Forest Service

United States Department of the Interior

Bureau of Land Management

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Final Supplemental Environmental Impact Statement

on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl

Volume I

Abbreviations and Acronyms

ACEC	Area of Critical Environmental Concern
ASQ	Allowable Sale Quantity
AQRV	Air Quality Related Values
BLM	Bureau of Land Management (USDI)
BMP	Best Management Practice
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CMAI	Current Mean Annual increment
dbh	diameter at breast height
DCA	Designated Conservation Area
EIS	Environmental Impact Statement
FEIS	Final Environmental Impact Statement
FEMAT	Forest Ecosystem Management Assessment Team
FLPMA	Federal Land Policy and Management Act
FSH	Forest Service Handbook
FSM	Forest Service Manual
FWS	U.S. Fish and Wildlife Service (USDI)
GIS	Geographic Information System
ISC	Interagency Scientific Committee
LS/OG	Late-Successional and Old-Growth Forest
MFP	Management Framework Plan
MMBF	Million Board Feet
MUSYA	Multiple-Use Sustained-Yield Act
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NFMA	National Forest Management Act of 1976
NMFS	National Marine Fisheries Service (U.S. Dept. of Commerce)
O&C	Oregon and California Railroad Company revested lands (see Glossary)
PM10	Particulate Matter (10 microns in diameter)
PSD	Prevention of Significant Deterioration
PSQ	Probable Sale Quantity
RMP	Resource Management Plan
RPA	Forest and Rangeland Renewable Resources Planning Act
RNA	Research Natural Area
ROD	Record of Decision
SAT	Scientific Analysis Team
SEIS	Supplemental Environmental Impact Statement
SIP	State Implementation Plan
TAMM	Timber Assessment Market Model
USDA	United States Department of Agriculture
USDI	United States Department of the Interior

In this Supplemental Environmental Impact Statement, any reference to "owl" or "spotted owl" refers to the northern spotted owl (*Strix occidentalis caurina*) unless specifically identified as another species or subspecies. Any reference to "the Assessment Team" refers specifically to the Forest Ecosystem Management Assessment Team.

Final Supplemental Environmental Impact Statement

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	U.S. Department of the Interior Bureau of Land Management
Cooperating Agencies:	U.S. Department of the Interior Fish and Wildlife Service National Park Service
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Abstract

The Forest Service and the Bureau of Land Management propose to adopt coordinated ecosystem management direction for the lands they administer within the range of the northern spotted owl. This Supplemental Environmental Impact Statement (SEIS) presents as alternatives the options, with slight modifications, developed by the Forest Ecosystem Management Assessment Team and presented in their report *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment.* The alternatives identify land allocations and management direction for forests on lands administered by the Forest Service and Bureau of Land Management. The alternatives respond to the underlying needs of managing substantial parts of these forests for late-successional and old-growth conditions, and for a predictable and long-term supply of timber. The preferred alternative is Alternative 9. For the Forest Service, this SEIS will supplement the *Final Environmental Impact Statement on Management for the Northern Spotted Owl in the National Forests* (January 1992) through the addition of 10 new alternatives and the disclosure of their environmental impacts. For the Bureau of Land Management, this SEIS will also supplement the Draft Environmental Impact Statements for the Draft Resource Management Plans for the Coos Bay, Eugene, Medford, Roseburg, and Salem Districts, and the Klamath Falls Resource Area of the Lakeview District in Oregon; the King Range National Conservation Area Management Plan; and the Final Environmental Impact Statements for the Resource Management Plans for the Arcata and Redding Resource Areas of the Ukiah District in California; through the addition of 10 new alternatives and the disclosure of their environmental impacts. Except as otherwise specified, the management direction in the Record of Decision for this SEIS will supersede the management direction contained in existing plans for the specific resources and the areas that are identified in this SEIS.

Notice

Readers should note that the Secretaries of Agriculture and the Interior are the responsible officials for this proposed action. This means that no administrative review ("appeal") through the Forest Service will be available on the Record of Decision under 36 CFR 217, nor will an administrative review ("protest") through the BLM be available on the Record of Decision under 43 CFR 1610.5-2. Because there is no administrative review of the decision, the Record of Decision will not be signed until 30 days after the Notice of Availability for this Final SEIS appears in the Federal Register (see 40 CFR 1506.10(b)).

The SEIS Interdisciplinary Team analyzed information acquired during the review of the Draft SEIS; updated information is contained in this Final SEIS. Summaries of substantive comments, as well as responses to those comments, are included in Appendix F of this Final SEIS.

DEDICATION

KATHY JOHNSON 1955-1993

Kathy Johnson, a member of the Interagency Team that prepared this Supplemental EIS, died in September 1993 after a long and courageous battle with cancer.

Throughout her career with the Forest Service, she worked to balance the needs of rare wildlife and plants with the needs of people and communities. She sought to see all sides of an issue, and worked to find that often elusive solution that had some benefit for all. She cared deeply for people, as individuals and as communities. She knew that as important as it is to save land for wildlife and plants, it could not always be done without real costs to real people.

She worked at all levels of the Forest Service, from Ranger Districts in Oregon and Washington to the national headquarters in Washington, D.C.. By turns a wildlife biologist, planner, line officer, and legislative fellow, Kathy joined the agency in 1978 after graduating from Central Washington State College. She advanced quickly because of her dedication, commitment, and zeal for finding resource management solutions in the face of conflicting resource demands. She was gifted in creating a vision of what could be, effectively sharing that vision, and helping to make it become real on the ground.

She led both the Pacific Northwest Region's and the Forest Service's national program for threatened and endangered species. She foresaw, better than most, the coming dilemma of the spotted owl and marbled murrelet, and offered management concepts to protect these and other species while continuing to actively manage the resources of the National Forests for timber and high environmental qualities. Her work for sensitive species was instrumental in protecting habitats for special and rare flora and fauna of National Forests in the Northwest. She created the Forest Service's "Every Species Counts" initiative for the recovery and conservation of sensitive and imperiled species.

In 1988, she became the District Ranger at Gold Beach on the Siskiyou National Forest. There she was instrumental in bringing a vision of ecosystem management to a reality in both the Silver Fire recovery and Shasta Costa resource management plans. At a time when few others had even heard of ecosystem management, Kathy was acting on her vision and helping bring about a positive and lasting change in how we view and balance management of our natural resources. She was liked and trusted by people on all sides of resource issues. She was understanding, fair, and articulate, and personally involved in finding solutions to local issues.

Kathy Johnson served as an interdisciplinary team member or active adviser on every effort to develop management direction for the northern spotted owl since 1986, including the draft of this SEIS. We share her vision that it is possible to manage forest ecosystems for both people and for rare life, and that it is possible to bring people together to reduce the conflict over managing our forests. That vision, her compassion, and her spunk will live on in our memories.

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Summary of Changes Between Draft and Final SEIS

Based on public comments received on the Draft SEIS, numerous corrections and clarifications were made to the Final SEIS. The key changes are identified at the beginning of each chapter. The following list summarizes the more notable changes in the SEIS between Draft and Final.

- An analysis of some of the fish, wildlife and plant species was conducted to clarify the Assessment Team's ratings, to examine possible standards and guidelines and land allocation changes that would benefit those species through improved habitat conditions on federal lands, and to assess the impacts of other revisions to Alternative 9. As a result, Alternative 9 was revised to incorporate Riparian Reserve Scenario 1 instead of Riparian Reserve Scenario 2. Standards and guidelines were also added to Alternative 9 that set levels of coarse woody debris and snag retention, require surveys and management for some rare and endemic species, add protection for bat roosting sites, retain old-growth stands in watersheds with less than 15 percent old-growth forest, and allocate 100 acres around all known northern spotted owl nest sites to Late-Successional Reserves. The description of Alternative 9 was revised in Chapter 2, and the additional or changed standards and guidelines are described in detail in Appendix B11. A description of the process and the effects of the revisions appears in Chapter 3&4.

- The 180-year rotation requirement for northern California National Forests in Alternative 9 was dropped in favor of following Forest Plan standards and guidelines.

- All relevant and applicable standards and guidelines from the FEMAT Report now appear in the text of this Final SEIS.

- References to "oversight" were changed to "review by the Regional Ecosystem Office" to clarify who has responsibility for such reviews. This conforms to the implementation structure established in the interagency Memorandum of Understanding for Forest Ecosystem Management that was added to Appendix E.

- A fire management appendix was added to clarify the role of fire and fuels management across all land designations.

- To supplement spotted owl protection for Alternative 9, Managed Late-Successional Areas were added for known owl activity centers in the Washington Eastern Cascades and the California Cascades Provinces.

- Numerous boundary adjustments, map changes, and corrections to the data base were made and incorporated in the document. A revised map of Alternative 9 is included to reflect the revisions to that alternative.

- Implementation structure, monitoring, adaptive management and other components related to implementation of the selected alternative were expanded and clarified.

- The projection of total job losses was changed due to the correction of an error in the analysis performed for the Draft SEIS and revisions to Alternative 9 resulting from the additional species analysis.

- Appendix F was added to summarize the comments received on the Draft SEIS, and provide responses to those comments.

- A statement was added to clarify that the management direction and land allocations of the preferred alternative (Alternative 9) constitute the federal lands' contribution to the recovery of the northern spotted owl.

- An air quality analysis was performed and the results are included in Chapter 3&4.

- Data from spotted owl demographic counts from 1992 and 1993 were analyzed, and the results are considered in the Final SEIS.

- The guidance for Late-Successional Reserves within the Finney and Northern Coast Range Adaptive Management Areas was changed. Adaptive Management Area plans in these two areas may modify Late-Successional Reserve designation or management, but must continue to meet the emphasis of these Adaptive Management Areas, which is restoration and maintenance of late-successional forest habitat and riparian or marbled murrelet habitat. In addition, the maximum age for thinning in the Northern Coast Range Adaptive Management Area was raised to 110 years.

Summary

Introduction

This Final Supplemental Environmental Impact Statement (Final SEIS) presents 10 alternatives and discloses their environmental effects. These alternatives propose alternate Forest Service and the Bureau of Land Management (BLM) management direction within the range of the northern spotted owl. These lands are in the Pacific Northwest and northern California. Each alternative consists of combinations of (1) land allocations managed to protect and enhance habitat for late-successional and old-growth forest related species and to protect and enhance aquatic resources, and (2) standards and guidelines for the management of these land allocations. Alternative 9 is identified as the preferred alternative, and represents the forest ecosystem plan proposed by President Clinton on July 1, 1993.

Background

The ongoing controversy concerning management of federal lands has resulted in what has been described as a gridlock of lawsuits, court rulings, appeals, and protests. The public debate has expanded from a focus on management of northern spotted owl habitat to include management of all old-growth forest associated species and old-growth ecosystems.

Recent court rulings require completion of environmental impact statements. The Forest Service is required by the U.S. District Court for the Western District of Washington to prepare a new or supplemental environmental impact statement (EIS) to correct deficiencies the court found in the 1992 *Final Environmental Impact Statement on Management for the Northern Spotted Owl in the National Forests*. The BLM is required by the U.S. District Court for the District of Oregon to prepare an EIS to incorporate new information on the effects of logging on the northern spotted owl and to consult on a conservation strategy. Both agencies are currently enjoined from selling timber in northern spotted owl habitat.

To seek a solution to the controversy, President Clinton held a Forest Conference in Portland, Oregon, on April 2, 1993. During the day-long conference, scientists, economists, representatives from the forest products industry and environmental groups, Indian tribes, and others were invited to present concerns, opinions, or proposals to the President concerning the various issues surrounding the management of federal lands in the Pacific Northwest and northern California.

After the Forest Conference, the Forest Ecosystem Management Assessment Team ("the Assessment Team") was assembled to prepare an assessment that took an ecosystem approach to forest management. The Assessment Team examined many options, evaluated them, and developed and presented 10 options in their report, *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment* ("the FEMAT Report"). It is available on request.

Using the FEMAT Report, the SEIS Interdisciplinary Team prepared a Draft SEIS with the Assessment Team's 10 options as alternatives. The Draft SEIS was available to the public, agencies, tribes, and other governments for review on July 30, 1993. Following a 90-day comment period which included public hearings and which elicited over 100,000 comments, the SEIS Interdisciplinary Team considered these comments, utilized new information, modified some of the alternatives, and subsequently prepared this Final SEIS.

The Underlying Needs and Purposes

The agencies are responding to dual needs: the need for forest habitat and the need for forest products.

The need for forest habitat is the need for a healthy forest ecosystem with habitat that will support populations of native species (particularly those associated with late-successional and old-growth forests) and includes protection for riparian areas and waters. This need was reflected by President Clinton in these words at the Forest Conference:

> *[A]s we craft a plan, we need to protect the long-term health of our forests, our wildlife, and our waterways. . . . [W]e hold them in trust for future generations.*

The need for forest products from forest ecosystems is the need for a sustainable supply of timber and other forest products that will help maintain the stability of local and regional economies on a predictable and long-term basis. This need was reflected by President Clinton in these words at the Forest Conference:

> *[W]e must never forget the human and the economic dimensions of these problems. Where sound management policies can preserve the health of forest lands, [timber] sales should go forward.*
>
> *[T]he plan should produce a predictable and sustainable level of timber sales and nontimber resources that will not degrade or destroy the environment.*

Each of the alternatives in this SEIS meets both needs to some degree. While meeting the underlying needs, the agencies also strive to meet additional purposes.

The agencies must take an ecosystem management approach to forest management, with support from scientific evidence, and meet the requirements of existing laws and regulations. These requirements were reflected by President Clinton at the Forest Conference:

> *[O]ur efforts must be, insofar as we are wise enough to know it, scientifically sound, ecologically credible, and legally responsible.*
>
> The agencies must cooperate with all the federal agencies. As also stated by President Clinton at the Forest Conference:
>
> *[W]e will do our best to make the federal government work together and work for you. We may make mistakes but we will try to end the gridlock within the Federal Government and we will insist on collaboration not confrontation.*

The alternatives considered in detail in this SEIS respond to these underlying purposes and needs. Alternatives that would not meet these underlying purposes and needs were eliminated from detailed study.

The Proposed Action

The proposed action is to adopt coordinated management direction for the lands administered by the Forest Service and the Bureau of Land Management within the range of the northern spotted owl that meets the underlying need and purposes. This regionwide management direction will provide overall coordination across administrative units, provinces, and watersheds. The action will amend the management direction established in all existing Forest Service and BLM land management plans for the areas and resources covered by this SEIS. This new management direction will apply to projects that will be conducted after site-specific environmental analysis. The existing management plans to be amended include existing Regional Guides, Forest Plans, Unit Plans, Timber Management Plans, Management Framework Plans, and Resource Management Plans for lands within the range of the northern spotted owl. The coordinated management direction established by the Record of Decision for this SEIS will also be incorporated into all land and resource management plans within the range of the northern spotted owl as they are completed or revised.

The Issues

For more than two decades there has been growing controversy about the management of the old-growth forests on federal lands. When harvested, they have great economic value and make way for younger forests and the wildlife they support. If preserved, they provide an environment for many other species and contribute to other nontimber forest values and environmental qualities.

At the Forest Conference, President Clinton posed the fundamental question in his opening remarks:

> *How can we achieve a balanced and comprehensive policy that recognizes the importance of the forests and timber to the economy and jobs of this region, and how can we preserve our precious old-growth forests, which are part of our national heritage and that, once destroyed, can never be replaced?*

President Clinton continued:

> *The most important thing we can do is to admit, all of us to each other, that there are no simple or easy answers. This is not about choosing between jobs and the environment, but about recognizing the importance of both and recognizing that virtually everyone here and everyone in this region cares about both.*

The ecological systems within the range of the northern spotted owl are complex and varied. Managing these ecosystems to preserve and enhance late-successional and old-growth forests and aquatic resources will have major effects on the overall structure, function, and appearance of the region's forests; the water quality in streams and rivers; and the distribution, connectivity, diversity, and sustainability of its terrestrial and aquatic communities.

In the last decade, the northern spotted owl became the focus in the debate over how federal forest lands should be managed. However, the management of habitat for the northern spotted owl affects other terrestrial and aquatic species and the region's ecological systems collectively. There are 40 federally-listed threatened or endangered species that may occur within the range of the northern spotted owl; of these, about half use coniferous forest habitat on federal lands.

The northern spotted owl and the marbled murrelet are listed as threatened species. The long-term persistence of the spotted owl and other old-growth related species depends in large measure on providing habitat of adequate amount and distribution to support their life functions. While most people want the spotted owl and other old-growth species to survive, there is disagreement over the size of populations that should be provided for, and the forest management that will allow for long-term survival.

Aquatic and riparian areas are integral parts of the region's ecosystems and major factors in supporting the economy of the region. Damage to forest aquatic and riparian systems has contributed to degradation of some plant and animal communities. Of immediate concern is the loss of salmon and steelhead runs, which are major cultural and economic elements in the Pacific Northwest and northern California.

Since World War II, timber harvest and reforestation have been a major part of the Forest Service and Bureau of Land Management's role of actively managing federal lands for a variety of sustainable benefits for the Nation and to establish younger forest stands. Species that need young forests and species that need older forests are affected in different, often opposite, ways by changes in the age, composition, and distribution of the habitat each need. Older forests are essential habitat for many species; as the amount of older forests has decreased, the survival of old-growth related species, including the northern spotted owl, has become more uncertain.

The BLM and Forest Service's timber management programs provide raw material for the wood products industry that, after milling and processing, serve the needs of a large number and variety of consumers. The wood products industry's principal employment is located in small cities, towns, and rural areas. From 1986 to 1990, wood from federal forests supported half the industry's jobs. Additionally, a quarter of the receipts from timber sales on federal lands (and half of the receipts from the Oregon and California Revested Lands (O&C lands)) go to county governments.

Reductions in the amount of timber sold for harvest directly affect employment and the economic health of the forestry and wood products industries. These, in turn, immediately affect the economic vitality of the communities dependent on them, and the well being of workers and families. These changes threaten the ability of some of these communities and their institutions to survive.

There are other human uses of federal forest lands that would be enhanced, maintained or curtailed if forests were managed to benefit the northern spotted owl and other late-successional and old-growth related species. Road construction and use, recreation, mining, and other land uses will be affected. There are alternate paths for people and communities to take to adjust to changes. The effectiveness of those paths and the human costs of making those changes are dynamic and significant issues.

The Alternatives

The No-Action Alternative

The No-Action Alternative is essentially comprised of the "No-Action" Alternatives in the EISs being supplemented by this SEIS. The No-Action Alternative in this SEIS basically represents management direction that was in place immediately before the release of the Interagency Scientific Committee's (ISC) *A Conservation Strategy for the Northern Spotted Owl* in the spring of 1990. Because of subsequent listings of the marbled murrelet and the northern spotted owl as threatened species, this No-Action Alternative is no longer a reasonable alternative and could not be implemented today.

Introduction to the Action Alternatives

The 10 action alternatives presented in this SEIS are developed, with modification, from the 10 ecosystem management options developed by the Forest Ecosystem Management Assessment Team and described in the FEMAT Report. The management direction in the alternatives applies only to lands administered by the Forest Service and Bureau of Land Management within the range of the northern spotted owl. Each alternative assumes other federal lands, such as those administered by the Fish and Wildlife Service, National Park Service, and Department of Defense, will be managed according to existing management plans and applicable federal law.

How the Alternatives are Structured

Like other recent strategies for management of northern spotted owl habitat or old-growth forests of the Pacific Northwest, the alternatives presented in this SEIS propose a network of designated areas managed primarily to protect and enhance habitat for the northern spotted owl and other late-successional and old-growth forest related species (hereafter referred to as designated areas), and nondesignated areas referred to as the matrix. Within each of these areas, standards and guidelines set management direction and apply to management activities.

Each action alternative uses current plans and draft plan preferred alternatives as a starting point, or baseline. Therefore, unless specifically excepted, standards and guidelines of the current plans and draft plan preferred alternatives apply to all alternatives where they are more restrictive or provide greater benefits to late-successional forest related species than the provisions of these alternatives.

Land Allocations

There are 24,455,300 acres of federal land within the range of the northern spotted owl. Each alternative in this SEIS allocates these acres to one of the following six categories of designated areas, or to the matrix. The categories are listed in the order that acreage was tabulated, and not necessarily in the order that corresponding standards and guidelines take precedence.

Designated Areas

Congressionally Reserved Areas

All alternatives retain land allocations for existing lands that are congressionally reserved. These include lands with congressional designations that preclude timber harvest, as well as other federal lands not administered by the Forest Service or BLM. This includes National Parks and Monuments, Wildernesses, Wild and Scenic Rivers, National Wildlife Refuges, and military reservations. The location and size of these areas do not change among the alternatives. Management of these lands follows direction written in the applicable legislation or plans.

Late-Successional Reserves

Late-Successional Reserves are identified for each alternative. These areas would be managed to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth related species including the northern spotted owl. For most alternatives, some level of silvicultural treatment (such as thinning young stands) is permitted in stands of a certain age to accelerate the development of old-growth habitat characteristics, subject to review by the Regional Ecosystem Office. These reserves are designed to maintain a functional, interacting, late-successional and old-growth forest ecosystem.A management plan should be prepared for each large Late-Successional Reserve (or group of smaller Late-Successional Reserves) before habitat manipulation activities are designed and implemented. Silvicultural activities and Late-Successional Reserve plans are subject to review by the Regional Ecosystem Office.

