation treatments are not likely to cause any measurable increase in stream temperature. Road decommissioning or repair in the upper Yachats watershed is likely to improve watershed function and negligibly lower stream temperatures, resulting in a cumulative decrease in temperature.

Aquatic species— Proposed actions are not likely to have adverse effects on aquatic species during project implementation in the short term. In the long term, net improvements to aquatic habitat are expected to accrue with accelerated growth of trees in riparian areas. These actions are expected to benefit aquatic species on federal lands. Considering no significant changes in management of private lands are expected, streams immediately downstream from plantations may have lower quality habitat for salmonids due to higher stream temperatures, shortage of large wood, and higher stream sedimentation.

Public and management access— The management strategy for existing system roads would be unchanged. The various easements, permits, and access agreements that exist—private landowners, federal agencies, and commercial and community interests—will not be affected by the Study. Generally, permit holders would be required to perform maintenance items on National Forest System roads related to the permitted uses.

Fire— Thinning is expected to increase fuel loading and associated wildfire risk in the short term (3 to 4 years) at each study site. Fuel reduction measures would be implemented to reduce the risk of wildfire. No substantial increase in wildfire risk would be expected in affected watersheds.

Domestic water sources— Based on distance between proposed actions and water sources and protection measures designed to minimize or prevent fine sediment from entering streams, no cumulative impacts to domestic water sources are expected.

Heritage resources— Treating managed stands and proposed roadwork would have minimal risk because actions are generally on previously disturbed ground. In addition, these areas have been surveyed for heritage resources in the past, with no sites found. Adverse cumulative effects are not expected.

Recreation— Treating the plantations would not substantially change the recreation experience. No trails or dispersed sites would be affected.

Scenery— All actions would be consistent with the scenic quality objectives for the affected watersheds. The study is likely to result in management that is more responsive to natural features of the forest scenery, and so is likely to result in a cumulative enhancement of forest scenery for future projects.

Special forest products— The opportunity for gathering these products would be maintained in affected watersheds, but harvesting would not be permitted in the Study sites to maintain the integrity of the long-term study. Short-term opportunities for firewood collection may be permitted after plantations are commercially thinned.

Summary

Considering other ongoing and likely actions on federal lands and on other lands in the affected watersheds, Alternative 2 is expected to slightly reduce the adverse cumulative effects of past actions on the landscape, thereby accruing net beneficial cumulative effects for most resources. The cumulative effects are generally beneficial over time and an improvement over existing conditions.

Comparing Likely Effects

Alternative 1 would discontinue the Study and forgo opportunities to learn more about changing the trajectory of plantations towards late-successional forest habitat. Alternative 2 would continue the Study and learn more about: overstory and understory response to thinning treatments, including second-entry treatments; .speeding the development of late-successional habitat; maintaining grass, forb, and shrub habitats in plantations; and managing for dead wood in plantations.

Aquatic Conservation Strategy

Primary goal of the Siuslaw Thinning and Under-Planting for Diversity Study is to gain information that will help improve future ecosystem restoration decisions.

The Siuslaw National Forest is proposing to implement a second treatment (Phase II) in three plantation thinning study areas. These areas are in the Nestucca watershed (Wildcat study area), Yachats watershed (Yachats study area), and North Fork of the Siuslaw watershed (Cataract study area). Initial treatments were implemented around 1992 in these same areas.

Comparing Phase I and Phase II Treatments

Initial Thinning Prescription Under Phase I (1992)	Phase I Acres Treated	Phase II (2006-2007) Proposed Residual Trees Per Acre/Acres to be Treated			
	Cataract, Wildcat, and Yachats	Cataract Study (stand 607167)	Wildcat Study (stand 302024)	Yachats Study (stand 506112)	Total Acres to be Treated
Control/no treatment areas (Relative density of 57)	13.9	N/A	N/A	N/A	N/A
30 trees per acre areas (Relative density of 8)	26.8	N/A	N/A	N/A	N/A
60 trees per acre areas (Relative density of 16)	20.4	17/5.4	17/7	17/8	20.4
100 trees per acre areas (Relative density of 37)	30.7	40/10.7	40/6	40/14	30.7
Total Acres	91.8	16.1	13	22	51.1
Road work		Close short spur used in Phase I 30tpa unit (300 ft)		Road maintenance on 2 temp spurs in Phase I 60tpa unit (1100 ft total)	
Percent of 6th field watersheds affected		*0.07% of 22,800 acres in Upper N Fk Siuslaw*	*0.07% of 18,700 acres in Beaver Cr.*	*0.12% of 17,500 acres in Upper Yachats*	*0.09% of 59,000 acres*
Percent of 5th field watersheds affected		*0.04% of 41,000 acres in N Fk. Siuslaw (key watershed)*	*0.008% of 163,100 acres in Nestucca watershed (Adaptive Mgmt Area)*	*0.06% of 38,600 acres in Yachats (key watershed)*	*0.02% of 242,700 acres*

Road work includes routine maintenance, such as road brushing and grading as well as installing a berm to close a road (in the Cataract site).

Effects

The implementation of treatments will have direct, indirect, and cumulative effects from proposed actions to ACS objectives.

For the action alternative, effects will be small, due to the very small area affected in each watershed where activities could occur, and because design criteria minimize potential adverse effects. However, initial study parameters limit the ability to apply design criteria (typically used on the Siuslaw NF) at all locations in order to avoid or minimize potential adverse effects to ACS objectives, because application of design criteria at all locations would significantly change study parameters, thus restricting the value of information from this study.

Due to the nature of this study, there is one site in Cataract and one in Wildcat where a few trees would be thinned in what would typically be the no-cut areas (riparian zone) of intermittent streams. Each tree to be cut in these zones will be evaluated and assessed by the resource specialists (hydrologist and/or fisheries biologist) to minimize potential risk of damages from those actions. Not all trees that are thinned in these areas will be left in the riparian area because this could complicate ground cover and other factors critical to the conditions of the study, yet emphasis will be placed to have down trees left in this riparian area where feasible.   However, the scale of potential adverse affects is small (as shown in the table above).

Ultimately, results from this study could affect plantation treatment methods over much larger areas, because information learned from this study could be applied by future management decisions.

Although information from this study could be applied by future management decisions, some of the study parameters/methods used to learn this information should not be applied to other areas. Parameters/methods that should not be applied to other areas include removing trees adjacent to intermittent streams, removing trees that are likely to provide large in-stream wood, and leaving smaller amounts of dead wood than typically retained in thinned plantations on the Siuslaw NF.

Alternative 1

Taking no action, Alternative 1, would not implement further treatments in the study areas; therefore, learning opportunities would be limited to the effects from original treatments from Phase I. Opportunities to learn from further treatments would be lost.

Alternative 2

We have evaluated the consistency of all actions under Alternative 2 with the nine aquatic conservation strategy objectives of the Northwest Forest Plan. Project activities would not retard or prevent attainment of any of the strategy's objectives. We have concluded the following for each objective:

Objective 1*--Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted.*

The array of treatments in plantations will create a variety of forest habitat conditions, including early seral in under-stories, and potentially accelerate restoration of old growth forest habitat. Early seral habitat is under-represented at the watershed scale on federal lands, and old growth forest habitat is under-represented at the watershed scale on all ownerships.

Road closure will reduce the amount of this over-represented landscape feature (in Cataract area only), and road maintenance will have minimum impact because these actions do not intersect streams.

Objective 2*--Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life- history requirements of aquatic and riparian-dependent species.*

Over the short term, proposed activities would not change connectivity within or between watersheds for aquatic and riparian dependant species, because activities would maintain existing connectivity.

Over the long term, spatial and temporal connectivity in and between watersheds would be improved through thinning plantations. Thinning would accelerate the rate at which plantations become mature stands and thus increase the connectivity among existing mature stands.

Road closure and road maintenance would not affect connectivity, because these roads are not connected to a stream channel.

Objective 3 --*Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.*

Design criteria would prevent adverse effects to the physical integrity of the aquatic system in all areas. No trees would be cut that affect shorelines, banks, and bottom configurations, and trees that are in unstable grounds near stream will be protected. Also, no yarding would affect these elements, because full suspension is required across all streams.

Encouraging growth of large trees that could later fall into streams will help restore the physical integrity of the aquatic system in the long run as a result of adding complexity to the stream channels.

Road closure and road maintenance would not affect the physical integrity of the aquatic system, because these actions do not intersect streams.

Objective 4--*Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.*

Design criteria will assure water quality is maintained.

The old logging corridors and landing sites that were used in 1991 (Cataract Thinning) and 1992 (Yachats and Wildcat Thinning) will be used again, where feasible, to minimize new impacts to water quality from logging operation.

Full suspension over streams, existing understory vegetation near streams, and avoidance of yarding across unstable sites combine to prevent addition of fine sediment, hence preventing increased turbidity in streams.

Understory vegetation is adequate to shade streams and protect water temperature for the streams within units (which are all first order). The only larger stream within the scope of this project is Bear Creek located adjacent to the Wildcat site, and stream temperature would not be affected, because the treatment area is north of the stream where trees do not provide shade.

Log haul will produce small amounts of dust and fine sediment at road stream crossings. This is a short-term localized effect that is not measurable within 100' downstream of road-stream crossing.

Road closure and road maintenance would not affect water quality, because these actions do not intersect streams.

Objective 5*--Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport.*

Short-term increases in fine-sediment production associated with road use would be minor because of the design criteria for this project.

Accelerating restoration of large trees, which could later fall into streams, will improve character of sediment input and storage.

Road closure and road maintenance would not affect sediment regime, because these actions do not intersect streams.

Objective 6*--Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.*

Treatments are not expected to result in measurable changes to in-stream flow, because of the small amount of area affected and the relatively small amount of vegetation removed.

In the long term, thinning supports restoration of stream flows to a more natural regime, because thinning accelerates restoration of large trees that will collect and store water as well as fall into streams and help restore natural patterns of sediment, nutrient, and wood routing.

Road closure and road maintenance would not affect in-stream flows, because these actions do not intersect streams.

Objective 7*--Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.*

Over the short term, floodplain inundation and water table elevation would not be affected, because existing in-stream wood would not be removed.

However, over the longer term, effects would be both adverse and beneficial.

Removing a few trees that are likely to contribute to future in-stream large wood (from the first two rows of trees in Cataract area only) would adversely affect the role large wood plays in holding sediment and locally raising water tables. Large wood also slows the flow of water during floods, which leads to floodplain inundation for longer periods of time. These adverse effects would only occur on small areas in small streams in a portion of the Cataract study site. These effects are minor even at the local scale (less than 20% of the channel lengths at the Cataract study area scale), and effects are inconsequential at the North Fork of Siuslaw 6th field watershed scale (0.06% of channel length).

Conversely, thinning will benefit this objective, because thinning hastens restoration of larger trees within the small area described above as well as along other channels in the study areas.

Road closure and road maintenance would not affect floodplain inundation and water table elevation, because these actions do not intersect streams.

Overall, this project is consistent with ACS objective 7.

Objective 8--*Maintain and restore the species composition and structural diversity of plant communities in riparian areas and wetlands to provide adequate summer and winter thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.*

Over the short term, course woody debris would be slightly increased, because existing down wood would not be removed and some additional down wood would be created. Over the long term, the effect to large down wood is the same as described above in objective 7.

Species composition and structural diversity of plant communities should benefit from the variety of treatments applied in the study areas, which create diverse overstory and understory conditions.

Road work will not affect course woody debris, because large down wood would not be removed by road work and road work is not near streams.

Objective 9--*Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.*

All actions are designed to restore important natural processes that create and maintain habitat for native riparian-dependent species. The majority of actions emphasize restoring old growth forest. Some actions encourage heavy thinning in riparian areas which may be more than optimal for the current stands, but such actions are necessary in order to demonstrate the range of results that could develop from the various prescriptions, and may reveal better ways to maintain and restore habitat for native riparian-dependent species.

Road work will not affect this ACS objective, because road work is not near streams.

Conclusion

Project activities would not retard or prevent attainment of any of the Aquatic Conservation Strategy objectives.

Short-Term Uses and Long-Term Productivity (The Team)

The use or protection of natural resources for long-term, sustained yield is the legislated basis of management and direction for the Forest Service (USDA, USDI 1994a, p. 321). Short-term uses include actions such as commercial thinning. The design criteria were developed to incorporate the standards and guides of the Siuslaw Forest Plan as amended by the Northwest Forest Plan. We expect that applying them to the actions proposed by the Study will reduce the potential for long-term loss in productivity of forest soils that may result from short-term uses. They will also allow for the long-term development of late-successional habitat and improvement of watershed function.

Unavoidable Adverse Effects (The Team)

Implementing any alternative would result in some adverse environmental effects that cannot be avoided. The design criteria, along with Forest standards and guides, are intended to keep the extent and duration of these effects within acceptable rates, but adverse effects cannot be completely eliminated. The following adverse environmental consequences would be associated to some extent with Alternative 2:

- Short-term, localized reductions in air quality from dust, smoke, and vehicle emissions resulting from management actions.
- Temporary increase in fire hazard from slash left on the ground from commercial thinning.
- Disturbance to wildlife when their habitat is disturbed by management actions.
- Temporary increase in large vehicle traffic during commercial thinning operations.

Irreversible Resource Commitments (The Team)

Irreversible commitments of resources are actions that disturb either a non-renewable resource (for example, heritage resources) or other resources to the point that they can only be renewed over 100 years or not at all. The design criteria--along with Forest standards and guides--are intended to reduce these commitments, but adverse effects cannot be completely eliminated. For example, the continued use of existing roads that access the Study sites is an irreversible commitment of the soil resource because of the long time needed for a road to revert to natural conditions.

Irretrievable Commitment of Resources (The Team)

An irretrievable commitment is the loss of opportunities for producing or using a renewable resource for a period of time. Almost all activities produce varying degrees of irretrievable resource commitments. They parallel the effects for each resource discussed earlier in this chapter. They are not irreversible because they could be reversed by changing management direction. The following irretrievable commitments of resources are expected:

- Loss of harvesting wood fiber for forest-product use (Alternative 1).
- Loss of harvesting wood fiber for forest-product use due to dead wood creation (Alternative 2).

Environmental Justice (Resource Planner)

Based on local knowledge, some low-income populations live in the vicinity of the Yachats study site. Some augment incomes through actions such as gathering firewood and picking brush to sell. Some farms exist in the planning area and domestic-use water systems include individual wells and spring-fed systems.

Thinning the plantations may provide opportunities for firewood gathering. Although commercial harvest of brush species would not be permitted in the study sites, opportunities for brush picking will be maintained in the affected watersheds. Some proposed actions in the planning area may provide opportunities for jobs. None of the proposed actions are expected to physically affect farms or water quality of domestic-use water systems.

Effects of alternatives on the human environment (including minority and low-income populations) are expected to be similar for all human populations regardless of nationality, gender, race, or income. No disproportionately high and adverse human health or environmental effects on minority populations and low-income populations are expected as a result of implementing actions described for the alternatives.

Other Disclosures (The Team)

Based on the Team's evaluation of the effects, we concluded:

- This environmental assessment is tiered to the Siuslaw Forest Plan FEIS, as amended by the Northwest Forest Plan, and is consistent with those plans and their requirements.
- None of the alternatives would affect minority groups, women, and consumers differently than other groups. These groups may benefit from employment opportunities and by-products that proposed actions will provide; the no-action alternative would have neither adverse nor beneficial effects. None of the alternatives adversely affects civil rights. All contracts that may be awarded as a result of implementation would meet equal employment opportunity requirements.
- None of the proposed actions will affect known prehistoric or historic sites because no new disturbance on previously undisturbed ground is expected. As outlined in the American Indian Religious Freedom Act, no effects are anticipated on American Indian social, economic, subsistence rights, or sacred sites.
- No adverse effects on wetlands and flood plains are anticipated; and no farm land, park land, range land, wilderness, or wild and scenic rivers will be affected.
- The proposed project is not in or adjacent to an inventoried roadless area.

- The proposed project is consistent with the Coastal Zone Management program.
- Because of the type of actions proposed, none of the proposed actions are expected to substantially affect human health and safety.
- Proposed activities are consistent with the Clean Air Act because effects from activities such as log hauling (dust) and prescribed burning are localized and short-term.
- Because of the design criteria to be applied (appendix A), this project is expected to be consistent with the Clean Water Act.
- The proposed study is not expected to measurably affect global warming. The US Forest Service will continue an active leadership role in agriculture and forestry regarding the reduction of greenhouse gas emissions (Joyce and Birdsey 2000).
- These actions do not set a precedent for future actions because they are similar to actions implemented in the past.

Chapter 4—Who was Consulted?

As described in chapter 1, comment on the proposed action was solicited through letters, local newspapers, and the Siuslaw National Forest's quarterly "Project Update" website and publications. The results of specific government and agency consultations are summarized below.

Local Confederated Tribes

The Confederated Tribes of Siletz, the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw, and the Confederated Tribes of Grand Ronde were informed of the Study's proposed actions during the scoping/30-day public comment period process. No comments on the proposed Study were received from them.

Federal Agencies

NOAA Fisheries

Actions proposed by the Study, such as commercial thinning, deadwood creation, and road maintenance, would not adversely affect Essential Fish Habitat in the short term. Maintaining the accelerated development of large overstory trees, understory trees, and shrubs are expected to benefit watershed function in the long term. Therefore, consultation with NOAA Fisheries is not required.

US Fish and Wildlife Service

The US Fish and Wildlife Service (FWS) is responsible for the wildlife species listed under the Endangered Species Act. Listed species that may occur in the Study areas include the bald eagle, northern spotted owl, and marbled murrelet. The Forest Service is responsible for supporting recovery of these species, and meets this obligation by working with the FWS through a required consultation process. Consultation for this project is completed, and the FWS concurred with the District wildlife biologist's determinations of effects for the Study (USDI 2007, FWS reference number 13420-2007-I-0077).

Regional Ecosystem Office (REO)

The U.S. Forest Service, Region 6 REO was consulted, regarding the consistency of the Study with the Northwest Forest Plan. The Study was found consistent and documented in a letter dated November 6, 2006.

US Congressional Representatives

Senators Gordon Smith and Ron Wyden and Representatives Peter DeFazio and Darlene Hooley were contacted about the proposed project. No comments were received from them.

State of Oregon

All proposed actions were evaluated under the programmatic agreement with the State Historic Preservation Office (SHPO) during the planning of Phase I of the Study. No further consultation with SHPO is needed because ground-disturbing activities under Phase II will be limited to the previously disturbed sites of Phase I.

Oregon Department of Forestry, Oregon Coastal Zone Management Program, Oregon Department of Fish and Wildlife, State Senator Joanne Verger, and Congressman David Wu were notified about the proposed project. No comments were received.

Local Governments

County commissioners of Lane, Lincoln, and Tillamook Counties; county soil and water districts; and the City Manager of Florence were notified. These scoping efforts elicited no response.

Watershed Councils

Members of the Alsea, Siuslaw, and Mid-Coast watershed councils were contacted. No comments were received.

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Appendix A

Design Criteria for the

Siuslaw Thinning and Underplanting for Diversity Study

Introduction

Design criteria for actions identified in the Siuslaw Thinning and Underplanting Diversity Study EA (Study EA) were developed to ensure the study is consistent with the standards and guides of the 1990 Siuslaw Forest Plan (SFP), as amended by the 1994 Northwest Forest Plan (NFP). Other requirements were followed, including those described in consultation documents for federally listed species or designated critical habitat and those in the 1997 Late-Successional Reserve Assessment, Oregon Coast Province—Southern Portion.

The objectives of this study are linked to the project needs identified in the EA, chapter 1: this study is one of two studies on the Siuslaw that focuses on providing information on the response of overstory and understory trees, shrubs and forbs to different treatment pathways for meeting these primary objectives. Continued long-term research through this study would assist managers in making plantation management decisions, including the management of snags and down wood. The purpose of this proposal is to further evaluate the outcomes of the Phase I treatments, to prescribe and implement follow-up density management treatments in the areas with 60 and 100 trees per acre, and to evaluate effects of creating dead wood (snags and down wood). Density management treatments include reducing the areas with 60 trees per acre to about 17 trees per acre (relative density of 8), and reducing the areas with 100 trees per acre to about 40 trees per acre (relative density of 16) (table 2). Thinning and yarding impacts to understory components, and decay class and diameter class of dead wood would also be measured. These treatments would serve to provide additional information on how to develop or maintain structural complexity.

The design criteria apply to all activities proposed by the study. Appropriate specialists will be consulted before any design criteria for proposed activities are changed.

Forest Service direction, regulations, and standards and guides for resource protection may change over time. If changes occur prior to completion of any project actions, then the actions should be modified to reflect mandatory changes.

Criteria Common to All Actions

Proposed, Endangered, Threatened, or Sensitive Species (PETS), and Essential Fish Habitat

Fish

No adverse effects to Essential Fish Habitat (EFH) are expected, largely because of distance between activity areas and EFH, potential debris torrent deposition sites would likely be upstream of EFH, and project design criteria to protect water quality. Thus, consultation with the NOAA Fisheries is not required.

Wildlife

Design criteria for federally listed wildlife must include the most current requirements from the US Fish and Wildlife Service (FWS). These generic requirements are described in the Letter of Concurrence for habitat modification (USDI 2006; FWS Reference Number 1-7-06-I-0190), primarily on pages 11-13). These generic requirements are applied where appropriate, and are based on current information. If information is learned in the future that creates a need for more requirements, then appropriate requirements would be applied.

Appropriate requirements at this time for the STUDS project are listed below:

- To minimize the risk of attracting predators to activity areas, all garbage (especially food products) shall be contained or removed daily from the vicinity of any activity.
- Between 1 April and 15 September heavy equipment or power tool use is restricted to 2 hours after sunrise to two hours before sunset for areas within 100 yards of mature or old growth forest.
    - When the Industrial Fire Precaution Level is 2 or above, the time of day restrictions may be waived during the late breeding period (August 6 to September 15).
- Yachats 17 TPA area must operate between 6 August and 28 February, where heavy equipment or power tool use would be within 100 yards of occupied habitat. This area is in the southernmost portion of this unit.
- All other treatment areas, including those in the Cataract and Wildcat sites, can operate anytime.

Plants

Leaving 17 to 40 trees per acre and minimizing soil disturbance and compaction will maintain habitat for 10 PETS fungi species that have potential habitat in the project area.

Water Quality and Heritage Resources

Follow Siuslaw Plan standards and guides (FW-114 through FW-118) to meet water-quality standards outlined in the Clean Water Act for protecting Oregon waters, and apply practices as described in General Water Quality Best Management Practices, Pacific Northwest Region, November 1988. Design criteria, including these practices, are incorporated throughout the project, such as in project location, design, contract language, implementation, and monitoring. The State has agreed that compliance with these practices will ensure compliance with State Water Quality Standards (Forest Service Manual 1561.5, R-6 Supplement 1500-90-12).

If the total oil or oil products storage at a work site exceeds 1,320 gallons, or if a single container (e.g., fuel truck or trailer) exceeds a capacity of 660 gallons, the purchaser shall prepare and implement a Spill Prevention Control and Countermeasures (SPCC) Plan. The SPCC plan will meet applicable EPA requirements (40 CFR 112), including certification by a registered professional engineer. (SFP: FW-119, 120, 122).

The literature was searched for possible heritage resources (historical or archaeological sites) in the planning area. No known sites were identified that could be affected by this project. Should heritage resources be discovered as a result of any project activities, cease work in that area and consult with the Forest Archaeologist. Protect, preserve, and treat sites in accordance with the National Historic Preservation Act.

Criteria for Plantation Treatments and Associated Actions

Thin and Harvest Actions

Stands

Criteria common to all commercial thinning prescriptions

Minimize short-term adverse effects and maximize long-term beneficial effects to water quality, fish, and wildlife.

Retain and develop large conifer and hardwood trees, trees with large limbs and cavities, large snags (where safely feasible), down wood, and species diversity.

Create snags and down wood, as identified in the Study Plan (EA, appendix B).

Insects, disease, and wind (NFP: p. C-12, C-13)

To reduce the potential for Douglas-fir bark beetle infestations, avoid felling trees for down wood during the period from May 1 through June 15 (adult beetle flight season)

Streams and riparian vegetation

Minimize log hauling on roads during the wet-season, where such use could adversely affect water quality. This criterion is especially important for road 5491.

Maintain existing protective vegetation leave areas or buffers for streams to maintain stream temperature, maintain stream-adjacent slope stability (including headwalls), and protect riparian vegetation.

Directionally fell trees away from buffers to protect riparian vegetation from damage. Retain trees accidentally felled into buffers to minimize stream sedimentation or damage to riparian vegetation. Some trees may be removed as determined by a fish biologist or hydrologist (SFP: FW-091).

Where skyline cable yarding is planned, design logging systems to yard away from stream channels to minimize soil disturbance on stream-adjacent slopes. If this strategy is not feasible, maintain full suspension of logs over streams (SFP: FW-091, -092).

Use existing landings and corridors to minimize the need for new skyline corridors through riparian buffers. Limit skyline corridors to between 10 and 20 feet wide. Corridor width may appear wider in areas where trees adjacent to the corridor are cut to meet the silviculture prescription. Where skyline corridors pass through riparian buffers, remove no more than 20 percent of the canopy in a given 1,000-foot reach of stream (SFP: FW-091).

To ensure proper drainage and reduce potential impacts to streams, add aggregate to and/or reshape roads prior to log hauling, where needed.

To reduce sedimentation into streams from aggregate-surfaced roads, minimize blading of ditches, monitor roads during periods of heavy rain, and use straw bales to trap sediment where necessary.

Suspend log hauling when it is determined that active erosion control measures cannot prevent sediment from entering streams. Where haul is allowed during wet weather, apply mitigating actions such as requiring "constant reduced tire pressure" **(**steering axle tires at 85 psi and all other tires inflated to the tire manufacturer's recommended minimum pressure) to reduce sedimentation. Include a hydrologist in making determinations about use of straw bales and suspension of log hauling.

Domestic water sources

No known domestic water-diversion sites and equipment are located in or near the Wildcat site. Although the Oregon Water Resources Department lists a water right for domestic use and fish culture on Cataract Creek below the Cataract site, the legal location is inconsistent with Cataract Creek as the water source. If Cataract Creek were a water source, it would be at least 0.5 mile below the tributaries in the Cataract site, and design criteria preventing introduction of sediment to the stream and its tributaries, listed above, will be sufficient to protect water quality at this distance.

The four water-rights facilities, except for the one for human consumption, are from the Yachats River, well below Yachats study site. The intake structure for the remaining water right is about 200 feet below the site and located in the control portion of the site, where no activities are proposed. Design criteria preventing introduction of sediment to the stream and its tributaries, listed above, will be sufficient to protect the water quality used by these four facilities.

Soils

Outside of areas designated for full log suspension and lateral yarding, use one-end log suspension on all areas designated for cable yarding systems to reduce soil displacement and compaction (SFP: FW-107).

Roads and skyline landings

Roads

A team of appropriate resource specialists and sale administrators will review road sites before preparing road plans for timber sale contracts. This group will review any changes in road plans before incorporating them into contracts.

Limit haul on roads that access the Yachats site to the dry season. This would minimize the need for additional rock and reduce costs.

Limit to dry season, as much as possible, the use of all system and non-system roads that access the Cataract and Wildcat sites. This would minimize the need for additional rock and reduce costs. If a road is to be used during the wet season, surface with rock aggregate where needed. Surfacing depth should allow for log trucks using constant reduced tire pressures.

If rock is needed for wet sites that may be present on existing non-system roads used during the dry season, limit rock to what is needed for traction, not structural strength. For the timber sale contract, identify existing non-system roads to be used during the dry season.

To minimize sedimentation from roads, waterbar and close temporary roads between operating seasons or as soon as the need for the road ceases.

To reduce soil erosion, seed exposed soils with native, certified weed-free species (if available).

Locate and design road closure devices to ensure effectiveness and to facilitate parking for researchers.

If wet-season haul occurs, limit potential sedimentation of streams by using standard erosion control methods such as filter cloth, diverting sediment onto stable, naturally vegetated slopes, or using catch basins to allow settling out of suspended sediment. Where necessary, install culverts or create ditches to disconnect water flow in ditches from streams. Use the guidelines in the Siuslaw Road Rules (1/98) to suspend log hauling when ground conditions will result in unacceptable road or resource impacts.

Landings

Consider machine piling and burning of landing piles, especially within 25 feet of roads kept open for mixed use. The district hydrologist, fire management officer, and sale administrator will determine appropriate sites for machine piling and burning. These sites generally include roads and landings that have been rocked (SFP: FW-162).

Use existing landings. If new landings are necessary, build them in stable areas with stable cut bank slopes (SFP: FW-115, 117).

Specific criteria for the Cataract site—Two existing landings on road 2570 access the 60 TPA portion. Use only the westernmost landing to avoid yarding over a seepy area below the easternmost landing.

Build a barricade to close the road into the 30 TPA portion of the site. The closure device generally includes earthen mounds or large boulders.

Specific criterion for the Wildcat site—Yard away from the intermittent stream channel that is located between the 100 TPA and 60 TPA portions of the site.

Specific criterion for the Yachats site—Notify the water-right holder prior to felling and yarding operations.

Where water bars are temporarily removed from project-maintained roads to facilitate harvest operations, add rock if needed at these sites to maintain a hardened road surface and reduce the potential for erosion.

Replace water bars and close project-maintained roads when the project is completed. Follow the Water Bar Placement Guide for Siuslaw Forest Roads.

Locate road drainage (cross drains) in areas that will not discharge over unstable slopes. If unstable roads are to be used, stabilize them prior to their use.