Managed Late-Successional Areas

Managed Late-Successional Areas are identified for some alternatives in areas where regular and frequent fire was a natural part of the ecosystem. The objective for these areas is to produce and maintain an optimum level of late-successional and old-growth stands on a landscape scale. In these designated areas, certain silvicultural treatments and fire hazard reduction treatments would be allowed to help prevent complete stand destruction from large catastrophic events such as high intensity, high severity fires; or disease or insect epidemics. As with Late-Successional Reserves, each Managed Late-Successional Area should have a management plan.

Adaptive Management Areas

Adaptive Management Areas occur only under Alternative 9. The objective for each of these areas is to develop and test new management approaches to integrate and achieve ecological and economic health, and other social objectives. Each of these 10 areas has a different emphasis to its prescription, such as maximizing the amount of late-successional forests or improving riparian conditions through silvicultural treatments. A complete description of the purpose for each Adaptive Management Area, as well as specific objectives, appears in Appendix B3, Adaptive Management Areas. Some scheduled timber harvest (that contributing to the probable sale quantity, also referred to as PSQ) takes place in some of the Adaptive Management Areas.

Administratively Withdrawn Areas

Administratively Withdrawn Areas are those areas identified in current plans and draft plan preferred alternatives as not scheduled for timber harvest and not included in calculations of allowable sale quantity (ASQ). Administratively Withdrawn Areas include recreation areas, lands not technically suitable for timber production, certain visual retention and riparian areas, and areas removed from timber production for the protection of locally endemic species. For all alternatives, unless specifically excepted in this SEIS, Administratively Withdrawn Areas and all other standards and guidelines of the current plans and draft plan preferred alternatives apply where they are more restrictive or provide greater benefits to late-successional and old-growth related species than other provisions of these alternatives.

Riparian Reserves

The Riparian Reserves provide an area along all streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis. Riparian Reserves are important to the terrestrial ecosystem as well, serving, for example, as dispersal habitat for certain terrestrial species. Riparian Reserves are not mapped; however, sample distributions of Riparian Reserves are shown on the Alternative 9 map included with this Final SEIS.

Matrix

The matrix consists of those federal lands outside the six categories of designated areas listed above. Most timber harvest and other silvicultural activities would be conducted in that portion of the matrix with suitable forest lands, according to standards and guidelines. Most scheduled timber harvest (that contributing to the PSQ) takes place in the matrix. The matrix also includes nonforested areas, and forested areas that are technically unsuitable for timber production, and therefore do not contribute to PSQ. Many alternatives apply the ISC Conservation Strategy's 50-11-40 rule for management of the matrix. Each alternative also specifies the amount of green trees, snags, and down logs that will be left following management activities.

Environmental Consequences

Chapter 3&4 describes in detail the environmental consequences of the alternatives. Under each of the alternatives considered, timber harvests of older forests will decline from historic levels. The environmental consequences associated with timber harvest, such as loss of late-successional forest habitat, new road construction, increased stream sedimentation, and water quality degradation, will be proportionately less. Social and economic impacts to timber-dependent communities will be proportionately greater. The preservation of late-successional and old-growth forests will have beneficial consequences to the fish, wildlife and plants associated with them, to water quality and to ecological diversity. The following discussion summarizes and compares the key impacts identified.

Effects on Late-Successional and Old-Growth Forest Ecosystems

The evaluation of late-successional and old-growth forest ecosystems is expressed as an expected likelihood of achieving long-term past conditions based on three attributes that characterize the quantity and quality of the ecosystem. The attributes are 1) abundance and ecological diversity - the acreage and variety of plant communities and environments, 2) processes and functions - the ecological actions that lead to the development and maintenance of the

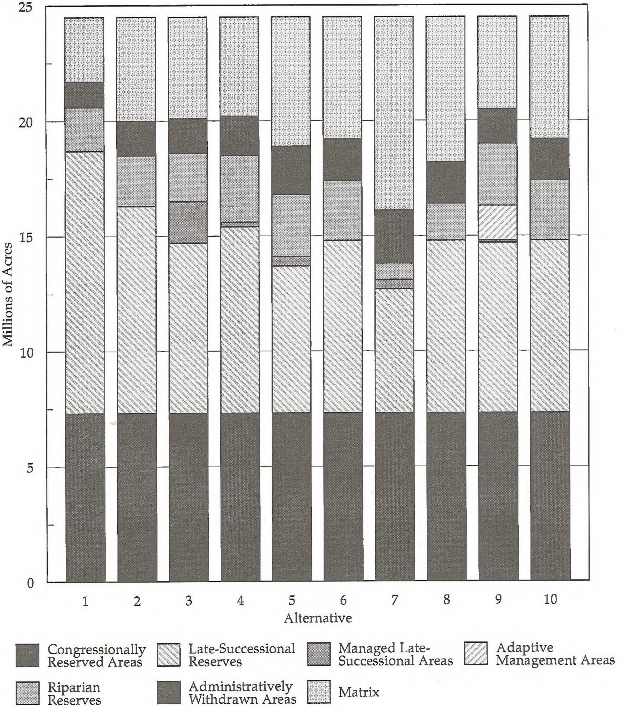
Table S-1. Summary and comparison of land allocations and standards and guidelines among alternatives

	Alternative	1	2	3	4	5	6	7	8	9	10
Congress. Res.	Million acres	7.321	7.321	7.321	7.321	7.321	7.321	7.321	7.321	7.321	7.321
Late-Successional Reserves	Million acres	11.402	8.951	7.359	8.066	6.376	7.501	5.423	7.501	7.431	7.501
	Timber harvest/salvage	None	Treatment of stands less than 50 years old. Very limited salvage	Same as Alternative 2	Treatment of stands and salvage per Northern Spotted Owl Recovery Plan	Same as Alternative 4	Same as Alternative 2	Same as Alternative 4	Treatment of stands in Murrelet Zone 1 up to 50 years. Other stands up to 180 years.	West - Treatment of less than 80 years old. East - Manage to reduce risk of catastrophic loss.	Same as Alternative 2
	Protection for sites occupied by marbled murrelets outside reserves	Yes	Yes	Yes	Yes	Yes	Yes	No[2]	No[2]	Yes	Yes
	Protection of SAT species closely associated with old growth	Yes	No	Yes	Yes	Yes	No	No	No	Yes	No
Managed Late-Successional Areas or Adaptive Management Areas (Alt. 9 only)	Million acres	0	0	1.700	0.238	0.381	0	0.381	0	1.522 (AMA) 0.102 (MLSA)	0
	Timber harvest/salvage	N/A	N/A	West - Long rotation, 50 percent retention East - Long rotation, or uneven-age management	Treatment of stands and salvage per Northern Spotted Owl Recovery Plan	Same as Alternative 4	N/A	Same as Alternative 4	N/A	Adaptive Management Areas and some Managed Late-Successional Areas	N/A
Administratively Withdrawn Areas	Million acres	1.080	1.509	1.499	1.652	2.067	1.828	2.282	1.828	1.477	1.828
Riparian Reserves	Million acres	1.880	2.164	2.134	2.896	2.674	2.513	0.622	1.503	2.628	2.513
	Widths[1]	2:1:1	2:1:1 in Tier I Key Watersheds, 2:1:$^1/_2$ other watersheds	Same as Alternative 2	Same as Alternative 1	Same as Alternative 2	Same as Alternative 2	Variable, usually no reserves on intermittent streams	2:$^1/_2$:$^1/_6$	Same as Alternative 1	Same as Alternative 2
Matrix	Million acres	2.773	4.511	4.443	4.284	5.637	5.293	8.428	6.303	3.975	5.293
	50-11-40	Yes	Yes	Yes	Yes	Yes	Yes	Natl. Forest-Yes BLM-modified	No	No	No
	Snags:logs:green trees per acre	2:2:6	2:2:6	Support 40% pop: West - 12, East - 2-10:4	Variable on National Forests. BLM - 2:2:6-9	Same as Alternative 4	2:2:6	Same as Alternative 4	Same as Alternative 4	Coastal areas WA/OR: 2:8-12:0 Other areas 2:8-12:15%	2:2:6

[1] Riparian Reserve Widths (e.g., 2:1:1), are expressed as multiples of the height of a maximum site-potential tree, measured on each side of fish-bearing streams, nonfish-bearing streams, and intermittent streams, respectively (see text).

[2] Not specifically required in the alternative, but currently required under the Endangered Species Act.

Figure S-1. Estimated federal land allocation by alternative



ecosystem and the values of the ecosystem for species and populations, and 3) connectivity - the extent to which the landscape pattern of the ecosystem provides for biological flows that sustain animal and plant populations.

In general, forest plantations, fire suppression, logging, ownership patterns, and human population and environmental influences have altered the regional ecosystem on Federal lands to the extent that none of the alternatives can provide for a return to conditions that closely match those of previous centuries. Site conditions across all landscapes will not return to their presettlement conditions within the next 100 years. However, all of the alternatives reverse the management trend of the last 50 years on Federal lands, which, if continued, would have resulted in a steep decline in the quantity and quality of late-successional ecosystems and the eventual loss of these ecosystems in many Federal planning areas.

Some alternatives provide greater likelihoods than others of maintaining and enhancing late-successional ecosystems at levels that approach typical long-term conditions. Alternatives 1, 3, 4, and 9 received the highest ratings. Alternatives 3 and 4 provide for relatively high amounts of late-successional forest and strong connectivity through the presence of riparian reserves and retention of old-growth components in managed forest matrix. Alternatives 3 and 4 also provide relatively high acreage of low elevation late-successional ecosystems, which are relatively rare throughout the entire region. Although Alternative 1 provides for the highest acreage of Late-Successional Reserves, it did not rate as high as Alternatives 3 and 9 because it lacks restoration silviculture in the reserves.

The Assessment Team assumed that without restoration silviculture, the development of late-successional conditions would be retarded. Alternative 9 achieved a 60 to 80 percent or greater cumulative likelihood of reaching less than long-term average conditions or better in moist provinces. Alternative 9 might have achieved a higher overall rating if it provided for more acreage of late-successional ecosystems in the low elevations of Oregon. The Assessment Team concluded that the opportunities to increase knowledge about ecosystem function and management in the Adaptive Management Areas of Alternative 9 actually increased the likelihood that this alternative would provide late-successional characteristics in the future.

The assessment of maintenance of a functional and interconnected, late-successional forest ecosystem was not revised to reflect the changes described in Appendix B11, Standards and Guidelines Resulting From Additional Species Analysis and Changes to Alternative 9, because the changes to the Outcomes as described in this assessment are expected to be relatively minor. Several of these standards and guidelines are likely to enhance the attributes of late-successional and old-growth forest ecosystems. The overall outcomes for the ecosystem are likely to improve at least slightly as a result of the additional measures incorporated into Alternative 9, but are not reflected in the results of the assessment.

Effects on Aquatic Ecosystems

The Aquatic Conservation Strategy (Appendix B6) was designed to address all elements of the aquatic and riparian ecosystem, including maintenance of hydrologic function; high water quality; adequate amounts of coarse woody material; a stable, complex stream channel; and a riparian area with suitable microclimate and vegetation. The likelihood of achieving an outcome with sufficient quality, distribution and abundance of habitat to allow riparian-dependent plant and animal species to stabilize, well-distributed across Federal lands, is lower for Alternatives 2, 3, 5, 6, and 10 than for Alternatives 1 and 4, and Alternative 9 with the standards and guidelines added since the Draft SEIS. However, the Assessment Team determined that all alternatives except 7 and 8 would reverse the trend of degradation and begin recovery of aquatic ecosystems and habitat on Federal lands within the range of the northern spotted owl. Even if changes in land management practices and comprehensive restoration are initiated, it is possible that no alternative will completely recover all degraded aquatic systems within the next 100 years. Faster recovery rates are probable for aquatic ecosystems under Alternatives 1 and 4, and Alternative 9 with the standards and guidelines added since the Draft SEIS than other alternatives. Alternatives 1 and 4, and Alternative 9 with the standards and guidelines added since the Draft SEIS would reduce disturbance across the landscape due to application of a larger Late-Successional Reserve network and the use of wider Riparian Reserves for intermittent streams throughout the planning area.

Effects on Air and Water Quality and Soil Productivity

Air Quality

All alternatives in this SEIS propose to continue the use of prescribed fire in the planning area. Consequently, all alternatives will have some smoke related impacts, which are the primary source of air quality degradation on federal lands under the proposed actions. This SEIS emphasizes the incorporation of ecosystem principles into forest management where fire is valued as a natural and necessary ecosystem process. Under ecosystem management, certain types of prescribed fire, such as understory burning, will be emphasized. Understory burning is designed to approximate natural low-to-moderate intensity wildfires, and generally burns with fewer particulate matter emissions than broadcast burning in clearcut harvest units. Total projected emissions aggregated over the planning area, therefore, are lower under all of the alternatives than historic emissions when fire use was primarily broadcast burning. While total particulate emissions are lower under each alternative than historic levels, the shift to lower intensity burning will result in different smoke dispersion characteristics that will need to be closely monitored to minimize air quality impacts.

Estimates of the expected acreage of prescribed fire use were calculated for all federally managed lands for each of the alternatives in this SEIS. Assumptions regarding the ecological need for prescribed burning, the hazard reduction necessary for risk management, and the amount of prescribed burning necessary for site preparation were made at this programmatic level. Results show that Alternative 9 would likely result in the greatest prescribed fire acreage at about 89,000 acres burned annually, followed by Alternatives 3, 7, 8, 5, 6, 10, 2, 4, and finally Alternative 1 with about 46,000 acres. All of these are below the 1985 to 1990 average of about 109,000 acres burned each year. Total emissions were estimated based on the acres of expected burning, the type of prescribed burning, and the emissions from each type of fuel consumed; so emissions by alternative would rank in a pattern similar to acreage burned.

The estimates are very generalized because many of the assumptions about the level of prescribed fire use for each land allocation within each province cannot be validated until watershed/landscape-level analysis or province-level planning are completed. Thus, air quality analysis at lower planning levels are critical in determining the actual amount of prescribed fire that may be needed on the landscape, and even more importantly, the air quality impacts of prescribed burning. The use of prescribed fire may reduce the likelihood of large, high-severity wildfire, as well as wildfire emissions. However, emissions tradeoff analyses are essential to document the optimum amount of prescribed burning necessary to offset wildfire emissions.

Water Quality

The effects to water quality under the alternatives vary depending on the acreages and distribution of the various land allocations and the type and location of land disturbing activities occurring under the alternative. The most significant factors related to potential water quality effects for each alternative are the selected Riparian Reserve scenarios, the level and location of road building, and the amount and method of timber harvest proposed. Alternatives 1, 4, and 9 would have the greatest benefit to water quality. Alternatives 2, 3, 5, 6 and 10 have the potential for not as great an improvement to water quality than Alternatives 1, 4, and 9, primarily because they provide less protection for intermittent streams in Tier 2 Key Watersheds and non-Key Watersheds. Alternatives 7 and 8 have the greatest potential to affect water quality of the 10 alternatives analyzed in this SEIS. Based on the Riparian Reserves scenario and other components of the Aquatic Conservation Strategy, all of the alternatives, except 7 and 8, are expected to maintain or improve water quality, although watershed recovery rates would be quickest for Alternatives 1, 4, and 9. Subsequent environmental effects analysis at the province, watershed, and site-specific levels will be needed to develop and implement water quality protection measures.

Soil Productivity

Alternatives 7 and 8 have the most matrix and thus, have the highest potential to adversely affect long-term soil productivity. Land disturbing activities affect long-term soil productivity by affecting: (1) soil bulk density (untilled skid trails, etc.); (2) soil displacement (road building, skid trails, etc.); (3) erosion (exposure of mineral soil, road placement and drainage); (4) nutrient status (removal of organic material by prescribed burning and intense utilization); and (5) soil biology. Alternatives 1 and 4 would have the least amount of soil disturbance predicted from management actions since they have the most Late-Successional Reserves and thus, would have the highest probability of maintaining long-term soil productivity. Alternatives 2, 3, 5, 6, 9, and 10 would have intermediate levels of disturbance and probability of maintaining long term soil productivity relative to the previously described alternatives. These alternatives have fewer areas within reserves but more matrix than Alternatives 1 and 4.

Effects on Threatened and Endangered Species

All of the alternatives provide for the continued existence of threatened and endangered species. In the case of the northern spotted owl and the marbled murrelet, many components of the alternatives were specifically designed to address the needs of these species. There are 39 federally listed and proposed species which may occur within the range of the northern spotted owl. The Fish and Wildlife Service also identified 10 of these species whose habitat use is known to include late-successional forest, or their occurrence is directly associated with such habitat. With this information, 23 of the listed and proposed species were eliminated from detailed discussion in the Final SEIS for one of three reasons: (1) they are not known to occur on the federal lands of the planning area, (2) they do not inhabit coniferous forests, or (3) their presence in the spotted owl's range is transitory or unaffected by forest management activities. It has been determined that the alternatives considered in the Final SEIS will have no effect on these species. The four salmon species are included in the narrative discussion to more completely describe the reasons for the determinations. The U.S. Fish and Wildlife Service and National Marine Fisheries Service have concurred with these determinations (see Appendix G).

The Fish and Wildlife Service identified six "species that are not restricted to only late-successional forests or that are associated with unique or specialized habitats that may not be considered late successional, but which may be affected by forest management activities." Some of these species were not evaluated by the Assessment Team because of their lack of association with late-successional forests, however, they are addressed in this SEIS to provide a complete accounting. The alternatives in this SEIS are not likely to adversely affect these species.

Four listed or proposed species are associated with late-successional forests: the bald eagle, the Oregon chub, the northern spotted owl, and the marbled murrelet. None of the alternatives is likely to adversely affect the bald eagle. Management of nonfederal lands and cumulative effects are affecting the Oregon chub, and cannot be mitigated by federal land management. The following discussion summarizes the effects of the alternatives on the other two species.

Northern Spotted Owl

The effectiveness of an alternative in providing for northern spotted owl recovery on Federal lands relies heavily on the spacing, size and location of the habitat. It was the conclusion of the Assessment Team that Alternatives 1 through 6 and 9 met or exceeded the conservation measures for federal lands for the Final Draft Spotted Owl Recovery Plan (USDI unpub. 1992a). Alternatives 7, 8 and 10 were found to have less assurance of owl recovery on federal lands, primarily due to inadequate provision of dispersal habitat. While Alternative 9 also lacked a specific dispersal habitat provision in the Draft SEIS, other aspects of this alternative were expected to provide adequate dispersal habitat. The additional standards and guidelines in Alternative 9 would increase this assessment of adequacy of the alternative. Therefore, selection of Alternatives 1 through 6, or Alternative 9 would provide the federal land allocations and standards and guidelines necessary to achieve recovery of the northern spotted owl.

Marbled Murrelet

In the short term, the alternatives will provide a varying degree of "reserve" protection for the population of murrelets known to occur in the planning area. However, eight alternatives (all but Alternatives 7 and 8) also provide for protection of murrelet sites outside of the reserves. The full impact of this protection outside reserves is not known at this time because of the limited surveys conducted for this species.

Alternative 1 provides habitat that would allow greater than 90 percent likelihood of providing habitat conditions to support a marbled murrelet population occurring well distributed on the federal lands. Alternatives 2, 3, 4, 5, and 6, had ratings of 84 percent likelihood of a well-distributed population on federal lands, and Alternatives 9 and 10 were rated at 80 percent. The lowest ratings were assigned to Alternatives 7 and 8. Alternative 7 was rated low because of its lack of specific protection of murrelet sites in the matrix and less protection of old-growth in coastal areas. Alternative 8 rated low because of poor protection of murrelet sites in the matrix, and also because of its allowance for timber harvest in stands up to 180 years of age.

In the Draft SEIS, Alternative 9 had a 80 percent likelihood of a murrelet population well distributed on federal lands. The modifications made to Alternative 9 have added protection of approximately 25,000 additional acres of Late-Successional Reserves in the Olympic Adaptive Management Area (AMA). Another change was for the Finney and Northern Coast Range AMAs, which have amended direction stating that this Late-Successional Reserve acreage may be reconsidered during development of the Adaptive Management Area plans, if the proposed actions are consistent with the Endangered Species Act requirements for the marbled murrelet. Other modifications to Alternative 9 which would likely improve the murrelet rating are: adoption of the Riparian Reserve Scenario 1, retention of 100 acres around spotted owl activity centers in the matrix, survey and manage provisions for a variety of other species, and retention of old-growth fragments in watersheds where little remains. These modifications would result in retention of more marbled murrelet habitat than the standards and guidelines for Alternative 9 described in the Draft SEIS. Based on the relative amount of Late-Successional Reserve acreage in the alternatives, it is likely that a rating of the modified Alternative 9 would fall between the ratings for Alternatives 2, 3, 4, 5 and 6 and the rating for Alternative 1.

Effects on Species not Threatened or Endangered

The Assessment Team determined that 1,116 terrestrial speci es were closely associated with late-successional and old-growth forests. These species were grouped into bryophytes, fungi, lichens, vascular plants, mollusks, amphibians and reptiles, birds, and mammals. A list of 15 functional groups of arthropods was also considered. Twenty-nine species of fish were determined to occur in streams within late-successional and old-growth forests within the range of the northern spotted owl. Each of the alternatives were evaluated to determine the likelihood of habitat on Federal lands to support populations of these species or groups of species. Expert panels were asked to predict a percent likelihood whether habitat would be of sufficient quality, distribution and abundance for species populations to: a) stabilize, well distributed, b) stabilize with significant gaps in distribution, c) continue existence only on refugia, or d) be at risk of extirpation. The assessment process and the potential outcomes that were predicted are described for each of the species or groups of species in Chapter 3&4. Additional species analysis was conducted between the Draft and Final Supplemental Environmental Impact Statements. The analysis focused on the likely outcomes for many of the species that were considered in the Draft SEIS. While the analysis focused most directly on responding to public comments on the preferred alternative (Alternative 9), much of it is also pertinent to the remaining nine alternatives.

The results of the original assessments and the additional analysis are summarized in Chapter 3&4, with extensive background material in Appendices A and J. Attempts to further summarize these results would be an oversimplification and possibly misleading. The following is a generalized comparison of the impacts anticipated for the alternatives based on the nature of the changes expected to occur to the habitat components important to the species or groups of species that were analyzed. The relative impacts described for Alternative 9 are those expected to occur with the standards and guidelines added between the Draft and Final SEIS.

Nonvascular Plants and Allies

This includes bryophytes, fungi and lichens. Bryophytes include hornworts, liverworts and mosses. The habitat components important to bryophytes include live, old-growth trees, decaying wood, riparian zones and generally the habitat characteristics achieved by more extensive and interconnected late-successional and old-growth forested conditions. Alternatives 1, 3 and 9, are generally the most favorable to bryophytes, because they provide the set of allocations and management practices that best produces the habitat components for bryophytes. Alternatives 4, 5, 7 and 8, provide respectively, less of these habitat conditions. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Fungi are neither plants nor animals but are recognized as a separate kingdom of organisms, both in structure and function. Species diversity of fungi appears highest in late-successional forests because of the diversity of habitat structures and host species, and the abundance of coarse woody debris and standing dead trees. Habitat components important to the fungi include dead, down wood; standing dead trees; and live, old-growth trees; as well as a diversity of host species and microhabitats. Also important for fungi is a well-distributed network of late-successional forest. Small forest fragments can function as refugia where fungi may persist until suitable habitat conditions become available in adjacent stands. Alternatives that retain more of these habitat features generally had higher ratings for species. Alternatives 1, 3, 4, and 9, are generally the most favorable to bryophytes, because they provide the set of allocations and management practices that best produces the habitat components for bryophytes. Alternative 5 would provide intermediate levels of this habitat. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for bryophytes. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Lichens are a conspicuous component of old-growth forest ecosystems where they play an important ecological role. The habitat components important to lichens include live, old-growth trees, decaying wood, riparian zones and extensive and interconnected late-successional and old-growth forested conditions. Alternatives 1, 4, and 9, are generally the most favorable to lichens, because they provide the set of allocations and management practices that best produces the habitat components for lichens. Alternatives 3 and 5 would provide intermediate levels of this habitat. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for lichens. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Vascular Plants

The largest and most dominant organisms of the late-successional and old-growth forest ecosystem are the vascular plants. Vascular plants are defined as those that contain conducting or vascular tissue. The habitat components important to vascular plants are those which generally increase amounts of late-successional, riparian, and old-growth habitat. Alternative 1 is generally the most favorable to vascular plants, because it provides the set of allocations and management practices that best produces the habitat components for vascular plants. Alternatives 3, 4, 5, and 9 are similar in providing intermediate levels of these habitat conditions. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for vascular plants. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Invertebrates

This includes arthropods and their allies, and mollusks. Arthropods include insects, crustaceans, arachnids, and myriapods and collectively constitute over 85 percent of biological diversity in late-successional and old-growth forests in the Pacific Northwest. The habitat components important to arthropods include all the features that comprise an extensive and interconnected late-successional and old-growth forested conditions, including a diversity of live, old-growth trees; standing dead trees; dead and downed wood; canopy structure; and riparian habitats. Alternatives 1, 3, and 4 are generally the most favorable to arthropods, because they provide the set of allocations and management practices that best produces the habitat components for arthropods. Alternatives 5, 7, and 9 would provide intermediate levels of habitat protection. Alternative 8 would provide less favorable habitat conditions for arthropods. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Mollusk species of northwest coniferous forests are comprised of land snails, slugs, aquatic snails and clams. The habitat components important to mollusks include moist forest environments; areas around springs, bogs, and marshes; basalt and limestone talus slopes; diverse vegetative cover; and the habitat characteristics provided in the Riparian Reserves and influenced by Late-Successional Reserve sizes. Alternatives 1, 3, and 9 are generally the most favorable to land snails, because they provide the set of allocations and management practices that best produces the habitat components for land snails. Alternative 4, 5, 7, and 8 would provide less favorable habitat conditions for the land snails. Alternatives 1, 4, and 9 are generally the most favorable to slugs, freshwater snails and clams, because they provide the set of allocations and management practices that best produces the habitat components for these species. Alternatives 3, 5, 7 and 8 would provide less favorable habitat conditions for slugs, freshwater snails and clams. Based on their overall features, Alternatives 2, 6, and 10 which were not rated by the Assessment Team would likely have effects on mollusk habitat similar to Alternative 5.

Vertebrates

This includes amphibians and reptiles, birds, mammals and fish. The number of species of amphibians and reptiles in coniferous forests of the Pacific Northwest is not large compared to the number of birds and mammals; however, amphibians and reptiles comprise a distinct and important component of the vertebrate fauna. No reptiles are closely associated with late-successional forests. The habitat components important to amphibians are those which would provide cool, moist old-growth conditions; cool water; reduced sedimentation; protection of headwater streams; and coarse woody debris, riparian zones and more extensive and interconnected late-successional and old-growth forested conditions. For the Riparian groups, Alternatives 1, 4, and 9, are generally the most favorable to amphibians, because they provide the set of allocations and management practices that best produces the habitat components for amphibians. Alternatives 3 and 5 would provide intermediate levels of habitat protection. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for these amphibians. For the Terrestrial groups, Alternatives 1 and 9, are generally the most favorable to amphibians, because they provide the set of allocations and management practices that best produce the habitat components for amphibians. Alternatives 3, 4, and 5 would provide intermediate levels of habitat protection. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for these amphibians. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

The habitat components important to birds are those which would increase large reserves, riparian protection and analysis, and retain green trees, snags, and down woody material within the matrix. Alternatives 1, 3, 4, 5, and 9, are generally the most favorable to birds, because they provide the set of allocations and management practices that best produces the habitat components for birds. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for birds. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Temperate coniferous forests of the Pacific Northwest provide habitat for a diverse array of mammal species. Habitat components important to mammals other than bats include: dead, standing wood; dead, downed wood; live, old-growth trees; and riparian zones. Large, decayed logs and snags are important to many mammals as resting and denning sites. Large expanses of live, old-growth trees are important to some mammals such as the fisher because they provide continuous canopy cover. Fisher may be negatively affected by forest fragmentation. Riparian zones provide potential habitat (including large snags and cover) for mammals such as fishers and American martens. In general, those alternatives that provide for greater amounts of late-successional and old-growth habitat resulted in higher ratings for mammal species. Alternatives 1, 3, and 9, are generally the most favorable to mammals, because they provide the set of allocations and management practices that best produces the habitat components for mammals. Alternatives 4 and 5 would provide intermediate levels of habitat conditions. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for mammals. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Bats are a diverse order of mammals. There may be more species of bats in North American temperate forests than any other group of mammals. The habitat components important to bats are those which would increase late-successional and old-growth forests, riparian areas, snags and down woody material. Alternatives 1, 3, and 9, are generally the most favorable to bats, because they provide the set of allocations and management practices that best produces the habitat components for bats. Alternatives 4 and 5 would provide intermediate levels of habitat conditions. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for bats. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

The fish species that are analyzed include resident fish and anadromous fish. There are an estimated 313 anadromous fish stocks at risk in the planning area. Habitat loss and degradation are principal factors in the decline of these fish on federal lands. Alternatives 1, 4 and 9 benefit aquatic and riparian habitats more than the other alternatives. These benefits are principally due to: (1) the application of Riparian Reserve Scenario 1 to intermittent streams in Tier 2 Key Watersheds and non-Key Watersheds, (2) the highest amounts of Late-Successional Reserves within Key Watersheds and throughout the range of the northern spotted owl, and (3) the least amount of the matrix contained within inventoried roadless areas. Aquatic and riparian habitats are expected to recover faster in part, due to these factors under Alternatives 1, 4 and 9. Alternatives 2, 3, 5, 6, and 10 benefit aquatic and riparian habitats to a greater degree than Alternatives 7 and 8, but to a lesser degree than Alternatives 1, 4 and 9. Some of the reasons for the differences are that Alternatives 2, 3, 5, 6, and 10 have less Late-Successional Reserves, include Riparian Reserve Scenario 2, and have more land in the matrix than Alternatives 1, 4, and 9. The opposite is true when comparing the benefits of Alternatives 2, 3, 5, 6, and 10 to aquatic and riparian habitat relative to Alternatives 7 and 8. Even though Alternatives 2, 3, 5, 6, and 10 benefit aquatic and riparian habitats to a lesser degree than Alternatives 1, 4 and 9, they would reverse the trend of aquatic and riparian habitat degradation and begin recovery of these habitats. The standards and guidelines for Alternatives 7 and 8 are not adequate to reverse the trend of aquatic and riparian habitat degradation and begin recovery of these habitats. The principal reasons are the lack of explicitly defined Riparian Reserves for Alternative 7, and the application of Riparian Reserve Scenario 3 for Alternative 8.

Effects on Timber Harvest Levels

Annual harvest levels from Federal forests within the range of the northern spotted owl averaged 4.5 billion board feet during the period 1980 to 1989. The alternatives considered to protect the habitat of the northern spotted owl and associated late-successional species will restrict timber harvest in these forests, resulting in substantial social and economic costs.

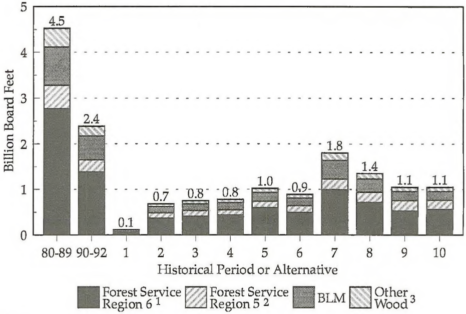
The probable levels of federal timber sales for the first decade for each alternative are summarized in Figure S-2, First Decade Probable Average Annual Timber Sale Levels (PSQ) by Historic Period and Alternative. The PSQ estimates in Figure S-2 include "other wood" which is the volume of cull, salvage, and other products that is not normally part of allowable sale quantity calculations. Historically, this has accounted for about 10 percent of the total harvest volume from timber suitable federal lands in the planning area.

The PSQ figures for Alternative 9 are changed from the Draft SEIS to reflect modifications made to Alternative 9 as a result of public comments and internal review. The overall result of the revisions to PSQ for Alternative 9 between the Draft SEIS and the Final SEIS is a reduction of 92 MMBF per year; from 1,050 MMBF to 958 MMBF per year, not including the "other wood."

Estimated sale levels under all alternatives are below program levels of the 1980s, as well as below the harvest levels of 1990-1992 when most new federal timber sales were enjoined. In 1990-1992, harvests consisted of sales under contract from the 1980's. The sale quantities of the alternatives will not permit 1990-1992 levels of timber harvest in the future. Due to several factors, it is likely that sale levels of the selected alternative will take one to three years to reach the decadal average sales potential.

In addition to reduced harvest quantities in the decade ahead, wood quality is also apt to decrease. In the first decade, thinning and other partial harvests would account for a large portion of the volume harvested under the various alternatives. Secondary wood products manufacturers may see an even greater decline in raw materials than the probable sale quantities would indicate as a result of smaller average tree size.

Figure S-2. First decade probable average annual timber sale levels (PSQ) by historical period and alternative



[1] Region 6 = Pacific Northwest Region
[2] Region 5 = Pacific Southwest Region
[3] Includes cull, submerchantable material, firewood and other products.

Effects on Regional Economics and Communities

Regional Employment

Under all of the alternatives, direct employment in timber harvesting and processing will decline as a result of reduced harvest levels as shown in Table S-2, Historic and Projected Employment in the Timber Industry in the Next Decade by Sub-Region and Alternative. The table compares the projected employment levels to employment in 1990 and estimated employment in 1992. The projections imply a range of job displacement from 4,600 to 15,900 jobs, relative to 1992. Compared to 1990, the potential displacement is 24,100 to 35,400 jobs.

The Final SEIS job displacement estimates are higher than the estimates displayed in the Draft SEIS. The differences result from corrections in predicting nonfederal harvest levels and, for Alternative 9, the reduction in PSQ from federal forests between Draft and Final SEIS. The majority of the affected jobs are in Oregon and are concentrated in southwestern Oregon.

The alternatives presented in this SEIS would have the greatest effect on the timber industry sector. In addition to displaced workers, there would be indirect effects caused by fluctuating business expenditures in the region and induced effects caused by changes in personal expenditures in the region. These ripple effects tend to increase the ramifications of job gains or losses in communities or regions. There is roughly one job affected outside the timber industry for every job affected within the timber industry.

Table S-2. Historical and projected employment in the timber industry in the next decade, by subregion and alternative[1]

	Actual	Estimated	Alternative									
State/Owl Region[2]	1990	1992	1	2	3	4	5	6	7	8	9	10
			-----------thousand jobs---------------									
Washington												
Olympic Peninsula	13.9		11.6	11.7	11.6	11.7	11.7	11.7	11.6	11.2	11.6	11.6
Puget Sound	25.7		20.3	20.4	20.4	20.4	20.3	20.4	20.3	20.5	20.3	20.4
Lower Columbia	14.1		12.4	12.6	12.6	12.6	12.7	12.6	12.7	12.6	12.6	12.6
Central	4.2		3.8	4.0	4.1	4.0	4.0	4.1	4.1	4.3	3.9	4.2
Total	57.9	51.3	48.1	48.7	48.7	48.7	48.7	48.8	48.7	49.0	48.4	48.8
Oregon												
Northwest	21.9		19.8	20.3	20.3	20.4	20.7	20.0	21.6	20.8	20.5	20.5
West-Central	20.9		13.7	14.4	14.5	14.6	15.0	14.3	16.0	15.4	15.0	14.9
Southwest	21.4		10.3	12.0	12.1	12.4	12.8	12.1	15.3	13.8	12.8	12.9
Central	8.9		7.4	8.0	8.0	8.0	8.1	8.0	8.4	8.2	8.1	8.1
Total	73.1	62.8	51.2	54.7	54.9	55.4	56.6	54.4	61.3	58.2	56.4	56.4
California												
Total	13.9	11.3	10.2	10.6	10.7	10.6	10.7	10.8	10.8	10.9	11.1	10.9
3 State Total	144.9	125.4	109.5	114.0	114.3	114.7	116.0	114.0	120.8	118.1	115.9	116.1

[1] Includes self-employed individuals in all solid wood products and pulp and paper sectors. Wage and salary employment is approximately 7.5 percent less than total employment.
[2] Owl Region = The range of the northern spotted owl.

Timber-based employment would decline under all alternatives considered as a result of reduced harvests. Subregions characterized as heavily timber dependent are apt to experience the most severe impacts. While service employment in forestry also appears to be faced with job declines, these declines could be offset through investments in reforestation, timber stand improvement, monitoring, inventory, and restoration activities.

Some employment gains could be made in recreation and tourism, as well as in special forest products. It may, however, be difficult to absorb displaced loggers and mill workers into these fields due to skill considerations and geographic locations. In the long run, the alternatives presented in this SEIS may provide an increased supply to commercial fisheries. Yet, in light of the current issues and the potential over-capacity of the industry, these gains may not be substantial. Restoration of salmon and trout runs, however, could have positive effects on coastal recreation.

Rural Communities

Washington, Oregon, and California differ in the pattern, severity, and regional distribution of the effects of reduced timber harvest to communities. The results of the analyses are discussed in terms of the severity and direction of the consequences, the communities' capacity to cope, and the resultant risk to the communities. The Assessment Team conducted a detailed analysis of Alternatives 1, 3, and 7. It found relatively few differences among the effects of the alternatives because the timber harvest levels in Alternatives 1 through 10 are far below recent averages. Impacts associated with Alternative 9 would likely fall between those presented for Alternatives 3 and 7.

Communities with combinations of low capacity to cope with change and negative consequences from the alternatives are "most at risk"; those with high capacity to cope and positive consequences are "least at risk." Using these definitions, Alternatives 1, 3, and 7 would result in about one-third of the 167 surveyed communities falling in the "most at risk" category. In all three alternatives, however, the changes are great compared to those for the 1985-87 harvest level scenario in which only 3 percent of the communities were so ranked. The majority of the communities "most at risk" in Alternatives 1, 3, and 7 are those highly dependent on the timber industry and on Federal forest lands as the source for much of their timber supply. Alternatives 1, 3, and 7 would likely lead to additional mill closures and reduced forest related employment, and to real damage to the economic and social infrastructure.

The "most at risk" communities differ from others in significant ways. These communities are smaller (average population 3,000), and they are located in counties with low population density. Isolated communities are more likely to experience negative consequences with Alternatives 1, 3, and to a lesser degree 7, because they have few options available locally or in nearby communities, and because of limited access to capital, transportation links, and other resources. Communities that are small, isolated, and lacking economic diversity are more likely to be "at risk" than others. These communities may find it difficult to mobilize and respond to changing conditions which may affect a variety of groups. These communities are likely to experience unemployment, increased poverty, and social disruption in the absence of assistance.

People Coping With Change

Changes in the management of the federal forests in the spotted owl region, administered by the Forest Service and BLM, have effects (impacts) on people and the families, groups, and communities to which they belong. The social, community, and cultural changes resulting from implementation of any of these alternatives will be disproportionately intense in rural and timber-dependent areas. The social effects of the alternatives stem fairly directly from changes in the timber harvest levels of the alternatives. This is not meant to indicate that timber harvest is the only meaningful link between the Forest Service/BLM and people, but it is the most crucial variable among these alternatives.

The changes in timber harvest from Alternatives 1-6, 9 and 10 will last longer than any firm or worker's ability to "wait it out." The changes in timber harvest under Alternative 8 would have less impact than under Alternatives 1-6, 9 and 10, but still result in a downturn from Alternative 7. All alternatives will force timber harvest levels lower than experienced in Washington, Oregon, and California in the last two decades, with Alternatives 1-4 and 6 reducing the timber harvest levels most, while Alternatives 5 and 9-10 have the smaller reductions, and Alternatives 7 and 8 which continue high timber harvests. However, this high level is lower than the historical averages in the 1980's and early 1990's.

American Indian People and Cultures

Given both traditional and contemporary links between American Indians and forests, it is clear that tribal members depend on public lands and resources for employment, subsistence, and cultural identity. It is recognized that Indians tribes have an interest in Forest Service and BLM administered forest resources and it is emphasized that the Indian rights and interests are not set aside by this SEIS nor does it impose any extra conservation burden on the tribes or Indian reservations. Timber harvest and management on tribal and Indian owned lands are not controlled or modified by this SEIS. The SEIS has examined the potential to impair or restrict the rights of various tribes and finds that none fall into that category.

Every alternative has some amount of logging and road construction activities on the federal forest lands which are potentially disturbing to the land, fisheries, and cultural sites. Yet the amounts of disturbance are well below historic levels. There appears to be little difference in consequences associated with the low levels of land disturbance in Alternatives 1, 2, 3, and 4. The degree of disturbance to vegetation, land, and cultural sites under Alternatives 5, 6, 8, 9, and 10 is slightly higher, but lower than Alternative 7, which would have the highest ground disturbance. On the other hand, since a large number of archaeological and historic places are discovered while conducting ground searches prior to ground disturbing activity, there may be fewer total archaeological and culturally important sites discovered under the alternatives that have reduced timber harvest and road construction activities. All alternatives except Alternatives 7 and 8 would reverse the trend of aquatic and riparian habitat degradation and begin recovery of these habitats. Application of the Aquatic Conservation Strategy within the range of the northern spotted owl would improve habitat conditions for stocks of fish important to American Indians.

Chapter 1
Purpose and Need

Chapter 1
Changes Between the Draft and Final SEIS

The following change was made in Chapter 1 between the Draft and Final Supplemental EIS. Minor corrections, explanations and edits have also been made.

- Language was added to more clearly link the underlying need and the purpose of the proposed action to the direction given by President Clinton at the Forest Conference.

Chapter 1
Purpose and Need

Introduction

This chapter specifies the underlying purpose and need to which the Forest Service and Bureau of Land Management (BLM) are responding in developing this Supplemental Environmental Impact Statement (SEIS). The Fish and Wildlife Service, Environmental Protection Agency, National Marine Fisheries Service, and the National Park Service are assisting as cooperating agencies. This SEIS assesses alternatives for managing those federal forests of the Pacific Northwest and northern California within the range of the northern spotted owl (*Strix occidentalis caurina*) that are administered by the Forest Service and the BLM.