Roadside danger trees

Identify dangerous trees, using the *Field Guide for Danger Tree Identification and Response* (USDA, USDI, et al. 2005).

Evaluate dangerous trees by including a road manager, a wildlife biologist, and a silviculturist (or another person trained in danger-tree identification) along timber-sale haul routes. These specialists will determine which trees, snags, or both need to be felled or topped to eliminate roadside hazards.

Priority for felled danger trees: 1) leave trees on site to meet down wood requirements, 2) store trees (logs) for later fish structure use, 3) remove trees through timber-sale contracts, 4) remove trees through firewood permits, or 5) remove trees through service contracts.

Post-Harvest Mitigation Actions

These treatments focus on incorporating management elements for dead wood (snags and down wood), noxious and undesirable weeds, and fire and fuels.

Dead wood creation (Refer to the Study Plan, Appendix B, for site-specific dead wood requirements)

Create dead wood (snags and down wood) in plantations by topping or girdling after the second entry.

Silvicultural prescriptions for plantations will ensure that dead wood will persist in all areas. Retain existing down wood in un-thinned areas and snags and down in un-thinned areas.

Consider creating snags and down wood in areas that enhance development of large trees and large limbs, including conifer and hardwoods.

Creating snags in plantations
Create 4 snags per acre—3 with a minimum of 10 inches DBH and one with a minimum of 20 inches DBH after the second entry.

Do not create snags where they appear likely to fall over or slide onto roads, to avoid increasing hazardous conditions in the range of the roadway and theft of snag material for firewood.

Do not create snags from trees that appear to contain stick nests, such as those used by red tree vole or raptors.

Defer creating snags in harvested units until three years after harvest to allow for canopy recovery, where needed, and to allow for blow-down. At that time, monitor the canopy cover before the trees are killed to ensure canopy cover remains at or above 40 percent in all units.

Creating down wood in plantations
From the overstory cohort, create down wood to comprise about 2% of the target cover.

Defer creating down wood in harvested units until three years after harvest to allow for canopy recovery, where needed, and to allow for blow-down. At that time, monitor the canopy cover before the trees are felled, and monitor the contributions from blow-down.

Refer to the Study Plan for site-specific down wood requirements.

Invasive plant prevention and mitigation

Follow the *Pacific Northwest Region Invasive Plant Program, Preventing and Managing Invasive Plants Final Environmental Impact Statement* (ROD, Oct. 11, 2005).

The project area has existing populations of noxious weeds, primarily along roads. Implementing this study will increase the potential for spreading existing populations and for introducing new infestations. Existing populations and any new infestations detected will be treated with mechanical, manual, and biological control methods.

To reduce the potential for the spread of noxious and undesirable weeds, maintain canopy cover to the extent possible when reopening roads or stabilizing and closing them. Seed disturbed sites lacking canopy cover (landings, roads, and road barricades) with available native, certified weed-free grass and forb species.

To reduce the potential for spread of noxious and undesirable weeds, all heavy equipment (including dump trucks, excluding log trucks) shall be clean and free of soil, vegetative matter, or other debris that may contain or hold weed seeds prior to entering National Forest System lands (WO-C/CT 6.36).

To prevent the spread of noxious and undesirable weeds from and between high weed risk stands and worksites, clean all heavy equipment (including dump trucks, excluding log trucks) used in high weed risk units and worksites prior to going to another project site or prior to leaving the work site. Use compressed air, high-pressure water, or other specified cleaning method to assure equipment is free of soil, vegetative matter, or other material that could contain or hold weed seeds. Prohibit the use of chemicals such as solvents and detergents to clean equipment on National Forest System lands. The Forest Service will specify cleaning areas, either on site or at a facility with a catch basin. Refer to the project file for a list of high-risk areas.

Develop noxious and undesirable weed treatment prescriptions for high weed risk project sites and their adjacent areas and control weeds as necessary prior to beginning study operations.

To reduce the risk of spreading noxious and undesirable weed infestations, begin study operations in un-infested areas before operating in weed-infested areas.

Locate and use weed-free staging areas. Avoid or minimize all types of travel through weed-infested areas or restrict those periods when spread of seed or propagules are least likely.

Inspect and document all limited term ground-disturbing operations in noxious weed infested areas for at least three (3) growing seasons following completion of the project. Provide for follow-up treatments, based on inspection results.

Inspect material sources (e.g., rock or soil borrow sites) on site and ensure that they are weed-free before use and transport. Treat weed-infested sources for eradication and strip and stockpile contaminated material before any use of pit material.

Fire and fuel management

Follow the Fire Management Plan for LSR RO267 for all wildfire suppression or pre-suppression prevention programs. For burning landing slash and hand piles, prepare a burn plan that meets all the parameters identified in FSM 5150. Register all material to be burnt through the Forest fuels planner and enter into the FASTRACS program. Allow 5 to 7 days to complete this process that must be done prior to burning. Conduct all burning according to the guidelines of the Oregon Smoke Management Plan and the Department of Environmental Quality’s Air Quality and Visibility Protection Plan.

Design fuel treatment activities to meet Aquatic Conservation Strategy objectives and to minimize disturbance to riparian vegetation. Refer to the Northwest Forest Plan (FM-1, 3, 4, 5; pp. C-35, 36) for additional information.

Where fuel borders forest roads maintained open for general use, provide fuel breaks to reduce the risk of human-caused fire. Measure fuel breaks from the edge of the road into the thinned units. Roads will require a minimum 25-foot fuel break for each side of the road bordered by fuel. High cut banks (with no slash) can be considered adequate fuel breaks. About 1.7 acres may be treated.

Burn or scatter landing slash within 25 feet of open-system roads. Follow-up burning with native, certified weed-free seeding if landing is larger than 1/5 acre (about 95’ X 95’) and has a native (non-rock) surface.

After harvest operations are completed on any given unit, conduct fuel treatments, where necessary, adjacent to roads as soon as practical to minimize exposure to fire hazards.

To reduce the potential for wildfire, do not fell trees for down wood in designated fuel breaks unless the tops are kept outside of the breaks. Designated fuel breaks need to be identified in the timber-sale contract or on implementation plan maps.

Study Plan Response Variables and Associated Sampling Units

The Study Plan (EA, appendix B, table 1) includes the response variables that will be measured and the associated sampling units. The response variables include overstory trees and snags, saplings, tree seedlings, shrubs, forbs and grasses, down wood, and substrate.

Implementation and Effectiveness Monitoring

Monitoring items include those required for implementation and effectiveness monitoring. Implementation monitoring determines if the project design criteria and Siuslaw Forest Plan standards and guides, as amended by the Northwest Forest Plan (NF Plan), were followed. For this study, removing trees larger than 20 inches DBH was determined by the REO as being consistent with the NF Plan (USDA, USDI 2006b). Effectiveness monitoring evaluates whether applying the management activities achieved the desired goals, and if the objectives of the standards and guides were met. Findings resulting from the Study and other project observations and monitoring are expected to help influence designing future projects and developing future monitoring plans.

Implementation Monitoring

Forest Plan Standards and Guides

Before the contract is advertised, review project contracts for consistency with the standards and guides of the Northwest and Siuslaw Plans, and project design criteria.

Contract and Operations

Involve appropriate specialists when developing timber sale contracts or conducting District operations work to ensure activities are implemented as designed. The appropriate specialists will also participate periodically during contract work, especially when unusual circumstances arise that may require a contract modification.

Key checkpoints include a plan-in-hand review, and a contract review of specifications before the next phase of work begins (to ensure key problem situations are addressed in the specifications).

During thinning operations, monitor to ensure Study Plan objectives, such as desired residual tree stocking, are being met.

Effectiveness Monitoring

The appropriate specialists will be involved in the various monitoring tasks identified below.

Threatened and Endangered Species

Implementation and monitoring forms need to be completed and submitted with a cover letter from the Forest Supervisor to formally verify all adverse effects to listed species have been reported. These reports are to be submitted yearly by November 3.

Vegetation Management

Monitor thinning effectiveness in achieving Study Plan objectives, such as the desired leave tree stocking.

Evaluate stands for existing snags and down wood within 3 years after the thinning treatment. Modify snag and down wood creation numbers, if necessary, to meet the snag and down wood objectives identified in the Study Plan.

Evaluate riparian leave areas as to their effectiveness in maintaining stream shading.

For a period of three years after project activities are completed, monitor project sites with a high risk of noxious weed infestation. Conduct monitoring annually and focus on effectiveness of noxoius weed control measures as well as detection of new infestations. Refer to the Botanist Report for specific treatment areas and prescriptions.

Wildlife Habitat Treatments

Sample treated areas to quantify cavity nester use of created snags. Stands should be sampled at approximately 1, 3, 5 and 10 years after harvest for evidence of both cavity nesting and foraging.

Road Treatments

Observe road surface treatments such as water bars to determine effectiveness and effects on the stability of the outer portion of the road prism.

Mitigation and Enhancement Actions

Table A-1 summarizes mitigation and enhancement actions associated with Alternative 2 and includes estimated costs. The table lists the actions in order of priority. Those not identified as mitigation are considered enhancement actions.

Table A-1. Alternative 2 mitigation and enhancement actions cost summary

Prioritized action	Mitigation	Unit of measure	Unit number	Cost per unit	Total cost
Control noxious weeds	Yes	Acres	5	$200	$1,000
Monitor noxious weeds	Yes	Acres	60	$10	$600
Create snags by removing tops of trees in plantations	Yes	Trees	204	$60	$12,240
Create down wood in plantations[c]	Yes	Trees	153	$10	$1,530
Monitor snags, down wood, and grass, forb and shrub habitat	No	Units	51	$70	$3,570
Total					**$18,940**

Note: Fuel treatment costs are accounted for in the timber-sale appraisal as “BD” (brush disposal) costs.

Appendix B1

Siuslaw Thinning and Underplanting for Diversity Study
Snag and Down Wood Prescription

<u>Background</u>

The Siuslaw Thinning and Underplanting for Diversity Study was undertaken to evaluate alternative silvicultural prescriptions for enhancing development of structural heterogeneity in young (30-35 year-old) Douglas-fir dominated plantation forests in the western hemlock/Douglas-fir region of the west-side Oregon Coast Range. This forest type is widely represented, occurring on several hundred thousand acres. Stands are typically simple in structure, often with low abundance of late-seral legacy features such as snags or large down wood considered important to wildlife habitat and other ecological functions.

Two silvicultural treatments, overstory thinning and underplanting, were implemented in 1992-93 for evaluation. Thinning was implemented at four initial intensities defined by residual density of overstory stems (thinned to 30, 60 or 100 stems per, or unthinned leaving approximately 200-220 stems per acre). Two types of planting assessments were undertaken, one to evaluate the potential contribution of underplanting to development of a second cohort of trees, and the second to evaluate species suitability for underplanting. In the first situation, 1-ac subplots within each thinned and unthinned treatment unit were planted with a mix of conifer seedlings or left unplanted. In the second underplanting test, small, dense plots of mixed conifer and mixed hardwood species were planted to document species variation in establishment and persistence under overstory canopies.

<u>Purpose of Snag and Down Wood Study Component</u>

Consideration of snags and down wood is being undertaken with the planned second thinning entry to these experimental treatment units. The intent is two-fold:

1) Provide a limited abundance of snags and down wood to serve near-term habitat and other ecological functions in these stands
2) Monitor snag and down wood recruitment as developmental responses of the stands to the experimental treatments

<u>Premise</u>

This prescription is based on the following operating assumptions:

- *Stands currently have very few large living trees – QMD < 20-25 in*
- *Treated stands have very few dead trees – first entry, thin from below, removed most suppressed stems – subsequent density dependent mortality at very low rate*
- *Stands have little large diameter down wood coverage*
- *Range of variability in snag and down wood abundance for young, unharvested, stands in the western Coast Range is high – substantial proportion of plot-sized areas in the landscape occupied by such stands do not have either snags or measureable levels of coarse down wood*
- *Lower levels of the ranges in variation for snag and down wood abundance in unharvested stands are reasonable initial targets for managed stands with small diameter trees, none-to-little snag and down wood abundance, and having little potential for density-dependent mortality in the next 20-30 years*
- *Some wood, even small diameter snag or down wood, provides habitat benefits; large diameter snag and down wood provides greater benefits*

- *Passive accrual of snags and down wood can be supplemented through active stand manipulation as deemed appropriate*

Application of DecAid in Setting Initial Target Levels

The Decayed Wood Advisor (DecAID) is an information tool developed by USFS and USFWS researchers to assist managers and planners in assessing down wood and snags (Mellen et al. 2002). It consists of three primary components: quantitative descriptions of snag and down wood abundance by size or condition class in the form of statistical summaries (frequency distributions); quantitative summaries of snag and down wood use by animal species and groups (cumulative species curves), and expert knowledge and interpretation for management application. It is applicable to forest lands of Oregon and Washington coarsely stratified by habitat type (approximate analogy to vegetation zones of Franklin and Dyrness (1972)) and seral condition (open canopy, large trees, small/moderate trees). The data is drawn primarily from three sets of vegetation inventory plots – FIA, CVS, and NRI. Additional data from research plots has been included when available (Ohmann and Waddell 2002). Data are summarized across all plots and for the subset of unharvested plots (plots for which no evidence of harvest exists). The statistical summaries typically indicate the percent of forest area having a particular snag or down wood characteristic. Thus, the summaries provide an indication of the relative likelihood for forest stands of a given habitat type and seral stage to have specified levels of down wood or snags. Tolerance levels of 30%, 50% and 80% describing low, middle and upper levels of the frequency distributions are provided for each snag and down wood attribute for each habitat type and seral condition. It is very important to recognize that the DecAID tool provides coarse-grained descriptive information and interpretative information. DecAID is not a predictive model. It does not produce deterministic or stochastic estimates of down wood or snags for specific stand or site conditions. Furthermore, DecAID does not directly address dynamics of recruitment or decay condition.

Snag and Coarse Down Wood Targets

In this prescription, DecAID is used to identify reasonable targets for the abundance of snags (density) and down wood (percent cover) immediately following the second thinning entry (age 45-48) and for a possible third entry prior to age 80 (around age 66-69). Specifically the target abundance of down wood and snags is set to at least equal that of the 20th percentile of unharvested stands of the corresponding habitat type and seral stage. While not maximizing potential snag and down wood creation – it is the intent of this prescription to provide reasonable assurance that these specific stands will provide habitat in the near-term, while the stands develop trees of larger size and longer-term habitat value; and to avoid compromising the primary objectives of the study which are focused on stand development and increased diversity through the recruitment of midstory and understory vegetation strata.