Background

The ongoing controversy concerning management of federal lands has resulted in what has been described as a gridlock of lawsuits, court rulings, appeals, and protests (see Appendix D, Related Direction and Activities). The public debate has expanded from a focus on management of northern spotted owl habitat to include management of all old-growth forest associated species and old-growth ecosystems. The Scientific Analysis Team Report (Thomas et al. 1993) appears as Appendix H of this SEIS. It offers an overview of the controversy in its Appendix 1-A, An Historical Perspective on the Evolution of the Spotted Owl Issue and Its Incorporation Into *de facto* Forest Management Policy. This overview offers a history of the research on the spotted owl since the late 1960's and the land management decisions made by the agencies since 1979 to provide increasing protection for habitat for the northern spotted owl.

Recent court rulings require completion of environmental impact statements. The Forest Service is required by the U.S. District Court for the Western District of Washington to prepare a new or supplemental Environmental Impact Statement (EIS) to correct deficiencies the court found in the *Final Environmental Impact Statement on Management for the Northern Spotted Owl in the National Forests* (USDA FS 1992). The BLM is required by the U.S. District Court for the District of Oregon to prepare an EIS to incorporate new information on the effects of logging on the northern spotted owl and to consult on a conservation strategy. Both agencies are currently enjoined from selling timber in northern spotted owl habitat.

To seek a solution to the controversy, President Clinton held a Forest Conference in Portland, Oregon, on April 2, 1993. During the day-long conference, scientists, economists, representatives from the forest products industry and environmental groups, Indian tribes, and others were invited to present concerns, opinions, or proposals to the President concerning the various issues surrounding the management of federal lands in the Pacific Northwest and northern California.

After the Forest Conference, the Forest Ecosystem Management Assessment Team ("the Assessment Team") was assembled to prepare an assessment that took an ecosystem approach to forest management (see Appendix C, Letters of Direction). The Assessment Team examined many options, evaluated them, and developed and presented 10 options in their report, *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment* ("the FEMAT Report"). It is Appendix A of this SEIS and, as are other uncirculated appendices, is available on request.

Using the FEMAT Report, the SEIS Interdisciplinary Team prepared a Draft SEIS with the Assessment Team's 10 options as alternatives. The Draft SEIS was available to the public, agencies, tribes, and other governments for review on July 30, 1993. Following a 90-day comment period which included public hearings and which elicited over 100,000 comments, the SEIS Interdisciplinary Team considered these comments, utilized new information, modified some of the alternatives, and subsequently prepared this Final SEIS.

The Underlying Need

The agencies are responding to dual needs: the need for forest habitat and the need for forest products.

The need for forest habitat is the need for a healthy forest ecosystem with habitat that will support populations of native species (particularly those associated with late-successional and old-growth forests) and includes protection for riparian areas and waters. This need was reflected by President Clinton in these words at the Forest Conference (Forest Conference Transcripts 1993:252-253):

> *[A]s we craft a plan, we need to protect the long-term health of our forests, our wildlife, and our waterways. . . . [W]e hold them in trust for future generations.*

The need for forest products from forest ecosystems is the need for a sustainable supply of timber and other forest products that will help maintain the stability of local and regional economies on a predictable and long-term basis. This need was reflected by President Clinton in these words at the Forest Conference (Forest Conference Transcripts 1993:252-253):

> *[W]e must never forget the human and the economic dimensions of these problems. Where sound management policies can preserve the health of forest lands, [timber] sales should go forward.*
>
> *[T]he plan should produce a predictable and sustainable level of timber sales and nontimber resources that will not degrade or destroy the environment.*

Each of the alternatives in this SEIS meets both needs to some degree.

The Purposes

While meeting the underlying needs, the agencies also strive to meet additional purposes.

The agencies must take an ecosystem management approach to forest management, with support from scientific evidence, and meet the requirements of existing laws and regulations. These requirements were reflected by President Clinton at the Forest Conference (Forest Conference Transcripts 1993:253):

> *[O]ur efforts must be, insofar as we are wise enough to know it, scientifically sound, ecologically credible, and legally responsible.*

The agencies must cooperate with all the federal agencies. As also stated by President Clinton at the Forest Conference (Forest Conference Transcripts 1993:253):

> *[W]e will do our best to make the federal government work together and work for you. We may make mistakes but we will try to end the gridlock within the Federal Government and we will insist on collaboration not confrontation.*

The alternatives considered in detail in this SEIS respond to these underlying purposes and needs. Alternatives which would not meet these underlying purposes and needs were eliminated from detailed study.

The Proposed Action

The proposed action is to adopt coordinated management direction for the lands administered by the Forest Service and the Bureau of Land Management within the range of the northern spotted owl that meets the underlying need and purposes. This region-wide management direction will provide overall coordination across administrative units, provinces, and watersheds. The action will amend the management direction established in all existing Forest Service and BLM land management plans for the areas and resources covered by this SEIS. This new management direction will apply to projects which will be conducted after site-specific environmental analysis. The existing management plans to be amended include existing Regional Guides, Forest Plans, Unit Plans, Timber Management Plans, Management Framework Plans, and Resource Management Plans for lands within the range of the northern spotted owl. The coordinated management direction established by the Record of Decision for this SEIS will also be incorporated into all land and resource management plans within the range of the northern spotted owl as they are completed or revised.

Scoping

Scoping is the term used for identifying issues, concerns and opportunities associated with the proposed action in an environmental impact statement. In this case, scoping focused on the management of late-successional and old-growth forests on federal lands. President Clinton's Forest Conference served as a focal point to discuss the issues surrounding management of late-successional and old-growth forests on federal lands within the range of the northern spotted owl. At the conclusion of that conference, he directed the members of his Cabinet to prepare a plan and enunciated five principles to guide the formulation of that plan (Forest Conference Transcripts 1993:252-253). Those five principles formed the basis for the underlying need and purposes identified above.

Following the Forest Conference, representatives of the Clinton administration held meetings with interested parties to solicit their ideas. In addition, the

Forest Ecosystem Management Assessment Team received and considered numerous submissions from interested groups and members of the public. The Forest Conference and the subsequent meetings and submissions served to confirm and specify the scope of the issues, potential effects and appropriate analysis.

Moreover, the issues surrounding the management of late-successional and old-growth forest ecosystems to be addressed in this SEIS have been before the public and discussed for a number of years. Congress has held several hearings on these issues. A report entitled *Alternatives for Management of Late-Successional Forests of the Pacific Northwest* (Johnson et al. 1991) was prepared at the request of the Agriculture Committee and the Merchant Marine and Fisheries Committee of the U.S. House of Representatives in October 1991.

The Forest Service has completed Forest Plans for most of the National Forests within the range of the northern spotted owl, and has prepared Draft Forest Plans for the remaining Forests. Additionally, scoping for these Forest Plans and the *Final Supplement to the Environmental Impact Statement for an Amendment to the Pacific Northwest Regional Guide* (USDA FS 1988) included issues regarding management of late-successional and old-growth forests, and served to focus the public on the issues. The Forest Service more recently received extensive public comment on the *Final Environmental Impact Statement on Management for the Northern Spotted Owl in the National Forests* (USDA FS 1992).

The Fish and Wildlife Service elicited comments when it proposed listing the northern spotted owl and marbled murrelet. They also held public hearings during the summer of 1991 on the proposed designation of critical habitat for the northern spotted owl, and have more recently received comments on the *Recovery Plan for the Northern Spotted Owl -Draft* (USDI 1992). During the spring of 1992, there was public comment and discussion in connection with the hearings conducted by the Endangered Species Committee ("the God Squad") on a proposed exemption to the Endangered Species Act.

The Bureau of Land Management is in the process of preparing Resource Management Plans (RMPs) for its Districts in western Oregon, and has completed plans for the lands they administer in California within the range of the northern spotted owl. Scoping for these plans identified issues surrounding the management of late-successional and old-growth forest ecosystems. Between 1986 and 1992, the Bureau of Land Management conducted scoping and solicited and received public comments regarding these issues.

All of these efforts, including those of Congress and the relevant land and resource management agencies, coupled with the actions during and after the Forest Conference, have served to focus the issues such that additional scoping was not necessary prior to the preparation of this SEIS (Appendix C, June 21, 1993, letter from the Council on Environmental Quality). Also, as stated in the regulations at 40 CFR 1502.9(c)(4), additional scoping is not required for a supplement to an environmental impact statement.

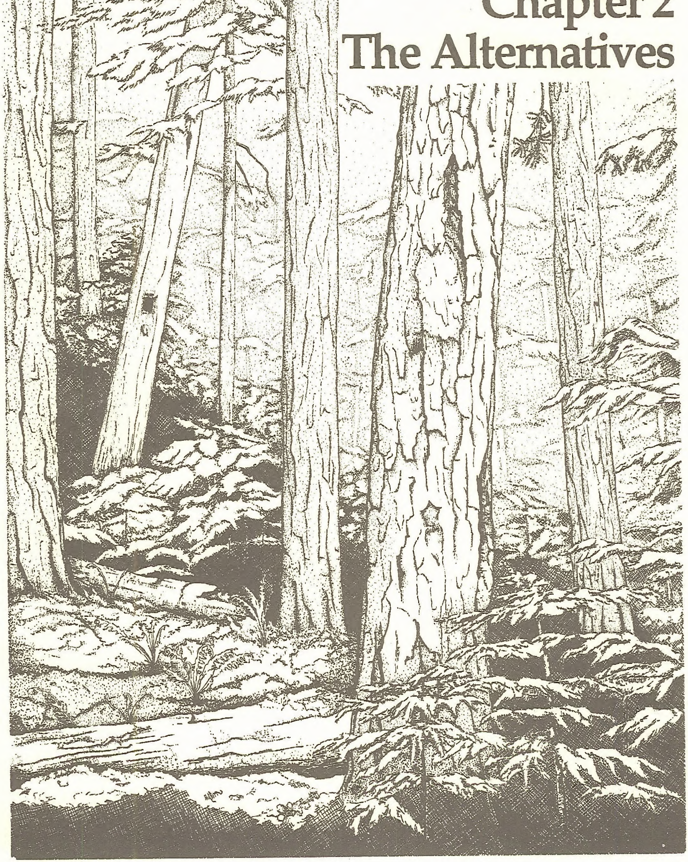
The Supplemental Environmental Impact Statement

For the Forest Service, this SEIS will supplement the *Final Environmental Impact Statement on Management for the Northern Spotted Owl in the National Forests* (USDA FS 1992). For the Bureau of Land Management, this SEIS will supplement the Draft Environmental Impact Statements for the Draft Resource Management Plans for the Salem, Eugene, Coos Bay, Roseburg and Medford Districts, and the Klamath Falls Resource Area of the Lakeview District in Oregon (USDI BLM 1992a-f). It will also supplement BLM's Final Environmental Impact Statements for the Resource Management Plans for the Arcata and Redding Resource Areas of the Ukiah District in California, and for the King Range National Conservation Area Management Plan.

Because these alternatives would amend several land management plans for both the Forest Service and the BLM which all provide direction in the same planning area, it does not represent a separate and distinct project, and does not warrant a new EIS. This is a Supplemental EIS because it is the most appropriate document to disclose the effects of modifying portions of existing plans—plans which continue in effect and form part of these alternatives.

The Assessment Team and the SEIS Interdisciplinary Team's work built on the analyses in earlier plans and environmental impact statements for lands administered by the Forest Service and BLM. So, too, does the analysis in this SEIS take into account the data and analysis in each of the NEPA documents it is supplementing. To the extent such data and analysis continue to be relevant to, and are not superseded by, the contents of this SEIS, they are incorporated by reference (40 CFR 1502.21). The regional scope of this analysis renders impracticable site-specific detail in this SEIS. The agencies will complete environmental analysis as appropriate for site-specific activities.

Chapter 2
The Alternatives



Chapter 2
Changes Between the Draft and Final SEIS

The following changes were made in Chapter 2 between the Draft and Final SEIS. Minor corrections, explanations and edits are not included in this list.

- As a result of additional species analysis, Alternative 9 was revised to incorporate Riparian Reserve Scenario 1 instead of Riparian Reserve Scenario 2. Standards and guidelines were also added to Alternative 9 that set levels of coarse woody debris and snag retention, require surveys and management for for some rare and endemic species, add protection for bat roosting sites, retain remnant old-growth stands in watersheds with less than 15 percent old-growth forest, and allocate 100 acres around all known northern spotted owl nest sites to Late-Successional Reserves.

- The 180-year rotation requirement for northern California National Forests in Alternative 9 was dropped in favor of following Forest Plan standards and guidelines.

- Language was added to clarify the requirement that thinning is permitted within Late-Successional Reserves only if it is "beneficial" to the creation and maintenance of late-successional forest conditions.

- Management of the portions of the Lassen and Modoc National Forests within the range of the northern spotted owl is more clearly addressed in the standards and guidelines.

- Federal lands not administered by the Forest Service or BLM are now shown on maps, tables, and figures as Congressionally Reserved Areas.

- Clarification was added to indicate that scheduled timber harvest is expected to occur in many of the Adaptive Management Areas as well as the matrix.

- Existing developed downhill ski areas under special use permit were removed from Late-Successional Reserves. This affects all or part of four additional ski areas.

- Map references were clarified, and the location of the "official SEIS maps" is now identified.

- Numerous minor boundary revisions were made to Late Successional Reserves and to Key Watersheds to correct errors and align boundaries with natural topographic features, and to better include late-successional stands.

- The standard and guideline for recreation in Riparian Reserves was revised to allow development to occur that does not prevent attainment of Aquatic Conservation Strategy objectives.

- Within the Columbia River Gorge National Scenic Area, the designated land allocation for developed public recreation and agricultural sites was changed from Late-Successional Reserves to Administratively Withdrawn Areas.

- All relevant and applicable standards and guidelines from the FEMAT Report now appear in the text of the SEIS.

- Although standards and guidelines from current plans and draft plan preferred alternatives apply to all alternatives where they are more restrictive or provide greater benefits to late-successional forest related species, the text was changed to reflect three exceptions: (1) direction specific to northern spotted owls and their habitat, (2) higher matrix green tree retention standards and guidelines, and (3) certain Administratively Withdrawn Areas for old-growth related species in Alternative 9.

- The text was clarified to state that management consistent with approved recovery plans for listed species, such as the bald eagle, and for Research Natural Areas takes precedence over Late-Successional Reserve standards and guidelines.

- A requirement was added to develop management direction specific to Late-Successional Reserves (including fire management direction), either as a separate document or as part of other plans.

- A standard and guideline was added stating that some research not otherwise consistent with the objectives of Late-Successional Reserves or Aquatic Conservation Strategy may be appropriate.

- To supplement spotted owl protection for Alternative 9, Managed Late-Successional Areas were added for known owl activity centers in the Washington Eastern Cascades and the California Cascades Provinces. This change affects approximately 21 activity centers and 102,000 acres.

- References to "oversight" were changed to "review by the Regional Ecosystem Office" to clarify who has responsibility for such reviews.

- The monitoring and adaptive management sections were expanded and clarified.

- The Interagency Coordination section was revised to reflect the direction in the Memorandum of Understanding for Forest Ecosystem Management.

- The planning section was revised and a discussion of watershed analysis was added to provide a context for implementation.

- The data base for the Draft SEIS and the acreage calculations for the alternatives based on that data were corrected. These corrections are listed in a separate section, Acreage and Data Changes Between Draft and Final, and are reflected in the Alternative 9 map that accompanies this Final SEIS.

- A statement was added to clarify that the management direction and land allocations of the preferred alternative (Alternative 9) constitute the federal lands' contribution to the recovery of the northern spotted owl.

Chapter 2
The Alternatives

Introduction

Chapter 2 discusses the issues and presents 10 alternatives for accomplishing the proposed action. Each alternative is an ecosystem management plan for managing habitat for late-successional and old-growth forest related species, including the northern spotted owl, on lands administered by the Forest Service and the Bureau of Land Management (BLM) within the range of the northern spotted owl.

Each alternative consists of combinations of: (1) land allocations managed to protect and enhance habitat for late-successional and old-growth forest related species and to protect and enhance aquatic resources, and (2) standards and guidelines for the management of these land allocations. Following these alternatives is a discussion of the alternatives considered but eliminated from detailed study. A comparison of the major effects of the 10 alternatives is presented at the end of the chapter.

The preferred alternative in this SEIS is Alternative 9, the substance of which has been slightly modified from Alternative 9 in the Draft SEIS by incorporating additional standards and guidelines. Designating an alternative as "preferred" indicates a preference, not a decision. The decision to select an alternative to implement will be disclosed in the Record of Decision, which follows this Final SEIS by at least 30 days.

The Issues

This description of the issues is based on past documents, public comments, court cases, media reports and features, and transcripts of the April 2, 1993, Forest Conference. These issues will serve to focus the comparison of the alternatives.

For more than two decades there has been growing controversy about the management of the old-growth forests on federal lands. When harvested, they have great economic value and make way for younger forests and the wildlife they support. If preserved, they provide an environment for many other species and contribute to other nontimber forest values and environmental qualities.

At the Forest Conference, President Clinton posed the fundamental question in his opening remarks (Forest Conference Transcripts 1993:4):

> *How can we achieve a balanced and comprehensive policy that recognizes the importance of the forests and timber to the economy and jobs of this region, and how can we preserve our precious old-growth forests, which are part of our national heritage and that, once destroyed, can never be replaced?*

President Clinton continued (Forest Conference Transcripts 1993:5):

> *The most important thing we can do is to admit, all of us to each other, that there are no simple or easy answers. This is not about choosing between jobs and the environment, but about recognizing the importance of both and recognizing that virtually everyone here and everyone in this region cares about both.*

The ecological systems within the range of the northern spotted owl are complex and varied. Managing these ecosystems to preserve and enhance late-successional and old-growth forests and aquatic resources will have major effects on the overall structure, function, and appearance of the region's forests; the water quality in streams and rivers; and the distribution, connectivity, diversity, and sustainability of its terrestrial and aquatic communities.

In the last decade, the northern spotted owl became the focus in the debate over how federal forest lands should be managed. However, the management of habitat for the spotted owl affects other terrestrial and aquatic species and the region's ecological systems collectively. There are 40 federally-listed threatened or endangered species that may occur within the range of the northern spotted owl; of these, about half use coniferous forest habitat on federal lands. The northern spotted owl and the marbled murrelet are listed as threatened species. The long-term persistence of the spotted owl and other old-growth related species depends in large measure on providing habitat of adequate amount and distribution to support their life functions.

The set of factors affecting long-term persistence of these species, including the northern spotted owl, is complex and not precisely known. While most people want the spotted owl and other old-growth species to survive, there is disagreement over the size of populations that should be provided for, and the forest management that will allow for long-term survival.

Aquatic and riparian areas are integral parts of the region's ecosystems and major factors in supporting the economy of the region. Damage to forest aquatic and riparian systems has contributed to degradation of some plant and animal communities. Of immediate concern is the loss of salmon and steelhead runs, which are major cultural and economic elements in the Pacific Northwest and northern California. The concern is both for the numbers of fish and for their genetic diversity.

Since World War II, timber management has been a major part of the Forest Service and Bureau of Land Management's role of actively managing federal lands for a variety of sustainable benefits for the Nation. The timber management program on federal forests within the range of the northern spotted owl has focused on harvesting older forest areas for timber and replacing them with faster-growing young stands. Older forests are essential habitat for many species; as the amount of older forests has decreased, the survival of old-growth related species, including the northern spotted owl, has become more uncertain.

Managing federal lands to provide habitat for northern spotted owls and other old-growth related species will result in a change in the extent and rate of harvest of older forest areas, as well as changes in how other forest areas are managed. Management to maintain or increase diversity of the forests' structure and function is itself an issue. Species that need young forests and species that need older forests are affected in different, and often opposite, ways by changes in the age, composition, and distribution of the habitat each need.

The BLM and Forest Service's timber management programs provide raw material for the wood products industry that, after milling and processing, serve the needs of a large number and variety of consumers. The wood products industry's principal employment is located in small cities, towns, and rural areas. From 1986 to 1990, wood from federal forests supported half the industry's jobs. Additionally, a quarter of the receipts from timber sales on federal lands (and half of the receipts from the Oregon and California Revested Lands (O&C lands)) go to county governments.

Reductions in the amount of timber sold for harvest directly affect employment and the economic health of the forestry and wood products industries. These, in turn, immediately affect the economic vitality of the communities dependent on them, and the well being of workers and families. These changes threaten the ability of some of these communities and their institutions to survive.

There are other human uses of federal forest lands that would be enhanced, maintained or curtailed if forests were managed to benefit the northern spotted owl and other late-successional and old-growth related species. Road construction and use, recreation, mining, and other land uses will be affected. There are alternate paths for people and communities to take to adjust to changes. The effectiveness of those paths and the human costs of making those changes are both dynamic and significant issues.

Consultation

Consultation on Alternative 9 was conducted with the Fish and Wildlife Service and the National Marine Fisheries Service in accordance with Section 7 of the Endangered Species Act. Their responses are included in Appendix G of this document. Actions proposed to implement the selected alternative will undergo consultation, either formal or informal, as appropriate.

Management direction and land allocations of Alternative 9 are intended to constitute the Forest Service and BLM contribution to the recovery of the northern spotted owl. Consultation would not be required for activities consistent with standards and guidelines of Alternative 9 if those activities will not result in incidental take.