An initial, year-15 target for snag density is based on the DecAid small/medium tree structural class. This class is defined as having greater than 10% stocking and QMD of 10-19 inches. In the western lowland conifer-hardwood ecoregion, 21% of unharvested forest area in the small/medium tree class has no snags greater than 10 inches dbh while 40% of the surveyed area has 0-4.5 10-inch snags per acre. Large snags are less common as 29 percent of these areas have 0 snags greater than 20 inches dbh and 29 percent have 0-2 large snags per acre. In this study, we will target 4 snags per acre following the second thinning entry – 3 snags with a minimum 10 inch diameter and one snag with a minimum 20 inch diameter (Table 1).

Mortality in the study units has been summarized from observational data collected through 8-years post initial thinning, and projected through 36 years-post initial thinning using the FVS simulation model. Estimates of mortality following the first entry through 15 years post-entry average 3, 2 and <1 stem per acre for the 100 tpa, 60 tpa, and 30 tpa treatments. These low rates of mortality reflect the virtual elimination of density-dependent mortality as a result of the initial thinning. Projected mortality from year 15 through year 36 is 2, 1 and 2 stems for the respective high, moderate, and low residual density treatments. These are annual mortality rates ranging from 0.2% to 0.4% which are substantially lower than the 1% - 2% annual mortality commonly observed in other Pacific Northwest forest studies as summarized in Greene et al. (1992).

Table 1. Live tree density, quadratic mean diameter and target snag density for overstory and planted conifer cohorts, by study treatment, immediately following the second phase of thinning treatments and at stand age 66-69.

Study Year (years post treatment)	Stand Age (yr)	Stand Cohort	High Density			Moderate Density			Low Density		
			Live Tree Density (tpa)	QMD (in)	Snag Density Target (tpa)	Live Tree Density (tpa)	QMD (in)	Snag Density Target (tpa)	Live Tree Density (tpa)	QMD (in)	Snag Density Target (tpa)
15	45-48	Over	36.0	21.2	1 > 20 in 3 > 10 in	15.1	22.9	1 > 20 in 3 > 10 in	27.1	20.5	1 > 20 in 3 > 10 in
		Under	144.4	3.7	0	171.7	6.4	0	177.0	8.5	0
36	66-69	Over	33.9	28.9	2 > 20 in	14.4	31.4	2 > 20 in	24.8	28.6	2 > 20 in
		Under	128.9	7.2	5 > 10 in	153.9	12.4	5 > 10 in	150.2	13.9	5 > 10 in

While the observed and projected mortality rates are low for the treated stands, if the projections are accurate, mortality should suffice for creation of the target large-snag densities for year-36 (Table 1). By age 66-69 years, the projected QMD of residual overstory trees will move the stands to the DecAid large tree structural class. For unharvested forests in this structural class, 21% of the area have 0-6 snags greater than 10 inches dbh and 38% of the area have 0-4 snags greater than 20 inches dbh. Our target for year 36 in the treatment units is to provide a minimum of 2 snags per acre of 20 inch or greater dbh and a minimum of 4 snags per acre of 10 inch or greater dbh (Table 1). It is anticipated that the large diameter snags will be derived from the residual overstory. Given projected recruitment and growth rates, it is possible that the small diameter snags will be generated from the planted conifer understory – most likely through active snag creation as it will be the more vigorous individuals of this cohort that meet the minimum 10 inch dbh criteria.

Coarse down wood cover in small/medium structural class, unharvested forests of the western Oregon lowland conifer hardwood ecoregion ranges from 0.4 to 15.8 percent in the DecAid database. Nearly 30% of the unharvested forest area in this class has 2 percent or less cover by down wood greater than 5 inches diameter. Nearly fifty percent of the area in this class has less than 2 percent cover by 20 inch diameter down wood. At year 15, the QMD of the treated stands is projected to be 20-23 inches depending on treatment. Individual Douglas-fir of such dimension provide about 0.25% cover each if felled and left to lie; a 10 inch dbh tree provides about 0.7% cover. Because of the number of stems required to create cover at this stage of stand development would be large, we are setting a conservative down wood cover target of 1% to be derived from the overstory cohort (Table 2).

At year-36, when the stands are projected to have reached the large tree structural class, we anticipate increasing the down wood cover target to 3 percent (Table 2). This coverage will be achieved through mortality, retention of down wood created at year-15 and through active recruitment of down wood; roughly equal coverage from large residual overstory trees and smaller second cohort trees. In the DecAid database, of the unharvested forest area in the large structural class, approximately 21% of the area has 2% or less CWD greater than 5 inches diameter, and 43% has less than 4%. In the large structural class forests, 25% of the area has no CWD greater than 20 inches diameter and 29 % of the area has 2% or less.

Table 2. Live tree density, quadratic mean diameter and target coarse down wood cover for overstory and planted conifer cohorts, by study treatment, immediately following the second phase of thinning treatments and at stand age 66-69.

Study Year (years post treatment)	Stand Age (yr)	Stand Cohort	High Density			Moderate Density			Low Density		
			Live Tree Density (tpa)	QMD (in)	CDW Target (%)	Live Tree Density (tpa)	QMD (in)	CDW Target (%)	Live Tree Density (tpa)	QMD (in)	CDW Target (%))
15	45-48	Over	36.0	21.2	2 > 5 in	15.1	22.9	2 > 5 in	27.1	20.5	2 > 5 in
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Estimates of wildlife benefit, derived from cumulative species curves in DecAID, are summarized with respect to the snag and coarse down wood prescriptions in Table 3. The table states that for those species or species groups observed, at least 30% of the observations were associated with woody structure of the prescribed size or abundance. From a wildlife perspective, the prescribed targets provide minimal habitat enhancement for the near-term, but substantially increase habitat quality in over the subsequent 20 years. There is a large habitat quality response to incremental increases in CWD. However at year-15, given the 20-23 inch QMD, the number of residual stems required to create a 1-percent increase in CWD is large relative to the residual stand densities. For active creation of CWD, it is reasonable to wait until the overstory trees are larger and the second cohort of planted conifers attain a size where they can contribute to coarse wood production and they are of a density that requires thinning.

It must be remembered that the actual habitat quality provided by the stands in this study will be influenced by any previously undocumented legacy structure or natural mortality and recruitment. The targets constitute minimum levels to be actively met if the desired conditions are not present at the time of assessment. If the desired woody material is created incidentally through thinning activities and stand developmental processes, then active snag and CWD creation will not be undertaken.

Table 3. Number of wildlife species or species groups with at least 30% likelihood of benefiting from the prescribed snag and coarse down wood target abundances.

Study Year (Years Post Initiation)	Stand Age (yr)	Habitat Feature	Target	Number of Benefiting Species/Species Groups
15	45-48	Snags	4 tpa	2 of 4
		CWD	1%	1 of 23
36	66-69	Snags	7 tpa	4 of 4
		CWD	3%	21 of 23

Methods

Prior to a second thinning entry in 2007/2008, snag and down wood abundance and composition will be inventoried. Snag and down wood enumeration will be made at the treatment level, thus requiring sample plots in addition to those currently installed within the two 1-ac sample plots per treatment unit. A set of 0.1-ac plots will be established at random locations at the density of one plot per acre in each treatment unit. All snags (standing dead trees > 3.9 inches DBH) within each 0.1-ac plot will be tallied by species, diameter breast height, height, and decay class. Two perpendicular transects, oriented along cardinal directions, bisecting each 0.1-ac plot will be established. Percent cover by coarse down wood will be estimated based on tallies of coarse wood pieces (>3.9 inches diameter at point of intersection, 12 inch minimum length) intersecting transects. The species, when possible, and decay class of each tallied piece will be recorded. Percent cover by coarse down wood will be calculated using algorithms defined for line-intercept sampling of logging residue (Howard and Ward 1972).

Pre-treatment snag densities and coarse wood cover will be compared to the target levels. If the target cover of down wood and snags exist, there will be no special treatment other than implementation of logging practices to retain these features. If there is a shortage of coarse down wood, then during the thinning operation an appropriate number of felled trees will be left to lie on site. These coarse wood trees will be selected so as to be dispersed across the unit. If snag densities are less than the target value, additional trees in numbers equal to the shortfall, will be retained in the residual stand to provide future snag input. The stand will be monitored for five years following the thinning entry. If the desired snags have not formed in that period, active snag creation will be undertaken to meet the target.

Monitoring of the abundance and condition of snags and coarse down wood will continue through the life of the study. Timing of repeated sampling will correspond with monitoring overstory and understory vegetation. Inventories will occur one-year prior to any harvest activity, the year immediately following harvest, at two year intervals through five years post-harvest, and at 5 year intervals thereafter. While it is not the current intent of the study to monitor wildlife responses to the treatments, should someone demonstrate an interest in monitoring snag and coarse down wood use as habitat, we would cooperate to facilitate such activity where it does not compromise the primary objectives of the study.

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Siuslaw Thinning and Underplanting for Diversity Study:
Phase II Study Plan

Siuslaw Thinning and Underplanting for Diversity Study: Phase II Proposal

Study Overview

Problem Statement

Since the 1960's harvest activities in the Oregon Coast Range have resulted in conversion of hundreds of thousands of acres of natural forest to young Douglas-fir plantations. The consequences of timber oriented plantation management for forest health and long-term ecosystem productivity have been a focus of concern for the past two decades. In particular, concerns exist over the harvest of old-growth forest and replacement with structurally less complex even-aged plantations. Such conversion is considered by many as being a threat to habitat quality and biological diversity indicative of ecosystem integrity. The 1991 listing of the northern spotted owl as an endangered species and the subsequent 1994 adoption of the Northwest Forest Plan restricting harvest of larger trees from Pacific Northwest coastal forests generated sufficient interest to research and develop alternative, ecologically-based silvicultural systems for enhancing structural development in young stands.

Forest ecologists and wildlife biologists have begun to recognize and understand the relationships of stand structure and landscape patterns to forest ecosystem functions (Swanson and Franklin 1992). Although specific stand structure needs are still unknown for many species, structural features resembling old growth have been suggested as necessary to a wide variety of plant and animal taxa. There exists a body of pre-Northwest Forest Plan research that suggests that young stands can be manipulated to provide some of these old growth habitat characteristics in a relatively short time frame (Marshall et al. 1984, Newton & Cole 1987, O'Hara 1990). Typically this involves thinning young stands to relatively low densities to stimulate the growth of dominant trees and to facilitate development of the understory. While the concept of thinning to enhance structural diversity has gained relatively wide acceptance, there remains a lack of stand dynamics data to project stand development of thinned stands over time (Harrington 1990) or broader sets of data verifying that thinning can initiate and sustain increased understory development and associated habitats and ecological processes.

The structural characteristics of forest stands can vary widely among stands of a given age. Stand basal area, density, canopy cover, species composition and crown class distribution can differ vastly among stands established at the same time. Through silvicultural manipulation nearly all of these stand structure characteristics can be modified with relative rapidity if the stand is established but still at a young age. This situation is of particular importance in wildlife management and the conservation biology of endangered species because attributes of stand structure determine a stand's suitability as wildlife habitat. Stands of the same stand density may have very different canopy and microsite characteristics.

The Siuslaw Thinning and Underplanting for Diversity Study (STUDS) was undertaken to form the scientific basis needed to demonstrate that stands can be partially harvested and managed to create habitat for old-growth or late-successional dependent wildlife species. The study will provide basic information on overstory and understory vegetation dynamics and microsite for any landowner who wishes to manage stands with increased structural diversity on a long rotation basis. It is intended to provide forest managers with information that will enable them to effectively employ an ecosystem approach to management focused on sustaining processes that restore and maintain diverse, healthy, and productive forest ecosystems.

Objectives

The overarching goals of this study are to demonstrate silvicultural methods to increase structural diversity in young, dense, even-age Douglas-fir stands of high site index in the Oregon Coast Range, and to characterize the effects of structural manipulation on stand development, biodiversity and productivity.

With respect to these overarching goals, the study addresses the following objectives, listed in descending order of priority:

1) Determine the efficacy of underplanting as a means for establishing a multi-cohort stand structure and vertical connectivity between the understory and forest canopy;

2) To characterize the temporal dynamics of stand growth and yield, and canopy structure under alternative thinning regimes; and

3) Assess the influences of alternative stand structures on understory microsites and the development of understory plant communities.

To date, the primary study objectives have been addressed through a single, initial thinning entry followed by monitoring over an eight-year period (Phase I). The initial treatment application has resulted in stands varying in development of understory plant communities and vertical structure. Within the context of the long-term objectives, it is our purpose in this plan for continued research to evaluate the outcomes of the first entry and to prescribe and implement follow-up density management treatments as deemed necessary to develop or maintain structural complexity. We refer to this proposed second entry and associated response monitoring and analysis as 'Phase II'.

The near-term objectives for Phase II of this study are to 1) measure and evaluate the current (14-15 years post initial treatment) stand and microsite conditions; to 2) implement density management prescriptions to maintain or enhance the development of structural heterogeneity initiated in the first thinnings, and to 3) monitor and evaluate the subsequent response relationships between structural manipulations of the overstory and stand growth and productivity, canopy structure and understory vegetation dynamics for a period of 20 to 30 years.

Methodology – Phase I Treatment Implementation and Monitoring

The Siuslaw Thinning and Underplanting for Diversity Study (STUDS) was implemented as an operational-scale silviculture experiment at three sites (Cataract, Mapleton RD; Yachats, Waldport RD; and Wildcat, Hebo RD) in the Oregon Coast Range. At each site 30- to 35-year-old Douglas-fir plantations were delineated into four experimental units that ranged in size from 7 to 10 acres. Three units per site were thinned to residual densities of 120 trees per acre (TPA), 60 TPA, or 30 TPA, and the fourth was left unthinned having approximately 225 TPA (Figure 1). The thinnings, conducted in 1992 (Cataract) and 1993 (Yachats and Wildcat) were from below, removing predominantly trees occupying suppressed or intermediate crown positions within the overstory canopy.

Nested within the overstory treatment units were two underplanting experiments: a regeneration trial and a species trial (Figure 1). The regeneration trial consisted of a comparison of regeneration between underplanted and unplanted 1-ac subplots within each overstory treatment. Douglas-fir and western hemlock seedlings were planted in alternate rows at 15 ft x 15 ft spacing (194 tpa) in the underplanted subplot. The abundance and growth of planted and natural regeneration were monitored in both the underplanted and unplanted sub-plots. The species trial consisted of planting seedlings of six conifer species, Douglas-fir, grand fir, western hemlock, western redcedar, Sitka spruce, and pacific yew, and two broadleaf species, red alder and bigleaf maple. The conifers were planted as 4-seedling species clusters at 5 ft x 5 ft spacing (1742 tpa). A 6 x 13 grid of species clusters provided 52 seedlings of each species for each treatment and site for survival and growth assessment. The deciduous species were planted at 8 ft x 8 ft spacing (680 tpa) in blocks consisting of 48 seedlings. Each block consisted of six 16-seedling rows, with species alternating between rows for a total of 64 seedlings per treatment and site. The species trial plantings were monitored through 8-years post overstory thinning for survival and growth performance (stem diameter, height, height:diameter ratio).

Overstory structure and stand development were evaluated in the two 1.0-ac subplots per overstory treatment unit. In each subplot breast height diameter was monitored for all trees while total height and height to base of live crown were monitored on a subset of 40 trees.

Understory vegetation abundance and composition, natural tree regeneration, and understory light conditions were monitored on a grid of 16 subplots within each 1.0 ac subplot (Figure 2). Nested circular plots were used in quantifying composition and percent cover by shrub, forb, and fern taxa. Hemispherical photography was used to quantify percent visible skylight. Microclimate at 1-m height above was characterized using point-in-time surveys of air temperature, relative humidity, photosynthetically active radiation, and net solar radiation.

Data were analyzed according to a split plot treatment structure within a randomized complete block design with sites considered blocks. Repeated measures analysis of variance was the predominant analytical model used providing tests of treatment effects as discerned from measurements made pre-treatment and at various intervals (depending on response variable) between 1 and 8 years following overstory thinning.

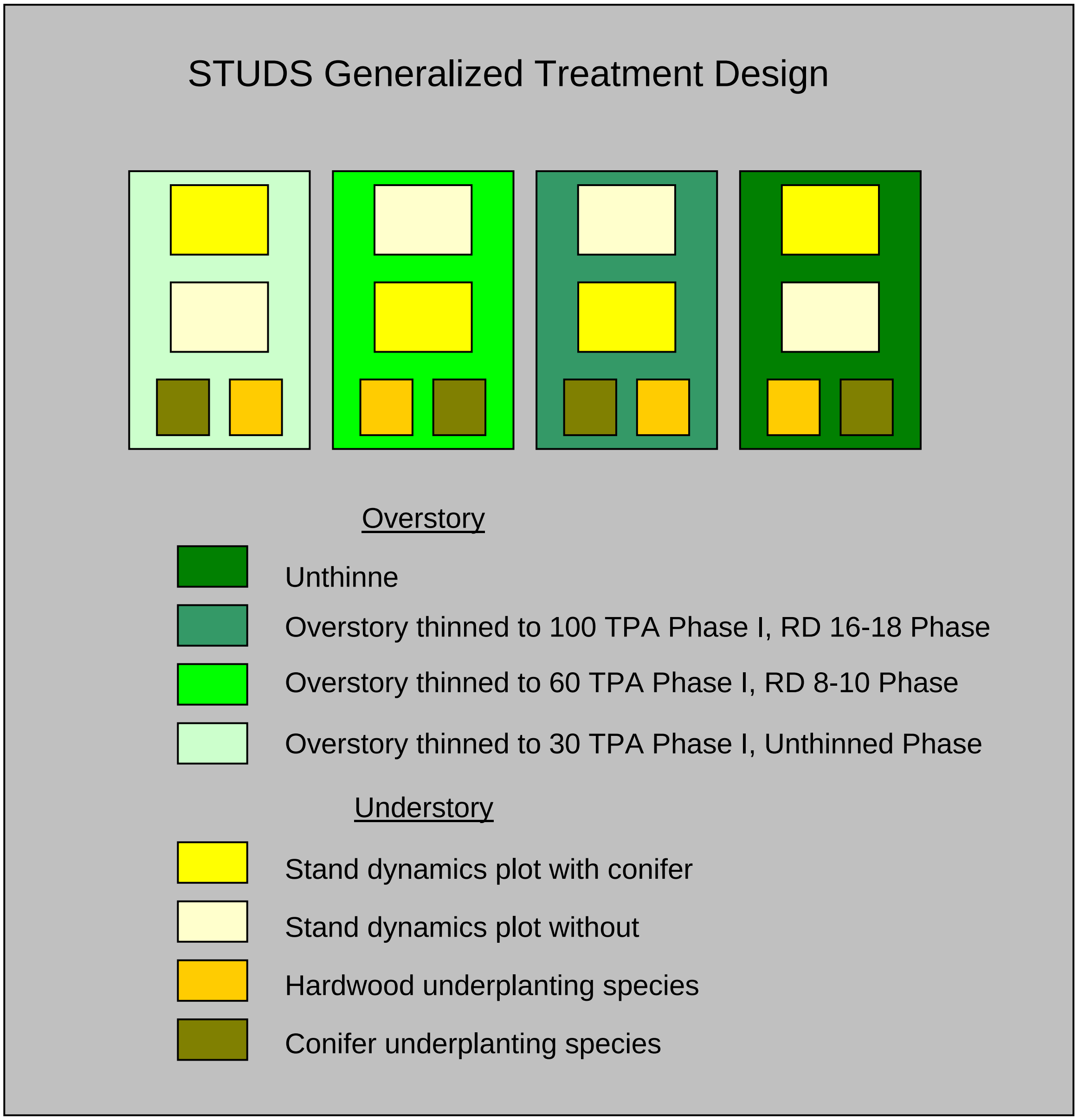

Figure 1. Schematic representation of the overstory and understory treatments implemented at each of three sites for the Siuslaw Thinning and Underplanting for Diversity Study. Overstory treatment units range from 7 to 10 ac. Stand dynamics plots are 1 ac. Underplanting species trial plots are 0.1 ac (hardwood) and 0.2 ac (conifer).

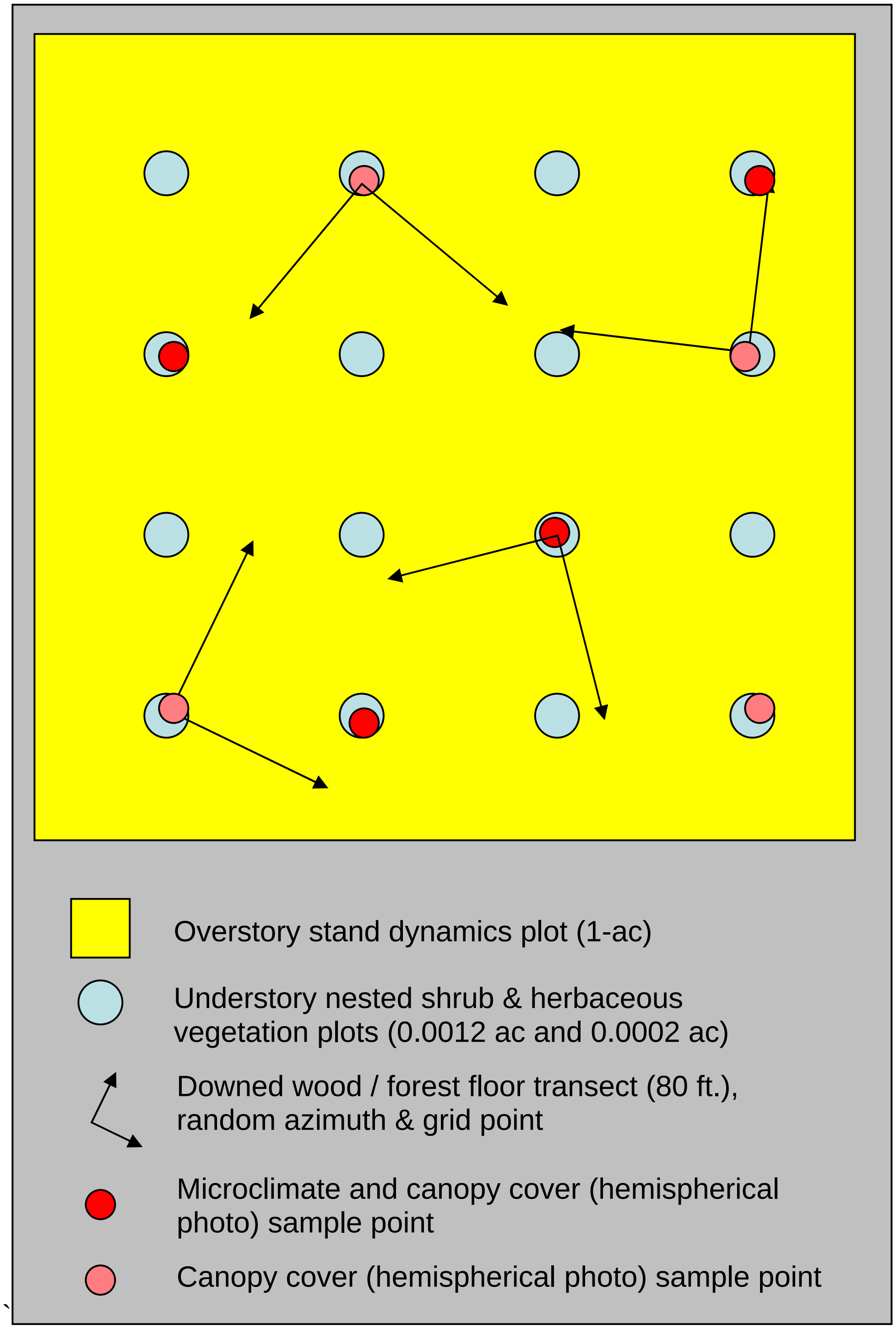

Figure 2. Schematic representation of nested sampling design for overstory and understory vegetation, downed wood, microclimate and canopy cover. This sampling design is implemented in both underplanted and unplanted measurement plots for each overstory treatment unit at each site.

Results from Phase I

Stand Development

Prior to the initial Phase I thinning, stand conditions were relatively uniform across treatments with density ranging from 223 to 277 TPA, basal area ranging from 187 to 205 $ft^2\ ac^{-1}$, and relative densities ranging from 53 to 59. The thinning treatments decreased basal areas by 0, 51, 67, and 84 percent for the unthinned, high residual density, moderate residual density, and low residual density treatments, respectively. The resulting relative densities were 53, 27, 16 and 8, respectively (Chan et al.).

In the eight years following the Phase I treatment implementation, stand densities continued to decline as a result of various mortality agents including a limited amount of windthrow (Chan et al.). Mortality ranged from 3.9 percent in the high residual density treatment to 9.6 percent in the unthinned stands, with the greatest percentage decline occurring within four years of treatment.

Regardless of post-treatment mortality, all stands grew following treatment as basal area increase ranged among treatments from 14 percent in unthinned stands to 43 percent in heavily thinned stands (Chan et al.). These increases in basal area corresponded to increases in relative density (RD) ranging from 8 percent in unthinned stands to 38 percent in heavily thinned stands, with the greatest percent change occurring between the 4th and 8th years post-treatment. Differences in stand structure among treatments remained visually apparent through 10 years post treatment (Figure 3). Individual tree growth varied significantly following Phase I treatment (Chan et al.). On average, mean tree diameters were nearly 2.6 inches greater in thinned stands relative to unthinned stands after eight years. Tree diameters in moderately and heavily thinned stands were approximately 1.2 inches greater than those in lightly thinned stands. Live crown ratios of trees in unthinned stands were approximately 13 percent less than those of thinned stands indicating crown recession in the absence of thinning. There were no effects of thinning treatment on mean tree height as trees grew from approximately 82 ft to 97 ft average height.

Canopy Cover/Understory Light

Post-thinning percent visible skylight ranged approximately from 2 percent in unthinned stands to 48 percent in heavily thinned stands. Over the subsequent eight years percent visible skylight in thinned stands decreased approximately 3.5 to 5 percent, mostly after the 3rd year post treatment. By the 8th year, understory light levels in the lightly thinned stands had diminished to pre-thinning levels. The relationship between percent visible skylight and basal area was non-linear with light levels decreasing asymptotically with increasing stand basal area. Overall there was a relatively rapid decline in percent visible light relative to immediate post-treatment values. In contrast, percent visible light in the unthinned stands increased about 2 percent over 8 years, even with increasing basal area as tree crowns continued to recede resulting in thinner canopies and lower leaf area densities.

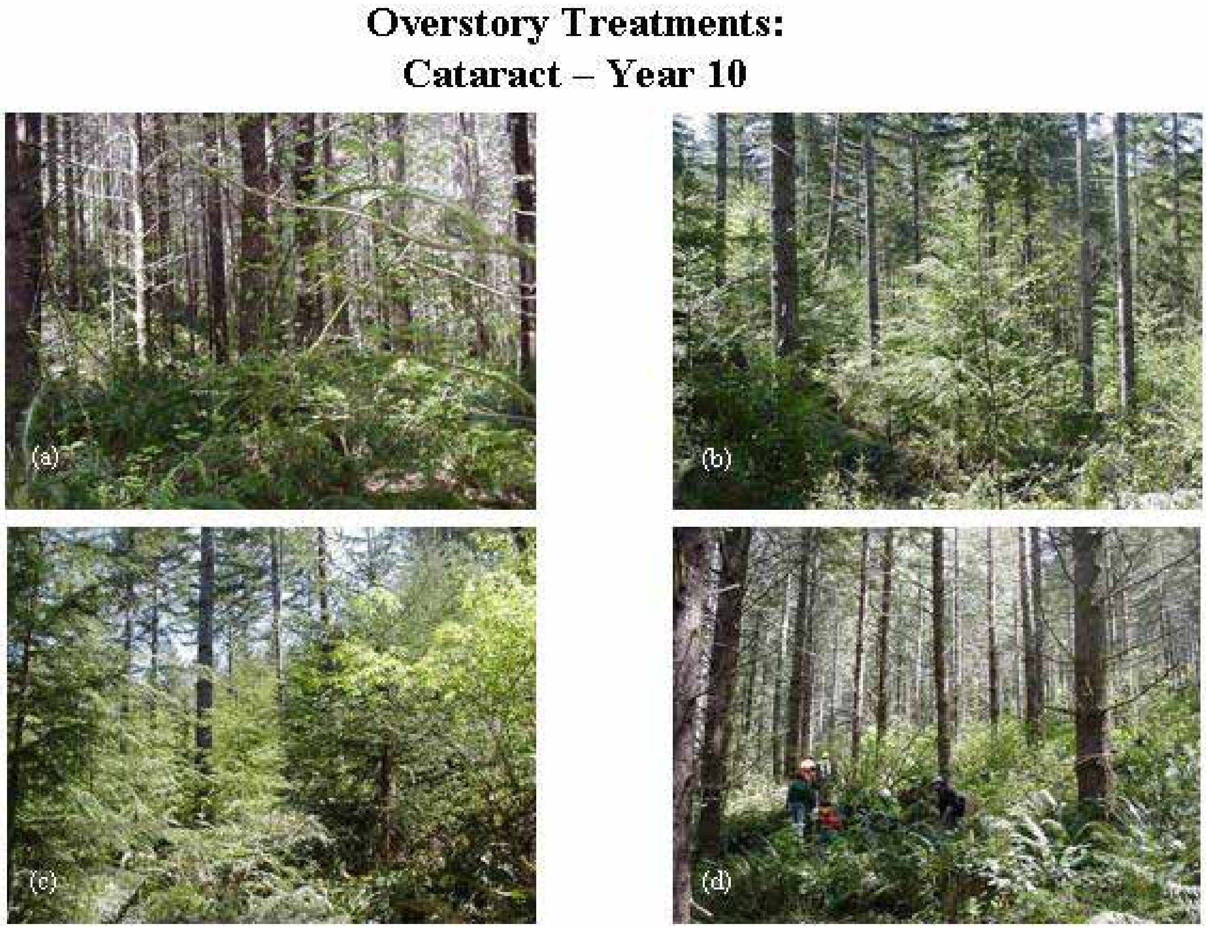

Figure 1. Stand structure 10 years following treatment at the Cataract site; (a) unthinned control, (b) 30 tpa, (c) 60 tpa , and (d) 120 tpa thinning.