In the event that anadromous salmonids are listed following the Record of Decision for this SEIS, the National Marine Fisheries Service will consult with the Forest Service and BLM on implementation of the selected alternative. Consultations may also be needed at lower levels of land management planning during implementation. In consultations with land management agencies in the Snake River Basin on currently listed anadromous salmonids, the National Marine Fisheries Service has recommended riparian protection and other measures, such as watershed restoration, that are consistent with the preferred alternative. Based on existing information, the National Marine Fisheries Service anticipates applying the Aquatic Conservation Strategy objectives with Riparian Reserve Scenario 1 during consultation on anadromous fish in the northern spotted owl's range. Consultation could be on a Forest, province, or watershed basis, depending on the sufficiency and specificity of available information. Also considered would be the scale at which management decisions are made. It is the intent of the National Marine Fisheries Service to work cooperatively and early in implementation planning, to facilitate and expedite compliance with Section 7 provisions.

Under the selected alternative specified in the Record of Decision, appropriate consultation under the Coastal Zone Management Act will take place with the appropriate state(s) concerning those activities that take place within the coastal zone.

Critical Habitat

Within the planning area there is designated critical habitat for the Oregon silverspot butterfly and the northern spotted owl. Regardless of which alternative is selected in the Record of Decision for this SEIS, the Forest Service and Bureau of Land Management will consult on any proposed actions that may affect critical habitat (50 CFR 402.14). The appropriateness of future proposed actions in critical habitat will be determined through consultation, informal or formal, with the Fish and Wildlife Service according to Section 7(a) of the Endangered Species Act.

In January 1992, the Fish and Wildlife Service determined the lands that comprise critical habitat for the northern spotted owl. After the Record of Decision for this SEIS has been signed, the Fish and Wildlife Service may review and revise its critical habitat designation for the northern spotted owl, based on the selected alternative.

In January 1994, the Fish and Wildlife Service issued a proposed rule designating critical habitat for the marbled murrelet. The Forest Service and Bureau of Land Management will confer on any proposed actions in proposed murrelet critical habitat as required under the Endangered Species Act.

The Biological Opinion (Appendix G) addressed the potential impacts of Alternative 9 on the proposed critical habitat for marbled murrelet.

The Planning Area

Three components contribute to the complexity of managing federal lands: multiple agencies, intermingled ownerships, and a variety of planning and legal requirements that have changed over the years. Because this SEIS proposes management direction for lands administered by both the Forest Service and Bureau of Land Management, descriptions of administrative units and references to management plans are lengthy and may be unavoidably confusing.

The "planning area" for this plan is the area of federally administered lands within the range of the northern spotted owl. These lands are located in western Washington, western Oregon and northwestern California. See Figure 2-1 below.

While the Forest Ecosystem Management Assessment Team (the Assessment Team) considered all federal lands within the range of the northern spotted owl, including those managed by the Fish and Wildlife Service, National Park Service, and Department of Defense, the management direction in this SEIS applies only to those lands managed by the Forest Service and Bureau of Land Management.

Federal lands other than those managed by the Forest Service and the BLM are expected to generally maintain their existing habitat conditions. The influence of these lands has been considered in the analysis of effects in this SEIS, but no new management direction for them is presented here. The National Parks and Monuments, Wildlife Refuges, and military reservations are shown as Congressionally Reserved Areas in all alternatives (see Appendix D).

Nonfederal lands, which include state and private land, and (for this analysis) tribal and Indian owned lands, are not included in the planning area of this SEIS, and no management direction is given for them. However, impacts from expected management activities on nonfederal lands were considered as part of the cumulative effects analysis in this SEIS in accordance with the requirements of NEPA.

Relationship of the SEIS Alternatives to Existing Forest Service and BLM Management Plans and Environmental Impact Statements

The direction established by the Record of Decision for this SEIS will be added to the existing management direction for those administrative units without adopted Forest or District Plans, and will supersede management direction contained in existing plans where it differs for specific resources or areas, except as otherwise specifically provided. Standards and guidelines and land

Figure 2-1. Range of the northern spotted owl within the United States

allocations in the existing plans not directly superseded by the selected alternative will remain in effect. The standards and guidelines and land allocations of the selected alternative will be incorporated into plans which are being developed. Resource management and the quantity of timber offered for sale will reflect the implications of the standards and guidelines and the land allocations of the selected alternative. Thus, the selected alternative will supplement or amend all of the plans and EISs listed in Table 2-1. Additional agency details are provided below.

Forest Service

This SEIS supplements the January 1992 *Final Environmental Impact Statement on Management for the Northern Spotted Owl in the National Forests* (FEIS) (USDA FS 1992). The alternatives described in this SEIS supplement (add to) the five alternatives described in the FEIS. The Record of Decision for this SEIS will supersede the Record of Decision dated March 3, 1992, for the *Final Environmental Impact Statement on Management for the Northern Spotted Owl in the National Forests* (USDA FS 1992).

The Record of Decision for this SEIS will amend the Pacific Northwest and Pacific Southwest Regional Guides with the standards and guidelines of the selected alternative.

The Record of Decision for this SEIS will amend approved National Forest Land and Resource Management Plans with the standards and guidelines of the selected alternative. For those National Forests without approved Forest Plans, the standards and guidelines of the selected alternative will apply directly to management activities, and will be incorporated into Forest Plans as they are developed.

BLM

The existing BLM Management Framework Plans for western Oregon Districts will be amended as a result of the direction established by the Record of Decision for this SEIS. This SEIS supplements the BLM Draft Resource Management Plans and Environmental Impact Statements (RMP/EISs) of August 1992 for the Salem, Eugene, Coos Bay, Roseburg, and Medford Districts, and the Klamath Falls Resource Area of the Lakeview District (USDI BLM 1992a-f). This SEIS supplements the seven alternatives analyzed in each of these Draft Plans.

The Record of Decision for this SEIS will amend the plans for the Redding Resource Area, the Arcata Resource Area, and the King Range National Conservation Area of the Ukiah District in California with the standards and guidelines of the selected alternative.

Implementation

The alternative selected in the Record of Decision for this SEIS will be implemented on lands administered by the Forest Service and BLM within the range of the northern spotted owl. Under the selected alternative, management activities will meet National Environmental Policy Act (NEPA) requirements. Resource management activities will be subject to site-specific environmental analysis and appropriate public participation before they are conducted. This will involve analysis of cumulative and other environmental effects.

Each alternative provides a strategy for the entire range of the northern spotted owl that includes land allocations, and standards and guidelines that cross physiographic provinces, and federal agencies' administrative boundaries. Management activities will be in accordance with the land allocations, and standards and guidelines prescribed in the selected alternative. The specific standards and guidelines of each alternative are described later in this chapter.

Monitoring

Monitoring is an essential component of natural resource management because it provides information on the relative success of management strategies. The implementation of the selected alternative will be monitored to ensure that management actions are meeting the objectives of the prescribed standards and guidelines, and that they comply with management laws and policy (see Appendix I, Monitoring and Evaluation Plan). Monitoring will provide information to determine if the standards and guidelines are being followed (implementation monitoring), verify if they are achieving the desired results (effectiveness monitoring), and determine if underlying assumptions are sound (validation monitoring). Some effectiveness and most validation monitoring will be accomplished by formal research.

Monitoring results will provide managers with the information to determine whether a goal has been met, and whether to continue or to modify the management direction. Findings obtained through monitoring, together with research and other new information, will provide a basis for adaptive management changes to the selected alternative. The processes of monitoring and adaptive management share the goal of improving effectiveness and permitting dynamic response to increased knowledge and a changing landscape. The monitoring program itself will also not remain static. The monitoring plan will be periodically evaluated to ascertain whether the monitoring questions and standards are still relevant, and will be adjusted as appropriate. Some monitoring items may be discontinued and others added as knowledge and issues change with implementation.

Monitoring will be conducted at multiple levels and scales. These may include site-specific projects; designated areas such as Late-Successional Reserves, Riparian Reserves and the matrix; watersheds; administrative units; physiographic provinces or river basins; states; and the planning area or region. At the project level, monitoring will examine how well specific standards and guidelines have been applied on the ground and how effectively they produce expected results. Monitoring at broader levels will measure how successfully projects and other activities have achieved the objectives, goals, and/or desired future conditions of those management areas. Monitoring will be conducted in a manner to accommodate the multiple levels and scales so that localized information may be compiled and considered in a broader regional context, and thereby address both local and regional issues.

The monitoring process will collect information on a sample basis. Monitoring could be so costly as to be prohibitive if it is not carefully and reasonably designed. It will not be necessary or desirable to monitor each standard and guideline of every project. Unnecessary detail and unacceptable costs will be avoided by focusing on key monitoring questions and proper sampling methods. The level and intensity of monitoring will vary, depending on the sensitivity of the resource or area and the scope of the management activity.

Monitoring will be coordinated among appropriate agencies and organizations in order to enhance the efficiency and usefulness of the results across a variety of administrative units and provinces. The approach will build on past and present monitoring work. Current monitoring plans will continue to be used where appropriate. In addition, specific monitoring protocols, criteria, goals, and reporting formats will be developed for the selected alternative, subject to review and guidance of the Regional Ecosystem Office. This guidance will be used to revise current monitoring plans and facilitate the process of aggregating and analyzing information on province or regional levels. Each administrative unit will continue to be responsible for the collection, compilation, and analysis of much of the data gained through monitoring activities. Province teams and the Regional Ecosystem Office will compile and analyze information at larger scales.

The monitoring program will involve a long-term commitment to gathering and evaluating data on environmental conditions and management implementation. In the Forest Service Pacific Northwest Region's Forest Monitoring and Evaluation Guide (USDA FS 1993b), the Regional Forester stated, "All programs and projects should contain appropriate levels of monitoring funds in their costs —or they should not be undertaken." Similar commitments to monitoring were made in the BLM western Oregon Draft Resource Management Plans and Environmental Impact Statements (USDI BLM 1992a-f). For example, the Roseburg District Draft RMP/EIS states, "Timber sale volumes and associated programs will be reduced if annual funding is not sufficient to support the relevant actions assumed in the plan, including mitigation and monitoring. The extent of the reduction will be based on the principle of program balance as envisioned in the plan" (USDI BLM 1992e). The current monitoring plans and commitments will remain in effect, although they will be revised to reflect the direction in the Record of Decision for this SEIS.

Current plans and draft plan preferred alternatives require monitoring of resources, activities, or effects, and will continue to do so under all alternatives. The monitoring items or elements of the current plans and draft plan preferred alternatives include soil, water, air, vegetation, Wild and Scenic Rivers, visual resources, cultural resources, lands, minerals, range, wildlife, fisheries, timber, and special areas (e.g., Areas of Critical Environmental Concern and Research Natural Areas). These broad categories include monitoring for species listed under the Endangered Species Act, and activities subject to the Clean Water Act, Clean Air Act and other laws, regulations and policy. Where relevant, these current monitoring plans include monitoring objectives or questions, sampling methods or techniques, criteria, standards, frequency of monitoring, evaluation and reporting procedures, and associated costs for each item or element. The various aspects of these current plans and draft plan preferred alternatives will remain in effect, and may be revised as appropriate to reflect the direction of the selected alternative. The results of monitoring and associated evaluations will continue to be shared with the public.

Adaptive Management

Adaptive management is a continuing process of action-based planning, monitoring, researching, evaluating and adjusting with the objective of improving the implementation and achieving the goals of the selected alternative. The alternatives analyzed in this SEIS are based on current scientific knowledge. To be successful, the selected alternative must have the flexibility to adapt and respond to new information. Under the concept of adaptive management, new information will be evaluated and a decision will be made whether to make adjustments or changes. Each alternative incorporates the concept of adaptive management (see Appendix E, Implementation Structure). This approach will enable resource managers to determine how well management actions meet their objectives and what steps are needed to modify activities to increase success or improve results.

The adaptive management process will be implemented to maximize the benefits and efficiency of the selected alternative. This may result in the refinement of standards and guidelines, land-use allocations, or amendments to Forest and District Plans. Adaptive management decisions may vary in scale from individual watersheds, specific forest types, physiographic provinces, or the entire planning area or region. Adaptive management modifications that require changes to Regional Guides, or Forest or District Plans will be adopted following applicable regulatory procedures. However, many adaptive management modifications may not require changes to Regional Guides, or Forest or District Plans.

While the adaptive management concept applies to all lands administered by the Forest Service and BLM, the Adaptive Management Areas of Alternative 9 are specific land allocations. The primary objective of these 10 Adaptive Management Areas is the development and testing of new approaches for integration and achievement of ecological and economic health, and other social objectives.

Interagency Coordination

All alternatives call for a high level of coordination and cooperation among agencies during implementation. Issues will be discussed, objectives clarified, and problems solved in collaboration. The Memorandum of Understanding for Forest Ecosystem Management established a framework for coordinated implementation of the selected alternative (see Appendix E, Implementation Structure). The parties to this memorandum of understanding are the Director of the White House Office on Environmental Policy, the Secretary of the Interior, the Secretary of Agriculture, the Administrator of the Environmental Protection Agency, and the Under Secretary of Commerce for Oceans and Atmosphere.

Interagency Groups

The following interagency groups have been established to develop, monitor, and oversee the implementation of the selected alternative. These interagency groups are identified in the Memorandum of Understanding for Forest Ecosystem Management (Appendix E). They do not substitute or alter the line of authority of individual agencies (see Figure 2-2).

Interagency Steering Committee

The Interagency Steering Committee will establish overall policies governing the prompt, coordinated and effective implementation of the selected alternative by all relevant federal agencies, and address and resolve issues referred to it by the Regional Interagency Executive Committee. The committee consists of representatives from the offices of the Secretary of the Interior, Secretary of Agriculture, Administrator of the Environmental Protection Agency, Under Secretary of Commerce for Oceans and Atmosphere, and is chaired by the Director of the White House Office on Environmental Policy or the director's designee. A White House appointed representative of the Interagency Steering Committee serves as interagency coordinator to provide general oversight and guidance of regional activities.

Regional Interagency Executive Committee (RIEC)

This group consists of the Pacific Northwest federal agency heads of the Forest Service, Bureau of Land Management, Fish and Wildlife Service, National Marine Fisheries Service, Bureau of Indian Affairs, and Environmental Protection Agency. Other participants on this committee include: the National Park Service; Soil Conservation Service; the States of Washington, Oregon, and California; and three tribal organizations. The RIEC will serve as the senior regional entity to assure the prompt, coordinated, and successful implementation of the selected alternative. It serves as the principal conduit for communications between the Interagency Steering Committee and the agencies in the planning area. It will be responsible for implementing the directives of the Interagency Steering Committee, reporting regularly on implementation progress, and referring issues relating to the policies or procedures for implementing the selected alternative to the Interagency Steering Committee. The RIEC's policy and planning decisions and recommendations will be made collaboratively, and will be consistent with federal and state laws, federal trust responsibilities, and government-to-government relationships with American Indian tribes. The RIEC provides direction to the Regional Ecosystem Office, province teams, and the Research and Monitoring Committee (see below). The RIEC also works with the Regional Community Economic Revitalization Team (RCERT) to develop criteria and priorities for ecosystem investment opportunities.

Regional Ecosystem Office (REO)

This office provides staff work and support to facilitate RIEC decision making and prompt interagency issue resolution in support of implementation of the selected alternative. It will also be responsible for evaluation of major modifications arising from the adaptive management process and will coordinate the formulation and implementation of data standards. This office reports to the RIEC and will be responsible for developing, evaluating, and resolving consistency and implementation issues with respect to specific topics including, but not limited to, Geographic Information Systems (GIS), pilot watershed analyses, restoration guidelines, Endangered Species Act requirements, adaptive management guidelines, monitoring and research.

Research and Monitoring Committee

This committee, comprised of research scientists and managers from a variety of disciplines, provides recommendations to the RIEC on implementation of the selected alternative through monitoring and research plans. The Research and Monitoring Committee will review and evaluate ongoing research; develop a research plan to address critical natural resource issues; address biological, social, economic, and adaptive management research topics; and develop and review scientifically credible, cost efficient monitoring plans. The Research and Monitoring Committee is under the direction of, and is responsible to, the Regional Interagency Executive Committee, and reports to the RIEC through the Regional Ecosystem Office.

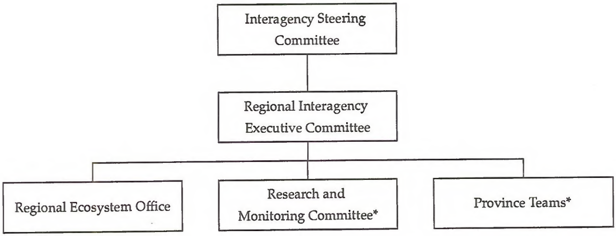
Province Teams

These teams consist of representatives of federal agencies, states, American Indian tribes, and others. These teams will provide or coordinate analyses at the province level that can provide the basis for amendments to Forest and District Plans and will provide monitoring reports for provinces. Province teams will also encourage and facilitate information exchange and complementary ecosystem management among federal and nonfederal land managers. The Interagency Steering Committee and the Regional Interagency Executive Committee will continue to develop and refine the appropriate role for these teams at the level of physiographic provinces, Adaptive Management Areas, or specific watersheds.

PLANNING

Ecological functions do not respect administrative or political boundaries, and assessments of ecosystem issues may require the use of boundaries which do not coincide with political or administrative boundaries. At the same time, current statutes, regulations and administrative responsibilities governing federal land management agencies must recognize and are based upon political and administrative boundaries. A major challenge in ecosystem management is providing a planning regime in which these fundamentally different perspectives can be integrated, a task that is especially difficult in the current statutory and regulatory planning structure.

Figure 2-2. Relationships of interagency groups



* Although they recieve direction from the Regional Interagency Executive Committee, the Research and Monitoring Committee and Province Teams will report to the Regional Interagency Executive Committee through the Regional Ecosystem Office.

As experience is gained in ecosystem management, statutes and regulations may be changed to provide for different decision points. Until statutes and regulations are changed, province-level "plans" or considerations will consist of analysis and coordination to help interpret or amend existing plans. The area delineation appropriate to this planning structure is shown in Figure 2-3, Province planning and analysis areas.

The term "planning" is often used colloquially to include assessments, analysis, or other processes that are related to, but distinct from, the planning decision-making process defined by laws and regulations. Decisions on standards and guidelines and land allocations will be adopted using the planning structure of existing regulations, which provide for three levels of plans for the Forest Service (Regional Guides, Forest Plans and project plans) and two levels of plans for the BLM (District Plans and activity plans). Decisions to change land allocations, or standards and guidelines will be made only through the adoption, revision, or amendment of these documents following appropriate public participation, NEPA procedures, and coordination with the Regional Interagency Executive Committee.

The FEMAT Report and the SEIS illustrate how different types of planning-related activities can be used to practice ecosystem management by assessing relevant issues from a variety of perspectives and facilitating a coordinated implementation of the selected alternative. Ecological "assessments" or "analyses" are aimed at viewing management issues from ecological perspectives, such as described in Appendix B2, Ecological Principles for Management of Late-Successional Forests. Assessments may include other perspectives relevant to land management decision making such as economic or social factors. The SEIS alternatives also propose coordinating planning activities across administrative boundaries, such as province plans, Adaptive Management Area plans and Late-Successional Reserve plans. Decisions will be made to adopt, revise or amend appropriate decision documents only when procedures for public participation and decision making have been followed.

The Record of Decision based on this SEIS will amend existing Forest Service and BLM management plans. This SEIS supplements the Environmental Impact Statements as described in the section of this chapter titled "Relationship of the SEIS to Existing Forest Service and BLM Management Plans and Environmental Impact Statements." The responsibility for implementing the decision made in the Record of Decision for this SEIS rests with the managers of the Forest Service and BLM units in the planning area. The interagency structure identified in the Memorandum of Understanding for Forest Ecosystem Management (Appendix E) designates the Interagency Steering Committee and Regional Interagency Executive Committee to assure the coordinated and effective implementation of the selected alternative, and to support the development and implementation of future or revised land and resource management plans. Changes or adjustments to decisions made in the Record of Decision for this SEIS may be made through amendments to those plans required by regulations as described above. The authority to change or amend those plans remains as specified in the applicable regulations. The amendments will be reviewed by the Regional Interagency Executive Committee to assure consistency with the objectives of the selected alternative.

Watershed Analysis

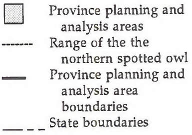
Watershed analysis is one of the principal analyses on which decisions implementing the ecosystem management objectives of this SEIS will be made. The watershed analyses will be the mechanism to support ecosystem management proposed by this SEIS at approximately the 20 to 200 square mile watershed level. Watershed analysis, as described here, focuses on its broad role in implementing the ecosystem management objectives proposed by this SEIS. The use of watershed analysis, as described in the Aquatic Conservation Strategy (see Appendix B6), is a more narrow focus and is just one aspect of its role.

Watershed analysis will focus on collecting and compiling information within the watershed that is essential for making sound management decisions. It will be an analytical process, not a decision-making process with a proposed action requiring NEPA documentation. It will serve as basis for developing project-specific proposals, and determining monitoring and restoration needs for a watershed. Some analysis of issues or resources may be included in broader scale analyses because of their scope. The information from the watershed analyses will contribute to decision making at all levels. Project-specific NEPA planning will use information developed from watershed analysis. For example, if watershed analysis shows that restoring certain resources within a watershed could contribute to achieving landscape or ecosystem management objectives, then subsequent decisions will need to address that information.

The results of watershed analyses may include a description of the resource needs, issues, the range of natural variability, spatially explicit information that

Figure 2-3. Province planning and analysis areas

The Eastern Washington Cascades, Yakima, Deschutes, Klamath and Northwest Sacramento province planning and analysis areas shown on this map include areas that extend beyond the range of the northern spotted owl, which is the planning area for this SEIS. The standards and guidelines, and requirements proposed in this SEIS apply only to the planning area for this SEIS. There is no expectation in this SEIS requirement to do analysis or planning for those areas outside the range of the northern spotted owl. The province planning and analysis areas are distinct from the terrestrial ecosystem physiographic provinces (see Description of Physiographic Provinces in Chapter 3&4 of this SEIS) which are used in describing the standards and guidelines for the alternatives.



will facilitate environmental and cumulative effects analyses to comply with NEPA regulations, and the processes and functions operating within the watershed. Watershed analysis will identify potentially disjunct approaches and conflicting objectives within watersheds. The information from watershed analysis will be used to develop priorities for funding. implementing actions and projects, and will be used to develop monitoring strategies and objectives. The participation in watershed analysis of adjacent landowners, private citizens, interest groups, industry, government agencies, and others will be promoted.

Watershed analysis will be an ongoing, iterative process that will help define important resource and information needs. As watershed analysis is further developed and refined, it will describe the processes and interactions for all applicable resources. It will be an information gathering and analysis process, but will not be a comprehensive inventory process. It will build on information collected from detailed, site-specific analyses. Information gathering and analysis will be related to management needs, and not be performed for their own sake. While generally watershed analysis will organize, collate, and describe existing information, there may be critical information needs that must be met before completing the analysis. In those instances, the additional information will be collected before completing the watershed analysis. In other instances, information needs may be identified that are not required for completing the watershed analysis but should be met for subsequent analyses, planning, or decisions.

Watershed analysis is a technically rigorous procedure with the purpose of developing and documenting a scientifically-based understanding of the ecological structures, functions, processes and interactions occurring within a watershed (see Appendix B6, Aquatic Conservation Strategy). The scope of the analysis for implementing the ecosystem management objectives of this SEIS may include all aspects of the ecosystem. Some of these aspects include beneficial uses; vegetative patterns and distribution; flow phenomena such as vegetation corridors, streams, and riparian corridors; wind; fire; wildlife migration routes; dispersal habitat; terrestrial vertebrate distribution; locally significant habitats; human use patterns throughout the ecosystem; cumulative effects; and hydrology. The number and detail of these aspects considered will depend on the issues pertaining to a given watershed.

Information Resource Management

An interagency Geographic Information System (GIS) data base will be developed to coordinate efforts in the collection and development of research and data, and to effectively coordinate planning within watersheds, provinces or the region.

Consultation and Coordination Process

Consultation under the Endangered Species Act will emphasize an integrated ecosystem approach. This will include involving the Fish and Wildlife Service and the National Marine Fisheries Service when the land management agencies begin to develop their plans for a particular area so their views can be made known. Concurrent coordination with the Environmental Protection Agency on water quality standards and beneficial use requirements of the Clean Water Act will minimize planning and project impacts.

The analysis and planning efforts used in implementing ecosystem management on lands administered by the BLM and Forest Service will comply with existing policies and laws relating to American Indian off-reservation trust resources. The analysis will identify Indian trust resources that would be affected, and identify potential conflicts between proposed federal actions and treaty rights or tribal plans and policies. Consultation on a government-to-government basis will be conducted early in the planning process with any effected tribes. Conflicts will be resolved consistent with the Federal Government's trust responsibilities.

The No-Action Alternative

The No-Action Alternative is comprised of the several existing plans described below (see Table 2-1). It is generally summarized in the 1992 FEIS, and the BLM August 1992 Draft Resource Management Plans/Environmental Impact Statements for western Oregon (USDI BLM 1992a-f). For both agencies, the No-Action Alternative basically represents management direction that was in place immediately before the release of the Interagency Scientific Committee's (ISC) *A Conservation Strategy for the Northern Spotted Owl* (Thomas et al. 1990).

In April 1993, when the Assessment Team began to develop the 10 action alternatives, BLM Districts and National Forests either had completed (current) Forest and Resource Management Plans, or they were in the process of developing such plans. For those units that had not completed their plans, the Assessment Team identified the then-current version, or draft, of the unit's preferred alternative. The Assessment Team used these current plans and draft plan preferred alternatives as the base or starting point for each of the 10 action alternatives. Unless specifically excepted elsewhere in this chapter, standards and guidelines from these plans apply to all of the action alternatives where they are more restrictive or provide greater benefits to late-successional forest related species than other standards and guidelines of these alternatives. These plans are identified in the shaded area in Table 2-1, and are referred to in this SEIS as "current plans and draft plan preferred alternatives."

The current plans and draft plan preferred alternatives, plus the *Final Draft Recovery Plan for the Northern Spotted Owl* as adapted by the Assessment Team, define Alternative 7 in this SEIS. Alternative 7 is intended to approximate direction that might have been implemented if the federal agencies had continued land and resource management planning processes and if they had adopted the elements of the Final Draft Spotted Owl Recovery Plan. As such, the Assessment Team considered Alternative 7 to be the closest reasonable (legally implementable) approximation of a no-action alternative.

Table 2-1. Description of the No-Action Alternative, and comparison of the No-Action Alternative with Alternative 7. The shaded area shows the direction referred to in this SEIS as "current plans and draft plan preferred alternatives," which is incorporated into all 10 of the action alternatives.

	No-Action Alternative	Alternative 7
Forest Service, Oregon and Washington	1984 Regional Guide as amended in 1988. Existing Forest Plans for the Olympic, Mt. Baker-Snoqualmie, Gifford Pinchot, Okanogan, Wenatchee, Siuslaw, Mt. Hood, Willamette, Deschutes, Winema, Umpqua, Rogue River, and Siskiyou National Forests, approved 1988-1991.	Same as the No-Action Alternative
Bureau of Land Management, Oregon	Existing Management Framework Plans for the Salem, Eugene, Coos Bay, Roseburg and Medford Districts; and the Klamath Falls Resource Area of the Lakeview District, approved during the late 1970's and early 1980's, and described in the respective August 1992 Draft RMP/EISs.	The Revised Preferred Alternative to the Draft Resource Management Plans and EISs (see Appendix B1) released August 1992 for the Salem, Eugene, Coos Bay, Roseburg and Medford Districts, and the Klamath Falls Resource Area of the Lakeview District.
Forest Service, California	1984 Regional Guide. Existing Forest Plans for the Lassen and Modoc National Forests. The Preferred Alternatives as of <u>March 1990</u> for Draft Forest Plans being developed for the Klamath, Shasta-Trinity, Mendocino and Six Rivers National Forests, as described in the 1992 FEIS.	1984 Regional Guide. Existing Forest Plans for the Lassen and Modoc National Forests. The Preferred Alternatives as of <u>May 1993</u> for Draft Forest Plans being developed for the Klamath, Shasta-Trinity, Mendocino and Six Rivers National Forests.
Bureau of Land Management, California	Existing Resource Management Plans for the Arcata and Redding Resource Areas approved 1992 and 1993, respectively. Existing Management Plan for the King Range National Conservation Area, approved 1974.	Same as the No-Action Alternative
Owl Conservation Strategy, Forest Service and Bureau of Land Management, all states.	Preserve 1000-3000 acre Spotted Owl Habitat Areas (SOHAs) and Oregon Dept. of Fish and Wildlife Agreement Areas (Spotted Owl Management Area-SOMAs) for an interacting network of owl pairs.	Final Draft Spotted Owl Recovery Plan, adapted by the Assessment Team. Provides for interacting network of Designated Conservation Areas (DCAs) each (generally) large enough to support 20 owl pairs, as well as other designated areas for individual or groups of owl pairs.

However, Alternative 7 is different from the "No-Action Alternative" required by CEQ regulations (see comparison in Table 2-1) because the No-Action Alternative:

- does not include the Final Draft Spotted Owl Recovery Plan
- does not include *Draft Forest and District Plans* still being developed.

Because of recent listings of the marbled murrelet and the northern spotted owl, concern over at-risk fish stocks, and other recent information regarding the management of habitat for other late-successional forest related species, the No-Action Alternative is no longer implementable, nor does it meet the purpose and need for this SEIS (see Appendix C, Letter from Council of Environmental Quality).

Normally, the No-Action Alternative is described within an environmental impact statement, even where it is not implementable, to serve as a baseline for comparison of effects among the action alternatives. In this case, the effects of the No-Action Alternative, as described above and without recent, legally required changes, are approximated by effects displayed in tables and figures in Chapter 3&4 as "1980-1989 Average" or equivalent.

Introduction to the Action Alternatives

The 10 action alternatives presented in this SEIS are developed from the 10 ecosystem management options developed by the Forest Ecosystem Management Assessment Team and described in the FEMAT Report (Appendix A). Although the FEMAT Report is included in this Final SEIS as Appendix A, and should be used for additional information and understanding the objectives and details of the alternatives, all required standards and guidelines for each of the action alternatives are presented here (in Chapter 2) and, as referenced, in Appendix B.

The alternatives apply to lands administered by the Forest Service and Bureau of Land Management within the range of the northern spotted owl. Each alternative assumes other federal lands, such as those administered by the Fish and Wildlife Service, National Park Service, and Department of Defense, will be managed according to existing management plans and applicable federal law.

Current Plans and Draft Plan Preferred Alternatives - Each action alternative uses current plans and draft plan preferred alternatives as a starting point, or baseline. Therefore, unless specifically excepted elsewhere in this chapter, standards and guidelines of the current plans and draft plan preferred alternatives apply to all alternatives where they are more restrictive or provide greater benefits to late-successional forest related species than the provisions of these alternatives. The current plans and draft plan preferred alternatives referred to in this SEIS are shown in the shaded area in Table 2-1.

An exception to the above, for alternatives other than Alternative 7, are standards and guidelines specific to management for the northern spotted owl and its habitat. Because of protection provided by the standards and guidelines of each SEIS alternative, the BLM (Oregon) direction adapted from the *Recovery Plan for the Northern Spotted Owl-Draft* (USDI 1992) has been modified (see Appendix B9, BLM Spotted Owl Standards and Guidelines), and the Forest Service direction adopting elements of *A Conservation Strategy for the Northern Spotted Owl* (Thomas et al. 1990) has been dropped.

Because the range of the northern spotted owl includes only small portions of the Modoc and Lassen National Forests, data for these forests are not included in tables, figures, and maps in this SEIS. Standards and guidelines, however, apply to National Forests and BLM-administered lands throughout the range of the northern spotted owl as described for the various alternatives. For Alternative 9, which is partially a map-based alternative (as opposed to other alternatives which are built from elements of various previously published efforts), Managed Late-Successional Areas apply to the three known owl activity centers on the Modoc National Forest, and a Late-Successional Reserve is specified for that portion of the Lassen-administered portion of the Shasta-Trinity National Forest corresponding to DCA #CD-82 in the *Final Draft Recovery Plan for the Northern Spotted Owl* (USDI unpub). This reserve can be generally described as all National Forest in T.36N., R.2E., and in T.37N., R.2E., except sections 8, 21-25, and 36, all of which are located generally west of Lake Britton.

Because current plans and draft plan preferred alternatives contain preferred alternatives not previously included in "approved" agency plans, they differ from the "No-Action" Alternative described in the previous section of this chapter.

LAND ALLOCATION CATEGORIES

Designated Areas
- Congressionally Reserved Areas
- Late-Successional Reserves
- Adaptive Management Areas
- Managed Late-Successional Areas
- Administratively Withdrawn Areas
- Riparian Reserves

Matrix
- Matrix

How the Alternatives are Structured

Like other recent strategies for management of northern spotted owl habitat or old-growth forests of the Pacific Northwest, the alternatives presented in this SEIS propose a network of designated areas managed primarily to protect and enhance habitat for the northern spotted owl and other late-successional and old-growth forest related species (hereafter referred to as designated areas), and nondesignated areas referred to as the matrix. Within each of these areas, standards and guidelines set management direction and apply to management activities. Appendix B contains additional information about particular standards and guidelines or processes.

Land Allocations

There are 24,455,300 acres of federal land within the range of the northern spotted owl. Each alternative in this SEIS allocates these acres to one of the following six categories of designated areas, or to the matrix. The categories are listed in the order that acreage was tabulated, and not necessarily in the order that corresponding standards and guidelines take precedence.

Designated Areas

Congressionally Reserved Areas

All alternatives retain land allocations for existing lands that are congressionally reserved. These include lands with congressional designations that preclude timber harvest, as well as other federal lands not administered by the Forest Service or BLM. This includes National Parks and Monuments, Wildernesses, Wild and Scenic Rivers, National Wildlife Refuges, and military reservations. The location and size of these areas do not change among the alternatives. Management of these lands follows direction written in the applicable legislation or plans.

Late-Successional Reserves

Late-Successional Reserves are identified for each alternative. These areas would be managed to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth related species including the northern spotted owl. For most alternatives, some level of silvicultural treatment (such as thinning young stands) is permitted in stands of a certain age to accelerate the development of old-growth habitat characteristics (see Appendix B2, Ecological Principles for Management of Late-Successional Forests), subject to review by the Regional Ecosystem Office. Stand and vegetation management of any kind, including prescribed burning, is considered a silvicultural treatment. The Regional Ecosystem Office may develop criteria that would exempt some activities from review. Excepted from review are reforestation activities legally required by, and planned as part of, existing sold timber sales, where the reforestation prescription has been modified as appropriate to meet the new objectives of the Late-Successional Reserve. Standards and guidelines for multiple-use activities other than silviculture appear in Appendix B7, Late-Successional Reserve Standards and Guidelines. Research Natural Areas and activities required by recovery plans for listed threatened and endangered species take precedence over Late-Successional Reserve standards and guidelines. These reserves are designed to maintain a functional, interacting, late-successional and old-growth forest ecosystem.

A management plan should be prepared for each large Late-Successional Reserve (or group of smaller Late-Successional Reserves) before habitat manipulation activities are designed and implemented. Land management agencies may choose to develop these plans as components of legally-mandated plans (e.g., Forest or District Plans), as part of province-level planning, or as stand-alone plans. If developed to stand alone, the plans should be closely coordinated with subsequent watershed analysis and province-level planning. Agencies are encouraged to refine standards and guidelines at the province level, prior to development of Late-Successional Reserve plans. Late-Successional Reserve plans should generally include: (1) a history and inventory of overall vegetative conditions within the reserve, (2) a list of identified late-successional associated species known to exist within the Late-Successional Reserve and information on their locations, (3) a history and description of current land uses within the reserve, (4) a fire management plan, (5) criteria for determining appropriate treatments, (6) identification of specific areas that could be treated under those criteria, (7) an implementation schedule tiered to higher order (i.e., larger scale) plans, and (8) monitoring and evaluation components to help assure that activities are carried out as intended and achieve desired results. Only in unusual circumstances would silvicultural treatments, including prescribed fire, precede preparation of this management plan. Late-Successional Reserve plans are subject to review by the Regional Ecosystem Office.

Adaptive Management Areas

Adaptive Management Areas occur only under Alternative 9. The objective for each of these areas is to develop and test new management approaches to integrate and achieve ecological and economic health, and other social objectives. Each area has a different emphasis to its prescription, such as maximizing the amount of late-successional forests or improving riparian conditions through silvicultural treatments. A complete description of the purpose for each Adaptive Management Area, as well as specific objectives, appears in Appendix B3, Adaptive Management Areas. Some scheduled timber harvest (that contributing to the PSQ) takes place in some of the Adaptive Management Areas.

Managed Late-Successional Areas

Managed Late-Successional Areas are identified for some alternatives in areas where regular and frequent fire was a natural part of the ecosystem. The objective for these areas is to produce and maintain an optimum level of late-successional and old-growth stands on a landscape scale. In these designated areas, certain silvicultural treatments and fire hazard reduction treatments would be allowed to help prevent complete stand destruction from large catastrophic events such as high intensity, high severity fires, or disease or insect epidemics. As with Late-Successional Reserves, each Managed Late-Successional Area should have a management plan. Standards and guidelines for multiple-use activities other than silviculture, which are found in Appendix B7, also apply to Managed Late-Successional Areas.

Administratively Withdrawn Areas

Administratively Withdrawn Areas are those areas identified in current plans and draft plan preferred alternatives as not scheduled for timber harvest and not included in calculations of allowable sale quantity (ASQ). Administratively Withdrawn Areas include recreation areas, lands not technically suitable for timber production, certain visual retention and riparian areas, and areas removed from timber production for the protection of locally endemic species. For all alternatives, unless specifically excepted elsewhere in this chapter, Administratively Withdrawn Areas and all other standards and guidelines of the current plans and draft plan preferred alternatives apply where they are more restrictive or provide greater benefits to late-successional and old-growth related species than other provisions of these alternatives.

Riparian Reserves

The Riparian Reserves provide an area along all streams, wetlands, ponds, lakes, and unstable and potentially unstable areas where riparian-dependent resources receive primary emphasis (see Appendix B6, Aquatic Conservation Strategy). Riparian Reserves are important to the terrestrial ecosystem as well, serving, for example, as dispersal habitat for certain terrestrial species. Riparian Reserves are not mapped; however, sample distributions of Riparian Reserves are shown on insets on the alternative maps included with the Draft SEIS, as well as on the Alternative 9 map included with this Final SEIS.

MATRIX

Matrix

The matrix consists of those federal lands outside the six categories of designated areas listed above. Most timber harvest and other silvicultural activities would be conducted in that portion of the matrix with suitable forest lands, according to standards and guidelines. Most scheduled timber harvest (that contributing to the PSQ) takes place in the matrix. The matrix includes nonforested areas, and forested areas that are technically unsuitable for timber production, and therefore do not contribute to PSQ. Many alternatives apply the ISC Conservation Strategy's 50-11-40 rule for management of the matrix. Each alternative also specifies the amount of green trees, snags, and down logs that will be left following management activities. Snag recruitment trees left to meet an identified, near-term (less than 3 decades) snag deficit do not count toward green tree retention requirements.

Elements from Previous Documents Incorporated into Alternatives by the Assessment Team

In developing the options on which the action alternatives are based, the Assessment Team borrowed from previous Federal Government efforts to develop a strategy for management of habitat for the northern spotted owl and other old-growth associated species. The following is a list of these efforts:

1. *A Conservation Strategy for the Northern Spotted Owl* (Thomas et al. 1990) - prepared by the Interagency Scientific Committee and supplemented by three sets of clarifying questions and answers (Mays and Mulder 1991, Thomas 1991, USDA FS 1991).

2. *Alternatives for Management of Late-Successional Forests of the Pacific Northwest* (Johnson et al. 1991) - prepared by the Scientific Panel on Late-Successional Forest Ecosystems (also referred to as the Scientific Panel) at the request of the Agriculture Committee and the Merchant Marine and Fisheries Committee of the U.S. House of Representatives.

3. *Final Draft Recovery Plan for the Northern Spotted Owl* (USDI unpub. referred to herein as the Final Draft Spotted Owl Recovery Plan) - prepared by the Northern Spotted Owl Recovery Team. The standards and guidelines applicable to the 10 action alternatives from this Recovery Plan are included in

Appendix B5 of this Final SEIS.

4. *Viability Assessments and Management Considerations for Species Associated with Late-Successional and Old-Growth Forests of the Pacific Northwest* (Thomas et al. 1993) - prepared by the Scientific Analysis Team (SAT). This document is sometimes referred to as the SAT Report, and includes recommendations of the Pacific Salmon Working Group, also known as PACFish.

The documents above identify and describe various land allocations and/or standards and guidelines designed to meet specific management objectives or themes. The Assessment Team incorporated these elements into one or more of their 10 options; correspondingly, each of these elements appear in at least one of the 10 alternatives in this SEIS. Further details for specific standards and guidelines can be found in the parent documents listed above.

These elements are described as follows and are referred to in the description of each alternative by element title only. The standards and guidelines for an element are not always the same, depending on the alternative. Where an element carries the same standards and guidelines regardless of the alternative, the standards and guidelines are included with the description of the element below. Otherwise, they are found in the descriptions of the alternatives, or in Appendix B, Additional Information on Standards and Guidelines.

LS/OG1, LS/OG2 and LS/OG3

The Scientific Panel classified late-successional and old-growth forests as most ecologically significant (LS/OG1), ecologically significant (LS/OG2), and the remainder (LS/OG3, generally any forest over 80 years old). The Scientific Panel mapped the LS/OG1s and LS/OG2s for its report (Johnson et al. 1991). Where LS/OG status is used to define the boundaries of a Late-Successional Reserve, the boundaries are fixed regardless of the future condition of those (or other) stands.

Spotted Owl Additions

The Scientific Panel also mapped areas that, when added to LS/OG1s, brought the LS/OG1 reserves into compliance with the spotted owl population standards of *A Conservation Strategy for the Northern Spotted Owl* (Thomas et al. 1990).