Tree Regeneration

a) Regeneration Trial

Growth and development responses of planted Douglas-fir and western hemlock seedlings to the overstory treatments mirrored those observed for these two species in the species trial. Both species survived through eight years in thinned stands but growth and seedling vigor after eight years were better for planted western hemlock (Chan et al.).

Natural regeneration was generally absent in the unthinned stands and variable among species and among thinning treatments through eight years (Chan et al.). For Douglas-fir, western hemlock and red alder 8th year natural seedling densities in thinned stands ranged from 11,400 to 26,100, 6040 to 8903, and from 1,475 to 23,300 respectively. While planted seedlings of western hemlock ranged from 3.5 to 5.2 m tall and planted Douglas-fir ranged from 2.0 to 4.0 m tall, naturally regenerating seedlings of these species averaged less than 0.5 m in height, regardless of thinning intensity.

Naturally regenerating red alder ranged from about 2.2 m to 4.5 m in height with mean height increasing with thinning intensity.

b) Species Trial

Through 8-years post planting, survival of underplanted seedlings was relatively high in thinned stands, exceeding 84% for all species except bigleaf maple (64%). In contrast, mortality of seedlings underplanted in unthinned stands was 100% for all species within four years of planting (Maas-Hebner *et al.* 2005).

While survival was generally high, species differences in growth were substantial (Maas-Hebner *et al.* 2005). By year eight, stem diameter and total height were greater for western hemlock than for Sitka spruce, Douglas-fir and grand fir. Western red cedar seedlings were typically smallest in both height and diameter, likely a result of heavy preferential browsing or damage by elk or deer. Differences in height and diameter among overstory treatment were insignificant. In contrast, the height:diameter ratio (H:D) differed significantly with the ratio being greatest in the high residual density treatment and least in the low residual density treatment. While species differences in H:D were insignificant by year eight, the trends since thinning differed greatly among species, with H:D of Douglas-fir, grand fir and Sitka spruce increasing and that of western hemlock decreasing substantially. Although it is inappropriate to compare H:D values among species, the temporal trend of H:D within species strongly suggests that western hemlock seedlings became increasingly robust while seedlings of the other species became less robust.

When average seedling size, vigor and damage were considered, it was concluded from the species trial was that through eight years post thinning, conifer species preference for underplanting were ranked from highest to lowest as western hemlock, Sitka spruce, Douglas-fir, grand fir, and western redcedar (Maas-Hebner *et al.* 2005). Fast growth by red alder suggested that it was a good choice of broadleaved species for underplanting thinned stands. In contrast heavy browse damage and associated slow growth rendered big-leaf maple a poor choice for underplanting.

Understory Vegetation

In unthinned stands, the percent cover by shrubs remained unchanged at slightly less than 15 percent over the eight years of Phase I monitoring, while the percent cover by herbaceous species increased from approximately 22 to 53 percent. The increase in herbaceous cover was likely related to the concurrent increase in understory light in the unthinned stands. Among treated stands, both shrub and herbaceous cover was initially decreased following thinning. However within three years of treatment, percent cover by shrubs and herbs increased to levels greater than observed in the unthinned stands. By year 8, herbaceous cover in thinned stands was near 70 percent and shrub cover exceeded 40 percent, indicating a positive relationship between increased light and abundance of understory vegetation. Furthermore, the richness of shrub and herbaceous species increased with increasing thinning intensity.

Justification for Continued Study

Throughout western Oregon and Washington, young second growth stands are progressing in age and development. A large proportion of stands suitable for thinning have yet to be thinned. For those stands that have been commercially thinned, the effects of the initial thinning entry on understory microclimate and light regimes have likely dissipated over time. We do not know the degree to which individual tree and stand growth and development responses to commercial thinning vary with age. Furthermore, we do not know how the effects of an initial entry on tree and stand condition, particularly crown vigor, will influence responses to a second entry.

Although Phase I has demonstrated that planted seedlings of a variety of conifer and deciduous species can become established under thinned canopies, it is uncertain the degree to which species differ in long-term persistence. There remains a lack of documented evidence indicating that the underplanted seedlings will persist and develop into a second canopy cohort that effectively contributes to tree species diversity at later stages of stand development – particularly as stands approach tree size thresholds, limiting further silvicultural manipulation (age 80 for many areas within the Northwest Forest Plan). Without further intervention, can the late-successional features initiated through a single thinning and underplanting at age 30 to 40 years be retained without further silvicultural manipulation?

While the initial STUDS thinning treatments bracketed a range of intensities considered appropriate at the time of implementation in the early 1990's, many practitioners have subsequently advocated or implemented higher intensity commercial thinnings. A second entry into these stands will facilitate evaluation of higher thinning intensities being operationally implemented but not yet rigorously tested.

From its inception in the early 1990's the Siuslaw National Forest has made great use of STUDS. The treatment units have served forest managers and resource specialists throughout the region as a demonstration of alternative approaches to thinning and the potential value of underplanting as treatments to enhance structural development while producing timber. The study has also served as a basis for developing a locally calibrated variant of the Forest Vegetation Simulator – a key tool to developing silvicultural prescriptions in operational planning. The results of the study can also be used as a means of validation monitoring to assist in the implementation of adaptive management. All of these beneficial roles can continue through a second phase of thinning implementation and monitoring to address ongoing knowledge and technical transfer needs.

Description and Rationale for Second Entry (Phase II) Treatments

Based on assessments of Phase I data as well as consideration of operational and other research applications of thinning to enhance diversity across the region, the principal partners of STUDS have developed the following second entry treatments where RD targets are based on residual overstory trees:

Overstory Treatments

- Unthinned Controls (year 8 RD 57) – Leave unthinned, do not replant.
- High Density (year 8 RD 37) – Rethin to an RD 16 (with additional stems retained to meet potential snag and downed wood requirements, see prescription below)

- Moderate Density (year 8 RD16) – Rethin to RD 8 (with additional stems retained to meet potential snag and downed wood requirements)
- Low Density (year 8 RD 8) – No entry at this time

Understory Treatments

- Survival and vigor of underplanted seedlings after thinning will determine if we need to continue underplanting
- If underplanting is needed, it will occur after a third entry when the last treatment is thinned to RD 8
- Maintenance of advanced regeneration may require control of competing vegetation – if so, release must be carried out in recognition that understory development is a significant response component of the study. Release activities will not be conducted in the 1-ac unplanted sub-plots.

Snag and Downed Wood Treatments

- Inventory snag and downed wood abundance in high, moderate, and low density treatments three years after Phase II thinning to allow time for canopy recovery and dead wood recruitment as a collateral effect of Phase II harvest operations.
- Create snags as needed for a minimum of one (1) snag > 20 in. diameter and three (3) snags >10 in. per acre, broadly distributed across the entire treatment units including the 1-ac stand dynamics subplots in all thinned treatments.
- Fell and leave three (3) trees greater than or equal to the quadratic mean diameter (approx. 20 in.) to provide a minimum of 2% downed wood cover for all thinned treatments.

One of the original questions in this study was "following thinning, how long before canopies close to the point that stands need to be rethinned?" With canopy closure following thinning progressing at rates of about 2 percent visible light per year – data generated from Phase I suggests that 10-12 years is a sufficient response period for addressing this question with respect to an initial commercial thinning. Therefore, there is little justification for continued monitoring of the Phase I thinning treatment units as they progress on their current trajectories. Rather, there is more value to be obtained by implementing a second phase of thinning to evaluate potential overstory development and understory vegetation responses to a second pulse of increased light availability.

The proposed Phase II overstory treatments are based on several assumptions derived from Phase I observations. First, the unthinned controls will continue to demonstrate decreases in crown vigor as evident by crown recession and will approach a self-thinning stage of stand development evident by increased rates of stem mortality. Second, as stands develop in response to the original treatments, there will be a differentiation in mean tree size that renders comparisons on the basis of stem density less useful. A relative measure of site occupancy such as Relative Density (Curtis 1988) is a more meaningful basis for a density management prescription. Third, stands initially thinned to 100 TPA (RD 37) were not re-spaced sufficiently to initiate desired enhancement of understory vegetation development or to maintain sufficient vigor and growth of underplanted seedlings. Fourth, the understory vegetation features and regeneration growth rates observed following the initial thinning to 60 TPA (RD 16) can not be maintained for an extended period without further thinning given the observed rates of canopy closure. Fifth, the original low density treatment of 30 TPA (RD 8) was believed to represent an extreme intensity of thinning when initially implemented in the early-1990's, but now represents a residual density target for young (35 to 50 year-old) stands that may be advocated as a norm among many practitioners.

The proposed Phase II overstory treatments represent three silvicultural regimes in which the existing overstory is decreased in density to facilitate recruitment of additional tree cohorts. The minimum site occupancy by the current overstory cohort (RD 8); is achieved in one, two or three thinnings (see figures 3-6). As with Phase I, thinnings in Phase II will be predominantly from below, removing trees of the smallest diameter classes although some trees of intermediate crown position will be retained to enhance connectivity.

The one-step approach, represented by the initial low density thin (30 TPA) treatment creates the most space early in stand development and provides a long window for establishment of planted seedlings and recruitment of natural tree regeneration and understory vegetation development. This one step approach may pose risks if crown vigor is low and trees are not windfirm. It may also decrease stocking levels to the point of sacrificing potential wood production. While for this treatment there is no prescribed thinning in Phase II, snags and downed wood will be created if monitoring indicates a shortage relative to prescribed amounts.

The two-step approach is based on the Phase I thinning to moderate density (60 TPA, RD 18), followed by Phase II thinning to RD 8. From an overstory standpoint, this is a conservative approach in which the first thinning may provide for crown adjustment as well as an initial increase in diameter growth rate. Furthermore, relative to the Phase I low density thinning, more basal area was carried on site potentially providing for greater total volume production. From an understory development perspective, the initial thin to moderate density was adequate for initial establishment and sustained vigor for all species of underplanted conifers with the exception of western redcedar which was heavily browsed. The Phase II entry should continue to promote greater understory vegetation abundance and diversity as well as to assist in maintaining the viability of planted Douglas-fir.

The three step approach is represented by the Phase I high density thinning (100 TPA, RD 37) followed by Phase II thinning to RD 16. The thinning regimen will be fully executed in an eventual third, Phase III, thinning where density is further reduced to RD 8 at some future time (approximately at 15 years after Phase II thinning when the stands attain an RD of 35 to 37). This regime will result in a more gradual decrease in stem density which would ensure opportunity for crown adjustment, and also will likely result in the greatest potential volume production and flexibility for future thinning or generation of snags. From an understory perspective, the prolonged retention of moderate stocking will likely diminish potential for increased understory abundance and diversity (relative to the one-step and two-step regimes) and will favor growth and development of the more shade tolerant species of underplanted conifers (particularly western hemlock) relative to Douglas-fir.

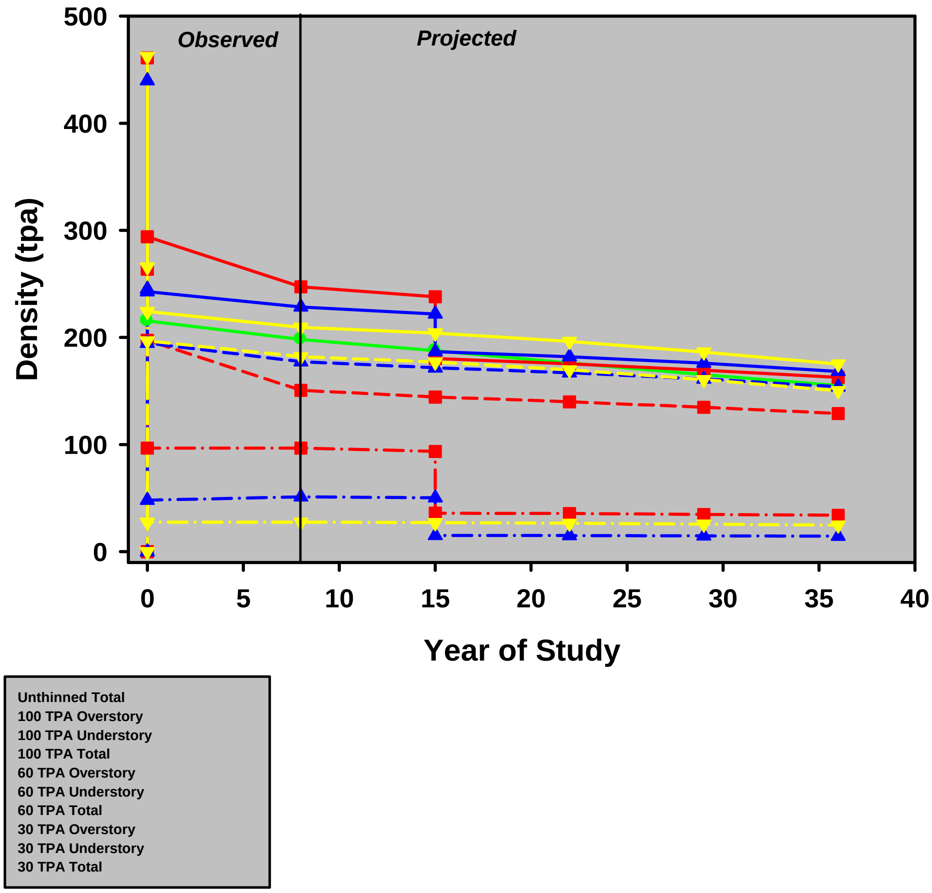

Figure 4. Observed and FVS-projected stand density by treatment through 36 years following the initial Phase I thinning. Dashed, dot-dashed, and solid lines represent the density of underplanted, residual overstory, and all trees, respectively, for underplanted stands.

With underplanting, the one-, two- and three-step thinning regimes result in similar total numbers of trees to that of unthinned stands by year 35 of the study. However, the vast majority of trees in the thinned stands at that time will be those of a second cohort, which is lacking in the unthinned stands.