Protection Buffers

The Scientific Analysis Team provided standard and guideline recommendations for specific rare and endemic species, and additional standards and guidelines for other specific species in the upland forests (Thomas et al. 1993:291-299, Mitigation Steps 5 and 6, see Appendix B4, Protection Buffers). Table 2-2 identifies mitigation steps as described in the SAT Report that create Late-Successional Reserves and Managed Late-Successional Areas, and that add additional matrix standards and guidelines.

Designated Conservation Areas (DCAs), Reserved Pair Areas, Residual Pair Areas, and Managed Pair Areas

These are areas designated in the *Final Draft Recovery Plan for the Northern Spotted Owl* (USDI unpub.) to be managed to improve northern spotted owl habitat. They are similar to, and based on, the Habitat Conservation Areas (HCAs) recommended by the Interagency Scientific Committee (Thomas et al. 1990). While the Final Draft Spotted Owl Recovery Plan was completed by the Northern Spotted Owl Recovery Team in December 1992, it was not signed and

Table 2-2. Mitigation steps from the Scientific Analysis Team Report (Thomas et al. 1993) that apply to Alternatives 1, 3, 4, 5, and (excepting American marten) Alternative 9 in this SEIS. Numbers and letters refer to the specific mitigation steps described in Appendix B4, Protection Buffers.

	Late-Successional Reserves	Managed Late-Successional Areas	Matrix Standards and Guidelines
SAT, Step 5			
Nonvascular plants	1a, b, e, f	1c, d, g, h	
Invertebrates	(No protection areas identified for specific species		
Amphibians	3c	3a, b	
SAT, Step 6			
Amphibians		1	
Birds	2b		2a
Mammals	3a (except Alt. 9)		3b

therefore not distributed to the public. Because some alternatives incorporate these areas, applicable standards and guidelines in the Final Draft Spotted Owl Recovery Plan were adapted for the FEMAT Report and are included in this Final SEIS in Appendix B5, Recovery Plan Standards and Guidelines.

THE 50-11-40 RULE

This rule states that for every quarter-township, timber harvest shall be permitted only when 50 percent of the federal forest landscape consists of forest stands with an average diameter (dbh) of 11 inches and a canopy closure of 40 percent (Thomas et al. 1990). Riparian Reserves and Administratively Withdrawn Areas contribute toward meeting the 50-11-40 rule.

Elements from the FEMAT Report Incorporated into the Alternatives

The FEMAT Report identifies and describes various land allocations and standards and guidelines designed to meet specific management objectives or themes. As above, these elements are described here and then referenced by title only in the description of each alternative.

MARBLED MURRELET

The area close to marine environments associated with most marbled murrelet activity is referred to as Marbled Murrelet Zone 1. Zone 1 extends approximately 40 miles inland in Washington, 35 miles inland in Oregon, 25 miles inland in California north of Fort Bragg, and 10 miles inland south of Fort Bragg. Some alternatives allocate certain older stands within Zone 1 to designated areas. Zone 2 is defined for survey purposes and does not affect allocations for any of the alternatives. Both Marbled Murrelet Zones 1 and 2 are shown on the Federal Land Ownership map included with the Draft SEIS, and the Alternative 9 map included with this Final SEIS.

All alternatives except 7 and 8 require preproject surveys of marbled murrelet habitat according to protocol currently used by the federal agencies. (Requirements under the Endangered Species Act may provide an equivalent level of protection for Alternatives 7 and 8.) Current protocol requires 2 years of surveys to assure that no marbled murrelet nests exist in areas planned for timber harvest. If behavior indicating occupation is documented (described below), all contiguous existing and recruitment habitat for marbled murrelets (i.e., stands that are capable of becoming marbled murrelet habitat within 25 years) within a 0.5-mile radius will be protected. The 0.5-mile radius circle should be centered on either the behavior indicating occupation, or within 0.5 mile of the location of the behavior, whichever maximizes interior old-growth habitat. When occupied areas are close to each other, the 0.5-mile circles may overlap. In all alternatives, timber harvest is prohibited within occupied marbled murrelet habitat at least until completion of the Marbled Murrelet Recovery Plan (USDI FWS in prep.). Silvicultural treatments in non-habitat within the 0.5-mile circle must protect or enhance the suitable or replacement habitat. When objectives of the Marbled Murrelet Recovery Plan have been identified, agencies will amend or revise management direction as appropriate.

Behavior indicating marbled murrelet occupation includes at least one of the following: (1) discovery of an active nest or a recent nest site as evidenced by a fecal ring or eggshell fragments; (2) discovery of a chick or eggshell fragments on the forest floor; (3) birds flying below, through, into, or out of the forest canopy within or adjacent to a stand; (4) birds perching, landing, or attempting to land on branches; (5) birds calling from a stationary location within the stand; (6) birds flying in small or large radius circles above the canopy (Ralph and Nelson unpub.).

Aquatic Conservation Strategy

Described in more detail in Appendix B6, the Aquatic Conservation Strategy was developed primarily to protect salmon and steelhead, and is a refinement of the approach outlined in Thomas et al. (1993). The four elements of the strategy are: Riparian Reserves, Key Watersheds, Watershed Analysis, and Watershed Restoration. These components are designed to operate together to maintain and restore the productivity and resiliency of riparian and aquatic ecosystems. All components of this strategy apply to all alternatives with the exception of Alternative 7.

Riparian Reserves

Riparian Reserves are incorporated into each alternative except Alternative 7, and specify a certain width on each side of fish-bearing, nonfish-bearing, and intermittent streams as well as around wetlands, ponds, lakes, and unstable and potentially unstable lands. Standards and guidelines for these reserves would prohibit or regulate activities not designed specifically to maintain and restore the structure and function of the reserve and benefit fish habitat. Salvage of dead trees following catastrophic events (e.g., fire, flood, volcanic eruption, wind, or insect infestation) would be allowed only when coarse woody debris guidelines are met and other riparian management objectives are not adversely affected. Roads would be managed to reduce sediment delivery to streams, grazing practices would be modified to reduce impacts, and mining impacts would be limited. Specific standards and guidelines for various resource management activities are included in Appendix B6, Aquatic Conservation Strategy.

Riparian Reserve widths are prescribed in terms of the height of a site-potential tree or site-specific geomorphic criteria such as a 100–year floodplain, whichever is greater (see Appendix B6, Aquatic Conservation Strategy). A site-potential tree height is the average maximum height of the tallest dominant tree (200 years or older) for a given site class.

Riparian Reserves are specified for five categories of water bodies as follows. For categories 1, 4, and 5, the widths remain constant for all alternatives. For categories 2 and 3, the widths vary by alternative, as described for each of the alternatives later in this chapter.

1. Fish-bearing streams - Riparian Reserves consist of the stream and the area on either side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance (600 feet, including both sides of the stream channel), whichever is greatest. This is the same in all alternatives.

2. Permanently flowing nonfish-bearing streams - Riparian Reserves consist of the stream and the area on either side of the stream extending from the edges of the active stream channel to the top of the inner gorge, or to the outer edges of the 100-year floodplain, or to the outer edges of riparian vegetation, or depending upon the alternative, a distance equal to the height of some fraction of a site-potential tree, or a specified slope distance, whichever is greatest.

3. Seasonally flowing or intermittent streams, wetlands less than 1 acre, and unstable and potentially unstable areas - This category applies to features with high variability in size and site-specific characteristics. At a minimum, the Riparian Reserve must include:

- The extent of unstable and potentially unstable areas
- The stream channel and extend to the top of the inner gorge
- The stream channel or wetland and the area from the edges of the stream channel or wetland to the outer edges of the riparian vegetation
- Depending upon the Riparian Reserve scenario, extension from the edges of the stream channel to a distance equal to the height of some fraction of a site-potential tree, or a specified slope distance, whichever is greatest (Table B6-2).

4. Constructed ponds and reservoirs, and wetlands greater than 1 acre - Riparian Reserves consist of the body of water or wetland and: the area to the outer edges of the riparian vegetation, or the extent of seasonally saturated soil, or the extent of unstable and potentially unstable areas, or to a distance equal to

the height of one site-potential tree, or 150 feet slope distance from the edge of the wetlands or maximum pool elevation, whichever is greatest. This is the same in all alternatives.

5. Lakes and Natural Ponds - Riparian Reserves consist of the body of water and: the area to the outer edges of the riparian vegetation, or the extent of seasonally saturated soil, or the extent of unstable and potentially unstable areas, or to a distance equal to the height of two site-potential trees, or 300 feet slope distance, whichever is greatest. This is the same in all alternatives.

The reserve widths prescribed for each of these categories are the widths analyzed in this SEIS. These widths could be adjusted if results of watershed analysis (see Appendix B6, Aquatic Conservation Strategy) demonstrate that an adjustment is appropriate.

In Alternative 7, Riparian Reserves would be managed according to current plans and draft plan preferred alternatives.

Key Watersheds

Key Watersheds were identified by building on previous work by the Scientific Panel on Late-Successional Forest Ecosystems, and the Scientific Analysis Team. Key Watersheds contain at-risk anadromous salmonids, bull trout, and resident fish species, or are important sources of high quality water. Key Watershed designation does not preclude regularly scheduled timber harvest and other management activities. However, watershed analysis is required in these areas before any management activities can take place under all alternatives except Alternative 7, and the results of the analysis must be incorporated into the decision-making process. The exception is: in the short term and until Watershed Analysis can be completed, minor activities such as those that would be categorically excluded under NEPA regulations (except timber harvest) may proceed, consistent with Riparian Reserve standards and guidelines. In all alternatives except 7 and 8, no new roads are to be constructed in remaining unroaded portions of inventoried roadless areas (as identified in Forest and District Plans) in Key Watersheds. Also, there will be no net increase in road mileage in Key Watersheds. For Alternative 9, Late-Successional Reserves are located within Key Watersheds wherever possible. There are two types of Key Watersheds:

Tier 1 (Aquatic Conservation Emphasis) Key Watersheds

Tier 1 Key Watersheds are shown on the Federal Land Ownership map included with the Draft SEIS, and the Alternative 9 map included with this Final SEIS. These have been identified because of sensitive fish stocks or poor overall watershed condition. In some alternatives, Tier 1 Key Watersheds prescribe Riparian Reserve widths that are different from reserve widths in other watersheds.

Tier 2 (Other) Key Watersheds

These have been identified because of existing watershed conditions supporting high quality water. They do not appear on the Federal Land Ownership map included with the Draft SEIS, but they do appear on the Alternative 9 map included with this Final SEIS.

Other Watersheds

This watershed category refers to any watershed not specified as Tier 1 or 2. Road construction in inventoried roadless areas will not occur until a watershed analysis indicates that construction is compatible with riparian and other ecological objectives. Watershed analysis is not a prerequisite to other management activities.

Watershed Analysis

The Watershed Analysis section of Appendix B6 describes procedures for conducting analysis that evaluates geomorphic and ecologic processes operating in specific watersheds. This analysis should enable watershed planning that achieves Aquatic Conservation Strategy objectives. Watershed analysis provides the basis for monitoring and restoration programs and the foundation from which Riparian Reserves can be further delineated.

Watershed Restoration

Watershed Restoration is a comprehensive, long-term program to restore watershed health and aquatic ecosystems including the habitats supporting fish and other aquatic and riparian-dependent organisms (see Appendix B6).

Fire Management

Each alternative incorporates, to various degrees, the fire management elements of wildfire suppression, wildfire hazard reduction, and prescribed fire applications. Standards and guidelines applicable to each of these elements and to the land allocation categories of the various alternatives are described in Appendix B8, Fire Management Standards and Guidelines.

Standards and Guidelines

All land allocations in each alternative have specific management direction regarding how those lands are to be managed, including actions that are prohibited and descriptions of the conditions that should occur there. This management direction for specific lands is known as "standards and guidelines"—the rules and limits governing actions, and the principles specifying the environmental conditions or levels to be achieved and maintained.

Some standards and guidelines vary from alternative to alternative, some are common to several alternatives, and some are common to all alternatives. Those common to all alternatives are included in the element descriptions above, and are not restated under each alternative.

Where standards and guidelines within an alternative vary between northern California and Oregon, management along administrative unit boundaries instead of the state line is acceptable as long as it is consistent, is stated as the intent of the unit, involves only a slight fraction of the unit, and does not violate a clear assumption of the selected alternative.

In some areas, land allocations overlap. Standards and guidelines for Congressionally Reserved Areas must be met first. Second, Riparian Reserve standards and guidelines apply and are added to the standards and guidelines of other designated areas. For example, where Riparian Reserves occur within Late-

Successional Reserves, the standards and guidelines of both designations apply. Key Watershed designations may overlay any of the allocations (Late-Successional Reserves, Managed Late-Successional Areas, Adaptive Management Areas, Administratively Withdrawn Areas, or the matrix). In this case, the standards and guidelines for the allocations apply, and the Key Watershed designation adds additional requirements. In all allocations, unless specifically excepted by standards and guidelines presented in this SEIS, standards and guidelines in current plans and draft plan preferred alternatives apply where they are more restrictive or provide greater benefits to late-successional forest related species. For example, thinning in a Late-Successional Reserve would be permitted only if it was consistent with the standards and guidelines of the selected alternative, and also was consistent with the standards and guidelines of the underlying current plan or draft plan preferred alternative.

Additional direction to management agencies includes, but is not limited to directives, policy, handbooks, manuals, as well as other plans, regulations, laws and treaties. The standards and guidelines presented in this SEIS would supersede other direction except treaties, laws, and regulations unless that direction is more restrictive or provides greater benefits to late-successional forest related species.

Maps

The essential features of each of the action alternatives are shown on maps included with this SEIS as follows.

- The five terrestrial designated areas and matrix, plus samples of the Riparian Reserves, are shown on the 1:500,000 scale maps. For Alternatives 1 through 8 and 10, these maps were included with the Draft SEIS. For Alternative 9, because of changes to this alternative between Draft and Final, the map is included with this Final SEIS.

- Land ownership is shown on the 1:500,000 scale Federal Land Ownership map in the Draft SEIS.

- Key Watersheds, and Marbled Murrelet Zones 1 and 2, are shown on the 1:500,000 scale Federal Land Ownership map in the Draft SEIS and on the Alternative 9 map in this Final SEIS.

- Maps at 1/2-inch to the mile scale showing all of the above elements are available for each Forest Service and BLM administrative unit at the individual unit offices.

- The official maps of the elements of this SEIS are maintained as part of the administrative record and are also stored electronically in the Spatially Unified Database (SPUD) maintained by the Interagency Geographic Information System (GIS) staff in the Regional Ecosystem Office at 333 SW 1st St., Portland, OR 97204.

Land Allocation Hierarchy for Comparison of Alternatives

There is considerable overlap between some land allocations. For example, a substantial portion of the 4.1 million acres of Administratively Withdrawn Areas from current plans and draft plan preferred alternatives are included within Late-Successional Reserves. Similarly, Late-Successional Reserves contain streams, and thus Riparian Reserves. For consistency, and to help the reader compare the various alternatives, such overlaps were placed into particular land allocation categories according to the following priority. Table 2-3 displays estimated acres by land allocation for each alternative utilizing this hierarchical method. With the exception of Riparian Reserves (for which acres were determined by samples), this is generally the same priority listed above for hierarchy of land allocation-related standards and guidelines.

1. Congressionally Reserved Areas

The acres for Congressionally Reserved Areas are considered first, and each of the alternatives contain the same amount - 7.321 million acres.

2. Late-Successional Reserves

Acres for Late-Successional Reserves are calculated next, and do not include any Congressionally Reserved Areas. One result of this hierarchy is that Late-Successional Reserves include areas already Administratively Withdrawn in current plans and draft plan preferred alternatives. This overlap affects from 1.8 million acres of Administratively Withdrawn Areas in Alternative 7, to nearly 3 million acres in Alternative 1.

3. Adaptive Management Areas

Adaptive Management Area acreage does not include Congressionally Reserved Areas or Late-Successional Reserves that may be within their boundaries, but they do include Riparian Reserves and Administratively Withdrawn Areas because Adaptive Management Areas provide for some flexibility in the way these two allocations are dealt with.

4. Managed Late-Successional Areas

Acreage for Managed Late-Successional Areas is calculated after the above three categories are calculated.

5. Administratively Withdrawn Areas

Current plans and draft plan preferred alternatives contain 4.1 million acres of Administratively Withdrawn Areas, but only those areas that do not fall into one of the land allocation categories above are shown here as Administratively Withdrawn Areas. As a result, the acres of Administratively Withdrawn Area vary among alternatives in this SEIS only as much as they are affected (reduced) by the four land allocations listed above.

6. Riparian Reserves

Because these reserves are not mapped for all areas included in this analysis, the area within Riparian Reserves was determined through a series of mapped sample areas. These samples resulted in a percentage of area affected. This percentage varies from 2 to 74 percent among National Forests and BLM Districts, and depending on the alternative. These percentages were used to calculate Riparian Reserve acreage after the five categories above were removed. This means the acres shown for Riparian Reserve only reflect those Riparian Reserves that are interspersed throughout the matrix.

7. Matrix

The matrix comprises all areas not allocated to one of the above six categories of designated areas. The matrix includes conifer and hardwood forests, brushfields, and open areas.

Acreage and Data Changes between Draft and Final

The data necessary to prepare this SEIS were obtained through the construction of the Spatial Unified Database (SPUD). The SPUD is a Geographic Information System (GIS) application containing 50 layers of information covering federal lands in Washington, Oregon, and northern California. Federal and state agencies, as well as private foundations, contributed data sets to build the data base for lands within the range of the northern spotted owl.

Given the time constraints to complete the analysis, several errors and inconsistencies were present in the data base upon completion of the Draft SEIS. The process of validation and correction of the SPUD data for use in the Final SEIS resulted in changes in acres reported in each land allocation. The maps included in the Draft SEIS reflected errors in the data base. Subsequent corrections to the data base are now reflected in the Alternative 9 map included with this Final SEIS. The following corrections and changes were made to the SPUD data for the Final SEIS:

1. The number of acres under federal management increased due to improvements to the data for lands along the Pacific coast. Several National Parks and Wildernesses were added that were missing from the data base used for the Draft SEIS.

2. All lands administered by the Department of Defense and the Fish and Wildlife Service were assigned to the Congressionally Reserved Area allocation for the Final SEIS. These lands were reported as matrix and Late-Successional Reserves in the Draft SEIS. This adjustment was made to clarify those lands not subject to the management direction of the alternative selected in the Record of Decision for this SEIS.