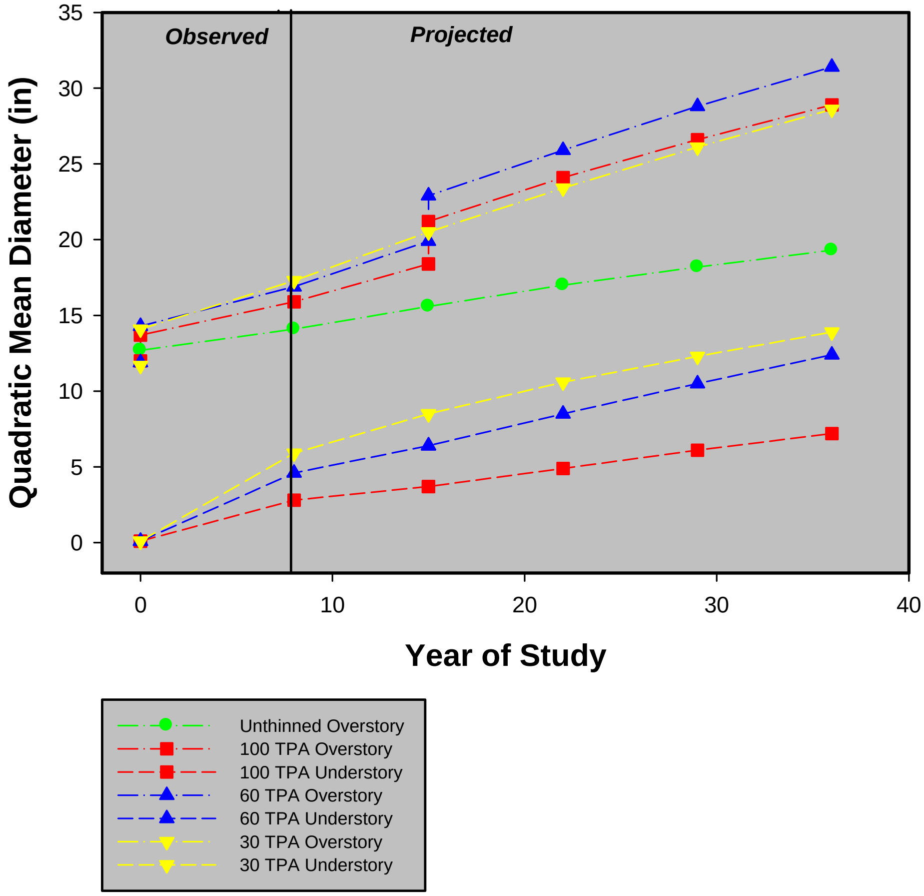

Figure 5. Observed and FVS-projected breast height quadratic mean diameter by treatment through 36 years, following the initial Phase I thinning. Dashed and dot-dashed, lines represent the diameter of underplanted and residual overstory trees, respectively, for underplanted stands.

Not only will the unthinned stands be unlikely to have a second cohort of trees, but after 35 years of thinning treatment, the quadratic mean diameters of residual overstory stems in the thinned stands are projected to be about double that of the unthinned stands. Furthermore, the second cohort of trees in the low and moderate density regimes will be attaining diameters of 10 inches, a minimum size suitable for snag creation.

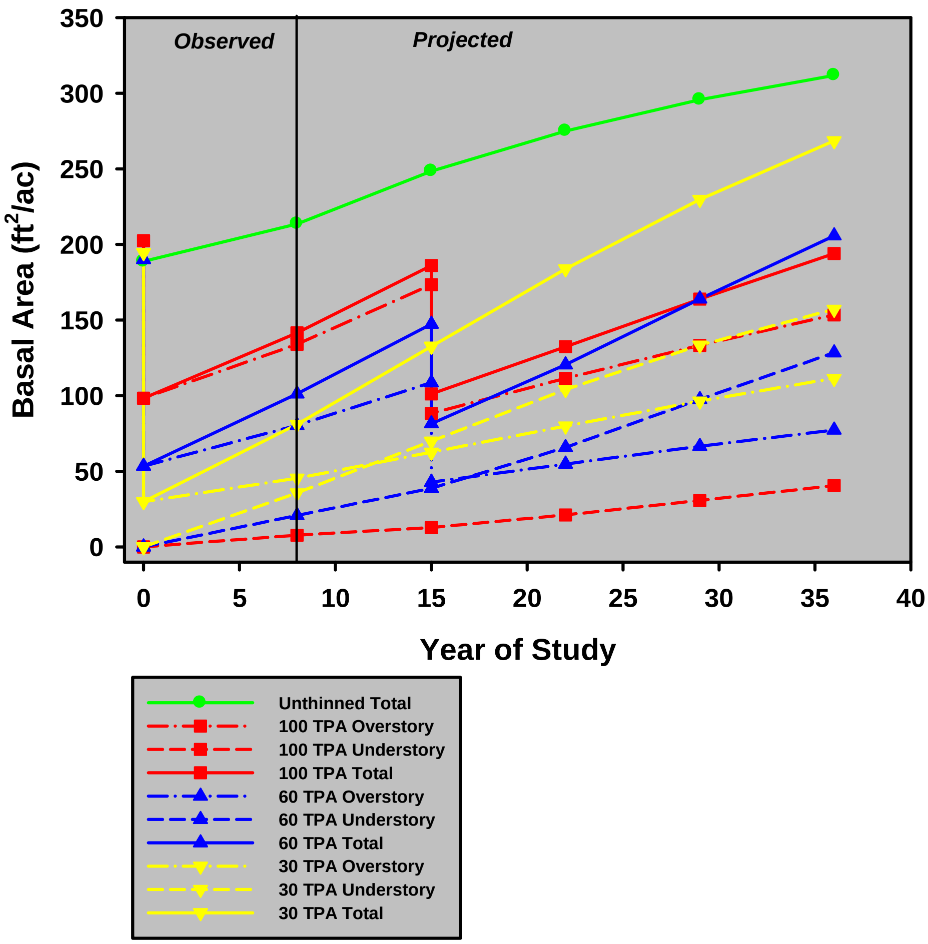

Figure 6. Observed and FVS-projected basal area by treatment through 36 years following the initial Phase I thinning. Dashed, dot-dashed, and solid lines represent the density of underplanted, residual overstory, and all trees, respectively, for underplanted stands.

Basal area development of unthinned stands is projected to increase throughout the duration of the study. The low residual density treatment (thinned at high intensity in a single step) achieves very rapid basal area development and is projected to nearly equal that of the unthinned stands by the 35th year. Much of this recovery in basal area occurs through recruitment of a second cohort. Similar though less complete recovery occurs for the moderate and high residual density treatments (two-step and three-step regimes).

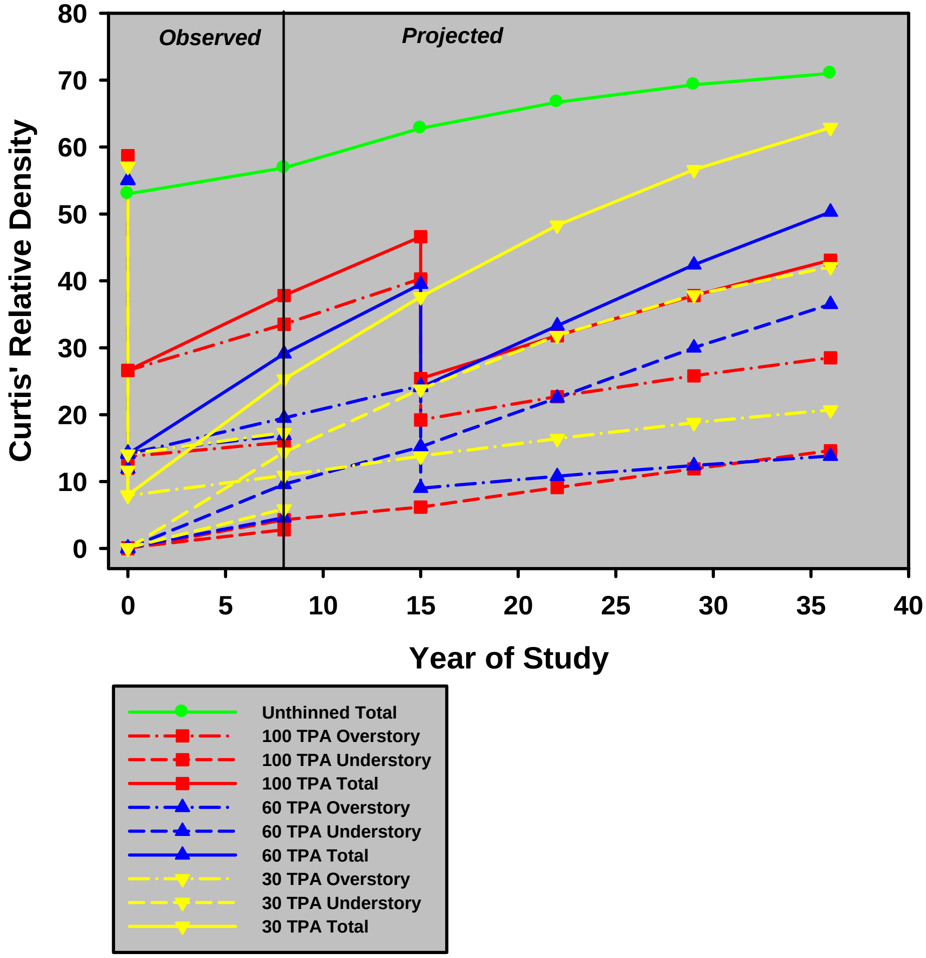

Figure 7. Observed and FVS-projected Curtis' Relative Density by treatment through 36 years following the initial Phase I thinning. Dashed, dot-dashed, and solid lines represent the density of underplanted, residual overstory, and all trees, respectively, for underplanted stands.

While similar to projected trends in basal area, projected relative densities of the clearly demonstrate the importance of a second cohort to site occupancy by the 35th year. Also, given a threshold RD of 35 for thinning, the third entry in the three-step regime should occur about the 30th year of the study.

The efficacy of the thinning regimes being evaluated is dependent on the establishment of multiple tree cohorts that provide vertical connectivity between the overstory and the understory. The Phase I underplanting was an attempt to facilitate second cohort development. Experience in Phase I suggests that the thinning regimes being tested, if successful, will enhance development of herbaceous and shrub taxa that compete with underplanted conifers, unless treated. Release treatments in a vigorous understory may not persist for a long period, thus if implemented at Phase II, would likely necessitate further release or replanting efforts. Furthermore, release of planted conifers from competing vegetation may confound the inferences drawn from the overstory treatments. Therefore, there will be no underplanting efforts in conjunction with the Phase II thinning treatments. But rather, following a Phase III thinning as the stands reach an age (and average tree size) that precludes further silvicultural manipulation, a final underplanting and release may be undertaken as deemed appropriate to ensure adequate regeneration stocking prior to the stand entering their passive management stage of stand development towards old-growth.

Consideration of snags and down wood is being undertaken with Phase II. The intent is to first, provide a limited abundance of snags and down wood to serve near-term habitat and other ecological functions in these stands, and secondly, to monitor snag and down wood recruitment as developmental responses of the stands to the experimental treatments. While not maximizing potential snag and down wood creation, the intent of the dead wood prescription is to provide reasonable assurance that these specific experimental stands will provide habitat in the near-term, while the stands develop trees of larger size and longer-term habitat value; and to avoid compromising the primary objectives of the study which are focused on the evaluation of stand development and increased diversity through the recruitment of midstory and understory vegetation strata. The target levels of snag and down wood abundance are consistent with the regional frequency distribution of observed abundances for unmanaged, small-to-moderate diameter stands of similar habitat type in the Oregon Coast Range, as summarized by the DecAID decision tool. A detailed explanation of rationale behind the prescribed snag and down wood targets is presented as Appendix 1.

Proposed Response Variables and Measurements

The influence of thinning and underplanting treatments intended to increase structural and biotic diversity requires assessment of features occurring at multiple scales - taxonomic, spatial and temporal. In this study, we use a nested sampling design to monitor the vegetation community including live and dead elements to characterize the development of communities and habitats in terms of composition, structure, and production (Table 1). The specific characteristics being monitored can be grouped into four categories—overstory trees, stand and canopy, understory vegetation, tree regeneration, and the forest floor—as listed in detail below:

Overstory Tree and Stand Development

Individual tree growth and vigor (diameter breast height, height, crown width, live crown ratio, epicormic branching, crown and stem damage)
Canopy cover (direct and indirect light transmittance)
Stand density and site occupancy (density, RD, relative basal area)
Stand productivity (wood volume—growth and yield)
Snag dynamics (density, size, condition/decay class)
Snag development (condition of man-made snags)

Understory Vegetation Dynamics

Shrub (density, size, cover, species composition)
Forb, Fern, Grass (cover, species composition)

Tree Regeneration
Planted conifers (abundance, survival, height, diameter, condition)
Natural conifer and hardwood (abundance, species composition, height, diameter, condition)

Forest Floor
Substrate (percent cover – bare soil, litter, rocks, disturbed soil, roots/stumps)
Downed wood (abundance, size distribution, condition class)

The response variables will be measured periodically to capture short- and long-term responses to treatment implementation (Table 2). For Phase II, pre-treatment sampling in 2007 (15^{th} year for Cataract, 14^{th} year for Yachts and Wildcat sites) will serve both as a final assessment of Phase I treatment effects as well as a base-line for assessing the responses to the proposed Phase II treatments. Following implementation of the Phase II thinnings, all experimental units will be re-sampled at two–year intervals from the first through 5^{th} years, following treatment. Subsequent sampling will occur at five-year intervals, with monitoring expected to occur at least through the 35^{th} year of the study. A third thinning entry—Phase III—will occur, based on rates of stand development, with the thought at this time being a third step in the reduction of the residual density of the 100 TPA treatment, when stands of that treatment reach a Phase II RD of 35 to 37.

Table 1. Response variables and associated sampling units.

Response Variable	Size	Measurement Plot Size	# Plots per Treatment Unit	Measurements
Overstory Trees & Snags	> 5 in. dbh	1 ac	2	[1]Species, dbh, total height, condition class, ht to live crown, ht to lowest live branch
Saplings	>4.5 ft tall & <5 in. dbh	0.01 ac	16	Species, dbh, total height, condition class
Tree Seedlings	1-4.5 ft tall	0.0012 ac	16	Species, height, diam at 6 in., percent cover
Tree Seedlings	< 12 in. height	0.0012 ac	16	Tally by species, percent cover
Shrubs	All	0.0012 ac	16	Species, # stems by diameter class, clump height x width x length, percent cover by species
Forbs & Grass	All	0.0002 ac	16	Percent cover by species, dominant height by species
Substrate	All	20 ft transect	4	Substrate (litter, rock, mineral soil, etc.) percent cover
Downed Wood	> 3 in max. diam.	80 ft transect	4	Number of intersects by diameter and decay class
	1-3 in. max. diam	20 ft transect	4	Number of intersects by diameter class
	0.25 – 1in. max. diam.	5 ft transect	4	Number of intersects by diameter class
Substrate		20 ft transect	4	Substrate percent cover

Proposed Timeline

The timeline for significant study activities are summarized in Table 2, below.

Table 2. Timeline of significant study activities, including treatment implementation and monitoring, from the inception in 1992 through 29 years post-initial thinning.

		Site	
Activity	**Study Year(s)**	**Cataract (Mapleton RD)**	**Wildcat (Hebo RD) & Yachats (Waldport RD)**
Phase I			
Pre-thin Survey	0	Summer 1992	Summer 1992
Thinning Treatments	1	Winter 1992-93	Winter 1993-94
Underplanting	1	Spring 1993	Spring 1994
Post-thin Vegetation Surveys	1, 3, 5, 8, 14 or 15	Summer 1993, 1995, 1997, 2000, 2006	Summer 1994, 1996, 1998, 2001, 2007
Post-thin Overstory Surveys	1, 4, 8, 14 or 15	Summer 1993, 1996, 2000, 2006	Summer 1994, 1997, 2001, 2007
Post-thin Light Surveys	1, 3, 5, 8, 14 or 15	Summer 1993, 1995, 1997, 2000, 2007	Summer 1994, 1996, 1998, 2001, 2007
Phase II			
Pre-thin Survey	14 or 15	Summer 2007	Summer 2007
Thinning Treatments	15	Winter 2007-08	Winter 2008-09
Underplanting	NA	NA	NA
Snag and Downed Wood Creation	19	Winter 2012	Winter 2013
Post-thin Vegetation Surveys	15, 17, 19, 24, 29	Summer 2008, 2010, 2012, 2017, 2022	Summer 2009, 2011, 2013, 2018, 2023
Post-thin Overstory Surveys	15, 19, 24, 29	Autumn 2008, 2012, 2017, 2022	Autumn 2009, 2013, 2018,2023
Post-thin Light Surveys	15, 17, 19, 24, 29	Summer 2008, 2010, 2012, 2017, 2022	Summer 2009, 2011, 2013, 2018,2023

Participants and Roles:

Siuslaw National Forest
Stuart Johnston, Forest Silviculturist – Research liaison, stand simulation modeling, overstory growth and yield.

USFS Pacific Northwest Research Station
Paul Anderson, Research Forester – Understory vegetation, regeneration, light, microclimate and microsite.

Oregon State University, Department of Forest Science
Doug Maguire, Silviculturist – Tree and stand canopy structure, overstory growth and yield.

Bill Emmingham, Silviculturist – Regeneration.

Oregon State University, Sea Grant Watershed Resources Program –
Sam Chan, Ecologist – Understory light, microclimate, and microsite.

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Appendix 1.

Siuslaw Thinning and Underplanting for Diversity Study Snag and Down Wood Prescription

Background

The Siuslaw Thinning and Underplanting for Diversity Study was undertaken to evaluate alternative silvicultural prescriptions for enhancing development of structural heterogeneity in young (30-35 year-old) Douglas-fir dominated plantation forests in the western hemlock/Douglas-fir region of the west-side Oregon Coast Range. This forest type is widely represented, occurring on several hundred thousand acres. Stands are typically simple in structure, often with low abundance of late-seral legacy features such as snags or large down wood considered important to wildlife habitat and other ecological functions.

Two silvicultural treatments, overstory thinning and underplanting, were implemented in 1992-93 for evaluation. Thinning was implemented at four initial intensities defined by residual density of overstory stems (thinned to 30, 60 or 100 stems per, or unthinned leaving approximately 200-220 stems per acre). Two types of planting assessments were undertaken, one to evaluate the potential contribution of underplanting to development of a second cohort of trees, and the second to evaluate species suitability for underplanting. In the first situation, 1-ac subplots within each thinned and unthinned treatment unit were planted with a mix of conifer seedlings or left unplanted. In the second underplanting test, small, dense plots of mixed conifer and mixed hardwood species were planted to document species variation in establishment and persistence under overstory canopies.

Purpose of Snag and Down Wood Study Component

Consideration of snags and down wood is being undertaken with the planned second thinning entry to these experimental treatment units. The intent is two-fold:

1) Provide a limited abundance of snags and down wood to serve near-term habitat and other ecological functions in these stands
2) Monitor snag and down wood recruitment as developmental responses of the stands to the experimental treatments

Premise

This prescription is based on the following operating assumptions:

- *Stands currently have very few large living trees – QMD < 20-25 in*
- *Treated stands have very few dead trees – first entry, thin from below, removed most suppressed stems – subsequent density dependent mortality at very low rate*
- *Stands have little large diameter down wood coverage*
- *Range of variability in snag and down wood abundance for young, unharvested, stands in the western Coast Range is high – substantial proportion of plot-sized areas in the landscape occupied by such stands do not have either snags or measureable levels of coarse down wood*
- *Lower levels of the ranges in variation for snag and down wood abundance in unharvested stands are reasonable initial targets for managed stands with small diameter trees, none-to-little snag and down wood abundance, and having little potential for density-dependent mortality in the next 20-30 years*
- *Some wood, even small diameter snag or down wood, provides habitat benefits; large diameter snag and down wood provides greater benefits*

- *Passive accrual of snags and down wood can be supplemented through active stand manipulation as deemed appropriate*

Application of DecAid in Setting Initial Target Levels

The Decayed Wood Advisor (DecAID) is an information tool developed by USFS and USFWS researchers to assist managers and planners in assessing down wood and snags (Mellen et al. 2002). It consists of three primary components: quantitative descriptions of snag and down wood abundance by size or condition class in the form of statistical summaries (frequency distributions); quantitative summaries of snag and down wood use by animal species and groups (cumulative species curves), and expert knowledge and interpretation for management application. It is applicable to forest lands of Oregon and Washington coarsely stratified by habitat type (approximate analogy to vegetation zones of Franklin and Dyrness (1972)) and seral condition (open canopy, large trees, small/moderate trees). The data is drawn primarily from three sets of vegetation inventory plots – FIA, CVS, and NRI. Additional data from research plots has been included when available (Ohmann and Waddell 2002). Data are summarized across all plots and for the subset of unharvested plots (plots for which no evidence of harvest exists). The statistical summaries typically indicate the percent of forest area having a particular snag or down wood characteristic. Thus, the summaries provide an indication of the relative likelihood for forest stands of a given habitat type and seral stage to have specified levels of down wood or snags. Tolerance levels of 30%, 50% and 80% describing low, middle and upper levels of the frequency distributions are provided for each snag and down wood attribute for each habitat type and seral condition. It is very important to recognize that the DecAID tool provides coarse-grained descriptive information and interpretative information. DecAID is not a predictive model. It does not produce deterministic or stochastic estimates of down wood or snags for specific stand or site conditions. Furthermore, DecAID does not directly address dynamics of recruitment or decay condition.

Snag and Coarse Down Wood Targets

In this prescription, DecAID is used to identify reasonable targets for the abundance of snags (density) and down wood (percent cover) following the second thinning entry (age 45-48) and for a possible third entry prior to age 80 (around age 66-69). Specifically the target abundance of down wood and snags is set to at least equal that of the 20th percentile of unharvested stands of the corresponding habitat type and seral stage. While not maximizing potential snag and down wood creation – it is the intent of this prescription to provide reasonable assurance that these specific stands will provide habitat in the near-term, while the stands develop trees of larger size and longer-term habitat value; and to avoid compromising the primary objectives of the study which are focused on stand development and increased diversity through the recruitment of midstory and understory vegetation strata.

An initial, year-15 target for snag density is based on the DecAid small/medium tree structural class. This class is defined as having greater than 10% stocking and QMD of 10-19 inches (prior to second entry QMDs range among treatments from 15.6 in to 20.5 in). According to DecAID, in the western lowland conifer-hardwood ecoregion, 21% of unharvested forest area in the small/medium tree class has no snags greater than 10 inches dbh while 40% of the surveyed area has 0-4.5 10-inch snags per acre. Large snags are less common as 29 percent of these areas have 0 snags greater than 20 inches dbh and 29 percent have 0-2 large snags per acre. In this study, we will target 4 snags per acre following the second thinning entry – 3 snags with a minimum 10 inch diameter and one snag with a minimum 20 inch diameter (Table 1).

Mortality in the study units has been summarized from observational data collected through 8-years post initial thinning, and projected through 36 years-post initial thinning using the FVS simulation model. Estimates of mortality following the first entry through 15 years post-entry average 3, 2 and <1 stem per acre for the 100 tpa, 60 tpa, and 30 tpa treatments. These low rates of mortality reflect the virtual elimination of density-dependent mortality as a result of the initial thinning. Projected mortality from year 15 through year 36 is 2, 1 and 2 stems for the respective high, moderate, and low residual density treatments. These are annual mortality rates ranging from 0.2% to 0.4% which are substantially lower than the 1% - 2% annual mortality commonly observed in other Pacific Northwest forest studies as summarized in Greene et al. (1992).

While the observed and projected mortality rates are low for the treated stands, if the projections are accurate, mortality should suffice for creation of the target large-snag densities for year-36 (Table 1). By age 66-69 years, the projected QMD of residual overstory trees will move the stands to the DecAid large tree structural class. For unharvested forests in this structural class, 21% of the area has 0-6 snags greater than 10 inches dbh and 38% of the area have 0-4 snags greater than 20 inches dbh. Our target for year-36 in the treatment units is to provide a minimum of 2 snags per acre of 20 inch or greater dbh and a minimum of 4 snags per acre of 10 inch or greater dbh (Table 1). It is anticipated that the large diameter snags will be derived from the residual overstory. Given projected recruitment and growth rates, it is possible that the small diameter snags will be generated from the planted conifer understory – most likely through active snag creation as it will be the more vigorous individuals of this cohort that meet the minimum 10 inch dbh criteria.

Coarse down wood cover in small/medium structural class, unharvested forests of the western Oregon lowland conifer hardwood ecoregion ranges from 0.4 to 15.8 percent in the DecAid database. Nearly 30% of the unharvested forest area in this class has 2 percent or less cover by down wood greater than 5 inches diameter. Nearly fifty percent of the area in this class has less than 2 percent cover by 20 inch diameter down wood. At year 15, the QMD of the treated stands is projected to be 20-23 inches depending on treatment. Individual Douglas-fir of such dimension provide about 0.25% cover each if felled and left to lie; a 10 inch dbh tree provides about 0.7% cover. Because of the number of stems required to create cover at this stage of stand development would be large, we are setting a conservative down wood cover target of 2% to be derived from the overstory cohort (Table 1).

At year-36, when the stands are projected to have reached the large tree structural class, we anticipate increasing the down wood cover target to 3 percent (Table 1). This coverage will be achieved through mortality, retention of down wood created at year-15 and through active recruitment of down wood; roughly equal coverage from large residual overstory trees and smaller second cohort trees. In the DecAid database, of the unharvested forest area in the large structural class, approximately 21% of the area has 2% or less CWD greater than 5 inches diameter, and 43% has less than 4%. In the large structural class forests, 25% of the area has no CDW greater than 20 inches diameter and 29% of the area has 2% or less.

Estimates of wildlife benefit, derived from cumulative species curves in DecAID, are summarized with respect to the snag and coarse down wood prescriptions in Table 2. The table states that for those species or species groups observed, at least 30% of the observations were associated with woody structure of the prescribed size or abundance. From a wildlife perspective, the prescribed targets provide minimal habitat enhancement for the near-term, but substantially increase habitat quality over the subsequent 20 years. There is a large habitat quality response to incremental increases in CWD. However at year-15, given the 20-23 inch QMD, the number of residual stems required to create a 1-percent increase in CWD is large relative to the residual stand densities. For active creation of CWD, it is reasonable to wait until the overstory trees are larger and the second cohort of planted conifers attain a size where they can contribute to coarse wood production and they are of a density that requires thinning.

It must be remembered that the actual habitat quality provided by the stands in this study will be influenced by any previously undocumented legacy structure or natural mortality and recruitment. The targets constitute minimum levels to be actively met if the desired conditions are not present at the time of assessment. If the desired woody material is created incidentally through thinning activities and stand developmental processes, then active snag and CWD creation will not be undertaken.

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Table 1. Live tree density, quadratic mean diameter, target snag density and target coarse down wood cover for overstory and planted conifer cohorts, by study treatment, immediately following the second phase of thinning treatments and at stand age 66-69.

Study Year (years post treatment)	Stand Age (yr)	Stand Cohort	Live Tree Density (tpa)	QMD (in)	Snag Density Target (tpa)	CDW Target (%)	Live Tree Density (tpa)	QMD (in)	Snag Density Target (tpa)	CDW Target (%)	Live Tree Density (tpa)	QMD (in)	Snag Density Target (tpa)	CDW Target (%))
15	45-48	Over	36.0	21.2	1 > 20 in 3 > 10 in	3 > 20 in	15.1	22.9	1 > 20 in 3 > 10 in	3 > 20 in	27.1	20.5	1 > 20 in 3 > 10 in	3 > 20 in
		Under	144.4	3.7	0	0	171.7	6.4	0	0	177.0	8.5	0	0
36	66-69	Over	33.9	28.9	2 > 20 in	1 > 20 in	14.4	31.4	2 > 20 in	1 > 20 in	24.8	28.6	2 > 20 in	1 > 20 in
		Under	128.9	7.2	5 > 10 in	2 > 5 in	153.9	12.4	5 > 10 in	2 > 5 in	150.2	13.9	5 > 10 in	2 > 5 in

Table 2. Number of wildlife species or species groups with at least 30% likelihood of benefiting from the prescribed snag and coarse down wood target abundances based on the DecAID advisor.

Study Year (Years Post Initiation)	Stand Age (yr)	Habitat Feature	Target	Number of Benefiting Species/Species Groups
15	45-48	Snags	4 tpa	2 of 4
		CWD	2%	12 of 23
36	66-69	Snags	7 tpa	4 of 4
		CWD	3%	21 of 23

Appendix C

Siuslaw Thinning and Underplanting Diversity Study—Phase II

List of Preparers

The Team

Name	Position Title	Primary Responsibilities
Terri Brown	Forest Fuels/Fire Planners	Fire hazard effects
Bruce Buckley	Resource Planner	Project coordinator, NEPA documentation and process
Frank Davis	Forest Environmental Coordinator	NEPA guide and team leader
Jessica Dole	Forest Landscape Architect	Scenery effects
Stu Johnston	Forest Silviculturist	Silviculture prescriptions, stand-treatment effects, and research liaison.
Ralph Lampman	District Fish Biologist	Effects to fish and fish habitat
Ken McCall	Forest Transportation Planner	Forest transportation system effects, roads analysis
Randy Miller	District Wildlife Biologist	Wildlife effects; wildlife specialist report, including the biological evaluation
Jan Robbins	District Hydrologist	Water quality and soils effects, roads stability assessment
Phyllis Steeves	Forest Archaeologist	Heritage resource effects
Marty Stein	Forest Botanist	Listed, sensitive, and survey-and-manage plant effects, effects to invasive plants

Contributors

Name	Position Title	Primary Responsibilities
Paul Anderson	PNW Lab Research Scientist	Phase II Study Plan, dead wood prescription for the Study Plan
John Sanchez	Forest Fish Biologist	Fish effects oversight
John Zapell	District Public Affairs Specialist	Public notification