Table 2-3. Estimated acres of federal land by allocation for each alternative by state and physiographic province

State/ Physiographic Province	Total Acres Federal Land	Congressionally Reserved Areas	ALTERNATIVE 1 Acres of federal land by allocation: Late-Successional Reserves	ALTERNATIVE 1: Administrative Withdrawn Areas	ALTERNATIVE 1: Riparian Reserves	ALTERNATIVE 1: Matrix	ALTERNATIVE 2 Acres of federal land by allocation: Late-Successional Reserves	ALTERNATIVE 2: Administrative Withdrawn Areas	ALTERNATIVE 2: Riparian Reserves	ALTERNATIVE 2: Matrix
Washington										
Eastern Cascades	3,470,400	1,479,400	1,149,900	222,400	212,500	406,100	951,700	261,700	225,400	552,200
Western Cascades	3,719,400	1,753,500	1,402,600	191,900	151,000	220,400	1,220,800	264,600	168,000	312,600
Western Lowlands	126,300	126,300	0	0	0	0	0	0	0	0
Olympic Peninsula	1,530,000	989,300	412,900	3,400	63,000	61,500	404,200	4,000	58,200	74,400
Total:	8,846,100	4,348,500	2,965,400	417,700	426,500	688,000	2,576,700	530,300	451,600	939,200
Oregon										
Klamath	2,118,900	261,300	1,383,000	57,000	164,500	253,000	1,059,800	69,000	228,100	500,600
Eastern Cascades	1,573,600	427,700	648,600	111,900	103,400	281,900	567,000	132,800	90,300	355,700
Western Cascades	4,488,100	723,700	2,673,400	127,500	394,800	568,900	2,106,700	191,400	473,300	993,200
Coast Range	1,411,900	23,800	953,600	37,500	196,600	200,400	869,600	39,400	189,000	290,000
	26,200	8,700	4,400	0	6,100	7,000	2,900	0	5,300	9,200
Total:	9,618,700	1,445,200	5,663,000	333,900	865,400	1,311,200	4,606,000	432,600	986,000	2,148,700
California										
Coast Range	471,300	189,500	129,300	32,700	43,100	76,600	118,600	34,300	33,000	95,900
Klamath	4,511,700	1,291,200	2,094,900	220,100	403,200	502,300	1,309,200	416,600	533,200	961,500
Cascades	1,007,500	46,200	549,800	75,500	141,500	194,600	340,500	95,500	160,200	365,200
Total:	5,990,500	1,526,900	2,774,000	328,300	587,800	773,500	1,768,300	546,400	726,400	1,422,600
3 State Total:	24,455,300	7,320,600	11,402,400	1,079,900	1,879,700	2,772,700	8,951,000	1,509,300	2,164,000	4,510,500

Table 2-3. (continued)

State/ Physiographic Province	Total Acres Federal Land	Congressionally Reserved Areas	ALTERNATIVE 3 Acres of federal land by allocation					ALTERNATIVE 4 Acres of federal land by allocation				
			Late-Successional Reserves	Managed Late-Successional Areas	Administrative Withdrawn Areas	Riparian Reserves	Matrix	Late-Successional Reserves	Managed Late-Successional Areas	Administrative Withdrawn Areas	Riparian Reserves	Matrix
Washington												
Eastern Cascades	3,470,400	1,479,400	589,600	453,000	254,500	198,400	495,500	891,000	100,700	265,000	244,400	489,900
Western Cascades	3,719,400	1,753,500	1,141,300	79,500	264,600	168,000	312,600	1,152,400	66,400	253,300	211,700	282,000
Western Lowlands	126,300	126,300	0	0	0	0	0	0	0	0	0	0
Olympic Peninsula	1,530,000	989,300	404,200	0	4,000	58,200	74,400	418,000	0	2,800	60,700	59,300
Total:	8,846,100	4,348,500	2,135,100	532,500	523,100	424,600	882,500	2,461,400	167,100	521,100	516,800	831,200
Oregon												
Klamath	2,118,900	261,300	913,500	146,300	69,000	228,100	500,600	965,900	15,100	86,500	295,400	494,700
Eastern Cascades	1,573,600	427,700	382,700	197,100	129,400	88,900	347,800	443,600	14,700	180,000	136,600	371,000
Western Cascades	4,488,100	723,700	1,590,200	516,500	191,400	473,300	993,200	1,705,600	200	231,700	737,400	1,089,600
Coast Range	1,411,900	23,800	866,900	2,800	39,400	189,000	290,000	900,900	19,200	39,200	211,100	217,800
Willamette Valley	26,200	8,700	2,600	300	0	5,300	9,200	3,200	0	0	6,600	7,600
Total:	9,618,700	1,445,200	3,755,900	863,000	429,200	984,600	2,140,800	4,019,200	49,200	537,400	1,387,100	2,180,700
California												
Coast Range	471,300	189,500	118,600	0	34,300	33,000	95,900	119,200	0	43,500	43,900	75,200
Klamath	4,511,700	1,291,200	1,208,600	100,700	416,600	533,200	961,500	1,229,200	17,100	421,000	694,400	858,800
Cascades	1,007,500	46,200	141,100	203,500	95,500	158,800	362,500	237,100	4,100	128,500	253,900	337,700
Total:	5,990,500	1,526,900	1,468,300	304,200	546,400	725,000	1,419,900	1,585,500	21,200	593,000	992,200	1,271,700
3 State Total:	24,455,300	7,320,600	7,359,300	1,699,700	1,498,700	2,134,200	4,443,200	8,066,100	237,500	1,651,500	2,896,100	4,283,600

Table 2-3. (continued)

State/ Physiographic Province	Total acres federal land	Congressionally Reserved Areas	ALTERNATIVE 5 Acres of federal land by allocation					ALTERNATIVES 6 & 10 Acres of federal land by allocation			
			Late-Successional Reserves	Managed Late-Successional Areas	Administrative Withdrawn Areas	Riparian Reserves	Matrix	Late-Successional Reserves	Administrative Withdrawn Areas	Riparian Reserves	Matrix
Washington											
Eastern Cascades	3,470,400	1,479,400	611,200	118,800	409,600	238,900	612,400	808,700	300,300	255,200	626,800
Western Cascades	3,719,400	1,753,500	986,100	84,800	290,600	225,500	379,000	1,103,700	302,100	200,900	359,200
Western Lowlands	126,300	126,300	0	0	0	0	0	0	0	0	0
Olympic Peninsula	1,530,000	989,300	418,000	0	2,800	52,700	67,300	404,200	4,000	58,200	74,400
Total:	8,846,100	4,348,500	2,015,300	203,600	703,000	517,100	1,058,700	2,316,600	606,400	514,300	1,060,400
Oregon											
Klamath	2,118,900	261,300	851,700	30,700	104,000	274,500	596,700	887,100	95,400	268,500	606,600
Eastern Cascades	1,573,600	427,700	195,700	22,000	264,100	138,000	526,000	414,400	194,000	111,700	425,700
Western Cascades	4,488,100	723,700	1,122,000	1,100	320,500	746,300	1,574,500	1,526,500	255,100	633,500	1,349,400
Coast Range	1,411,900	23,800	818,000	99,000	39,200	170,600	261,200	866,600	39,800	190,000	291,800
Willamette Valley	26,200	8,700	2,200	0	200	5,600	9,500	2,600	0	5,500	9,400
Total:	9,618,700	1,445,200	2,989,600	152,800	728,000	1,335,000	2,967,900	3,697,200	584,300	1,209,200	2,682,900
California											
Coast Range	471,300	189,500	119,000	0	43,700	30,700	88,400	118,200	34,700	33,000	95,900
Klamath	4,511,700	1,291,200	1,034,700	19,800	461,700	606,400	1,097,900	1,157,200	467,900	569,600	1,025,700
Cascades	1,007,500	46,200	217,800	4,900	130,600	184,600	423,600	211,700	135,100	186,500	428,000
Total:	5,990,500	1,526,900	1,371,500	24,700	636,000	821,700	1,609,900	1,487,100	637,700	789,100	1,549,600
3 State Total:	24,455,300	7,320,600	6,376,400	381,100	2,067,000	2,673,800	5,636,500	7,500,900	1,828,400	2,512,600	5,292,900

Table 2-3. (continued)

State/ Physiographic Province	Total acres federal land	Congressionally Reserved Areas	ALTERNATIVE 7 Acres of federal land by allocation: Late-Successional Reserves	ALTERNATIVE 7: Managed Late-Successional Areas	ALTERNATIVE 7: Administrative Withdrawn Areas	ALTERNATIVE 7: Riparian Reserves	ALTERNATIVE 7: Matrix	ALTERNATIVE 8 Acres of federal land by allocation: Late-Successional Reserves	ALTERNATIVE 8: Administrative Withdrawn Areas	ALTERNATIVE 8: Riparian Reserves	ALTERNATIVE 8: Matrix
Washington											
Eastern Cascades	3,470,400	1,479,400	611,200	118,800	409,600	54,600	796,700	808,700	300,300	143,100	738,900
Western Cascades	3,719,400	1,753,500	896,200	84,800	331,200	52,500	601,300	1,103,700	302,100	124,400	435,700
Western Lowlands	126,300	126,300	0	0	0	0	0	0	0	0	0
Olympic Peninsula	1,530,000	989,300	352,700	0	10,500	14,900	162,600	404,200	4,000	43,700	88,800
Total:	8,846,100	4,348,500	1,860,100	203,600	751,300	122,000	1,560,600	2,316,600	606,400	311,200	1,263,400
Oregon											
Klamath	2,118,900	261,300	456,600	30,700	217,100	75,400	1,077,800	887,100	95,400	160,900	714,200
Eastern Cascades	1,573,600	427,700	194,400	22,000	264,100	29,400	636,000	414,400	194,000	62,100	475,400
Western Cascades	4,488,100	723,700	1,110,000	1,100	320,600	156,300	2,176,500	1,526,500	255,100	360,200	1,622,900
Coast Range	1,411,900	23,800	588,800	98,400	42,900	52,600	605,400	866,600	39,800	125,300	356,500
Willamette Valley	26,200	8,700	1,100	0	200	1,200	15,000	2,600	0	3,600	11,300
Total:	9,618,700	1,445,200	2,350,900	152,200	844,900	314,900	4,510,700	3,697,200	584,300	712,100	3,180,300
California											
Coast Range	471,300	189,500	118,100	0	44,300	7,200	112,300	118,200	34,700	20,400	108,400
Klamath	4,511,700	1,291,200	875,900	19,800	510,700	134,100	1,680,000	1,157,200	467,900	333,100	1,262,200
Cascades	1,007,500	46,200	217,800	4,900	130,600	44,100	564,000	211,700	135,100	125,800	488,700
Total:	5,990,500	1,526,900	1,211,800	24,700	685,600	185,400	2,356,300	1,487,100	637,700	479,300	1,859,300
3 State Total:	24,455,300	7,320,600	5,422,800	380,500	2,281,800	622,300	8,427,600	7,500,900	1,828,400	1,502,600	6,303,000

Table 2-3. (continued)

State/ Physiographic Province	Total acres federal land	Congressionally Reserved Areas	ALTERNATIVE 9 Acres of federal land by allocation: Late-Successional Reserves	Adaptive Management Areas	Managed Late-Successional Areas	Administrative Withdrawn Areas	Riparian Reserves	Matrix
Washington								
Eastern Cascades	3,470,400	1,479,400	874,700	100,100	92,100	221,100	247,000	455,900
Western Cascades	3,719,400	1,753,500	1,094,900	167,100	0	193,600	218,100	292,100
Western Lowlands	126,300	126,300	0	0	0	0	0	0
Olympic Peninsula	1,530,000	989,300	413,900	124,500	0	300	1,000	1,000
Total:	8,846,100	4,348,500	2,383,500	391,700	92,100	415,000	466,100	749,000
Oregon								
Klamath	2,118,900	261,300	858,700	249,500	0	60,000	267,000	422,400
Eastern Cascades	1,573,600	427,700	378,400	0	0	194,700	159,000	413,800
Western Cascades	4,488,100	723,700	1,303,600	236,100	0	275,900	767,300	1,181,500
Coast Range	1,411,900	23,800	924,200	78,900	0	35,800	161,700	187,500
Willamette Valley	26,200	8,700	1,100	100	0	100	7,500	8,700
Total:	9,618,700	1,445,200	3,466,000	564,600	0	566,500	1,362,500	2,213,900
California								
Coast Range	471,300	189,500	118,300	0	0	42,600	44,500	76,400
Klamath	4,511,700	1,291,200	1,227,800	398,700	0	356,900	564,700	672,400
Cascades	1,007,500	46,200	235,200	166,800	10,100	96,100	189,700	263,600
Total:	5,990,500	1,526,900	1,581,300	565,500	10,100	495,600	798,900	1,012,400
3 State Total:	24,455,300	7,320,600	7,430,800	1,521,800	102,200	1,477,100	2,627,500	3,975,300

3. The 270,000 acres in the Goosenest Adaptive Management Area (California Cascades Province) that were missing in the data base used for the Draft SEIS were added.

4. The National Forests and BLM Districts made minor adjustments to Key Watershed and Late-Successional Reserve boundaries to more accurately identify topographic breaks. In response to public comments, a number of changes to land allocations were also incorporated into the data base for the Final SEIS.

5. The Final SEIS added LS/OG1s and LS/OG2s (Johnson et al. 1991) to the Late-Successional Reserves category in Marbled Murrelet Zone 1 (except the Quinault Special Management Area of the Olympic Adaptive Management Area) for all alternatives except 7. While this was stated in the FEMAT Report, the acreages were not reflected in the land allocation data base.

6. Owl additions (Johnson et al. 1991) were added to Late-Successional Reserves for Alternatives 1, 2, 3, 6, 8, and 10. Owl additions within the Northern Coast Range and Finney Adaptive Management Areas are also reserved in Alternative 9. This reflects a change from Adaptive Management Area acres to Late-Successional Reserve acres.

7. In the Draft SEIS, all alternatives used the same hierarchy of land allocations except Alternative 3. In the Final SEIS, Alternative 3 was analyzed using the consistent hierarchical method as all other alternatives.

8. Standards and guidelines were retained from the BLM Revised Preferred Alternative (Appendix B1) to provide Connectivity/Diversity Blocks for northern spotted owl dispersal habitat. These Connectivity/Diversity Blocks are not mapped in the Final SEIS. For additional discussion see Appendix B9, BLM Spotted Owl Standards and Guidelines.

9. In the Draft SEIS, seral stage data identified "large conifer, single story" as "medium conifer, multistory," and vice versa for all alternatives. These are correctly described in the Final SEIS.

10. The Riparian Reserve strategy for Alternative 9 was changed from Riparian Reserve Scenario 2 to Riparian Reserve Scenario 1 in the Final SEIS.

11. The Quinault Special Management Area was changed from Late-Successional Reserve to the Olympic Adaptive Management Area allocation for Alternative 9 in the Final SEIS.

Data sets already in the SPUD will be updated and may undergo revisions as new data are collected, and standards are developed and applied. This updating process will allow agencies to respond to data requests for future studies of ecosystem components of the Pacific Northwest.

The Alternatives

This section describes each alternative, focusing on those elements and standards and guidelines that vary by alternative. Key elements of these alternatives are summarized in Table 2-4 for reference and comparison.

Alternatives 2, 6, and 10 were not analyzed by the Assessment Team in the same detail as were the other seven action alternatives. For example, Alternatives 2 and 6 were not included in the second round of species habitat sufficiency assessments, and Alternative 10 was developed after the viability analysis was completed. However, since these three alternatives are made up of components present in one or more of the other alternatives, the principal effects of these alternatives reasonably can be inferred from the analyses of the other alternatives. These three alternatives are described here in Chapter 2 with the other action alternatives, and included in Chapter 3&4 only for those parameters for which effects can be described.

Alternative 1

24,455,300 acres total federal land

This alternative is designed to have the highest probability of meeting five biological criteria: (1) viability of northern spotted owls, (2) viability of marbled murrelets, (3) viability of fish species and stocks at risk, (4) viability of other species associated with old-growth forests, and (5) maintenance of interactive late-successional forest ecosystems on federal lands. Essentially, all old-growth forests would be protected; forests adjacent to streams would receive significant protection to protect fish; and, to permit spotted owl dispersal, some forest cover would be retained in areas where timber harvest is allowed.

Congressionally Reserved Areas - 7,320,600 acres

Late-Successional Reserves - 11,402,400 acres

Elements:
LS/OG1, spotted owl additions, LS/OG2, LS/OG3, occupied marbled murrelet sites, and protection buffers for other species.

Standards and Guidelines:
There would be no cutting of trees or salvage of dead trees.

Riparian Reserves - 1,879,700 acres

1. Fish-bearing streams - an area on each side of the stream channel equal to two times the height of a site-potential tree or 300 feet (whichever is greater).

2. Permanently flowing nonfish-bearing streams - an area on each side equal to the height of one site-potential tree or 150 feet (whichever is greater).

Table 2-4. Summary and comparison of land allocations and standards and guidelines among alternatives

	Alternative	1	2	3	4	5	6	7	8	9	10
Congress. Res.	Million acres	7.321	7.321	7.321	7.321	7.321	7.321	7.321	7.321	7.321	7.321
Late-Successional Reserves	Million acres	11.402	8.951	7.359	8.066	6.376	7.501	5.423	7.501	7.431	7.501
	Timber harvest/salvage	None	Treatment of stands less than 50 years old. Very limited salvage	Same as Alternative 2	Treatment of stands and salvage per Northern Spotted Owl Recovery Plan	Same as Alternative 4	Same as Alternative 2	Same as Alternative 4	Treatment of stands in Murrelet Zone 1 up to 50 years. Other stands up to 180 years.	West - Treatment of less than 80 years old. East - Manage to reduce risk of catastrophic loss.	Same as Alternative 2
	Protection for sites occupied by marbled murrelets outside reserves	Yes	Yes	Yes	Yes	Yes	Yes	No[2]	No[2]	Yes	Yes
	Protection of SAT species closely associated with old growth	Yes	No	Yes	Yes	Yes	No	No	No	Yes	No
Managed Late-Successional Areas or Adaptive Management Areas (Alt. 9 only)	Million acres	0	0	1.700	0.238	0.381	0	0.381	0	1.522 (AMA) 0.102 (MLSA)	0
	Timber harvest/salvage	N/A	N/A	West - Long rotation, 50 percent retention East - Long rotation, or uneven-age management	Treatment of stands and salvage per Northern Spotted Owl Recovery Plan	Same as Alternative 4	N/A	Same as Alternative 4	N/A	Adaptive Management Areas and some Managed Late-Successional Areas	N/A
Administratively Withdrawn Areas	Million acres	1.080	1.509	1.499	1.652	2.067	1.828	2.282	1.828	1.477	1.828
Riparian Reserves	Million acres	1.880	2.164	2.134	2.896	2.674	2.513	0.622	1.503	2.628	2.513
	Widths[1]	2:1:1	2:1:1 in Tier 1 Key Watersheds, 2:1:1/2 other watersheds	Same as Alternative 2	Same as Alternative 1	Same as Alternative 2	Same as Alternative 2	Variable, usually no reserves on intermittent streams	2:1/2:1/6	Same as Alternative 1	Same as Alternative 2
Matrix	Million acres	2.773	4.511	4.443	4.284	5.637	5.293	8.428	6.303	3.975	5.293
	50-11-40	Yes	Yes	Yes	Yes	Yes	Yes	Natl. Forest-Yes BLM-modified	No	No	No
	Snags:logs:green trees per acre	2:2:6	2:2:6	Support 40% pop: West - 12, East - 2-10:4	Variable on National Forests. BLM - 2:2:6-9	Same as Alternative 4	2:2:6	Same as Alternative 4	Same as Alternative 4	Coastal areas WA/OR: 2:8-12:0 Other areas 2:8-12:15%	2:2:6

[1] Riparian Reserve Widths (e.g., 2:1:1), are expressed as multiples of the height of a maximum site-potential tree, measured on each side of fish-bearing streams, nonfish-bearing streams, and intermittent streams, respectively (see text).

[2] Not specifically required in the alternative, but currently required under the Endangered Species Act.

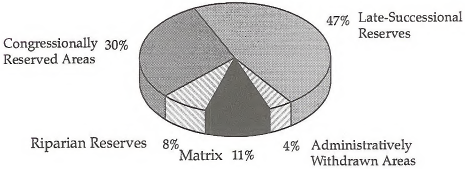
3. Intermittent streams - an area on each side equal to the height of one site-potential tree or 100 feet (whichever is greater).

Administratively Withdrawn Areas - 1,079,900 acres

Matrix - 2,772,700 acres

STANDARDS AND GUIDELINES:
Apply the 50-11-40 rule. Retain at least six large, green trees per acre that exceed the average stand diameter, two large snags per acre, and two large logs per acre. At least 10 percent of the matrix should be over 180 years old at any one time, and the remainder of the matrix is to be managed using area control to achieve a rotation of 180 years. Provide protection buffers for other species.

Figure 2-4. Alternative 1



Alternative 2

24,455,300 acres total federal land

This alternative is designed to protect ecologically significant old-growth forests and additional areas determined to be valuable for northern spotted owl population viability. Management of the intervening lands would be focused to provide for successful spotted owl dispersal. Limited salvage and silvicultural practices would be allowed within the Late-Successional Reserves, a high level of protection for forests adjacent to streams is prescribed, and some forest cover would be retained in areas where timber harvest is allowed.

Because the elements of this alternative are similar to those in one or more of the other action alternatives, its effects were not analyzed for every parameter presented in Chapter 3&4.

Congressionally Reserved Areas - 7,320,600 acres

Late-Successional Reserves - 8,951,000 acres

ELEMENTS:
LS/OG1, spotted owl additions, and LS/OG2.

STANDARDS AND GUIDELINES:
Cutting of trees is restricted to restoring late-successional forest attributes, primarily through precommercial and commercial thinning of forest stands less than 50 years old that have been established following logging. Harvest proposals are subject to review by the Regional Ecosystem Office to ensure consistent application of the provisions of this alternative. The Regional Ecosystem Office may develop criteria that would exempt some activities from review. Salvage of dead trees would be limited to stand-replacing disturbance events exceeding 100 acres under guidelines for salvage adapted from the Final Draft Spotted Owl Recovery Plan (see Appendix B5, Recovery Plan Standards and Guidelines).

Other Late-Successional Reserves

ELEMENTS:
Occupied marbled murrelet sites.

Riparian Reserves - 2,164,000 acres.

1. Fish-bearing streams - an area on each side equal to two times the height of a site-potential tree or 300 feet (whichever is greater).

2. Permanently flowing nonfish-bearing streams - an area on each side equal to the height of one site-potential tree or 150 feet (whichever is greater).

3a. Intermittent streams in Tier 1 Key Watersheds - an area on each side equal to the height of one site-potential tree or 100 feet (whichever is greater).

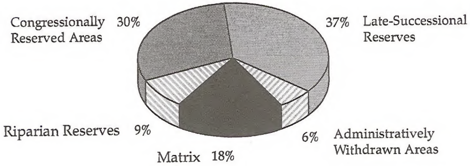
3b. Intermittent streams in all other watersheds - an area on each side equal to half the height of a site-potential tree or 50 feet (whichever is greater).

Administratively Withdrawn Areas - 1,509,300 acres

Matrix - 4,510,500 acres

STANDARDS AND GUIDELINES:
Apply the 50-11-40 rule. Retain at least six large, green trees per acre that exceed the average stand diameter, two large snags per acre, and two large logs per acre.

Figure 2-5. Alternative 2



Alternative 3

24,455,300 acres total federal land

This alternative is designed to provide for intact late-successional forest ecosystems that are interconnected, while at the same time allowing for the production of forest products from some late-successional forests. Land allocations and management prescriptions would vary by physiographic province; the Oregon Eastern Cascades, Washington Eastern Cascades, and the California Cascades Provinces would be treated differently than the other physiographic provinces.

"Eastside Cascades" includes the Oregon Eastern Cascades, Washington Eastern Cascades, and the California Cascades Physiographic Provinces (see Description of Physiographic Provinces in Chapter 3&4 of this SEIS). "Westside" includes all other provinces.

Congressionally Reserved Areas - 7,320,600 acres

Westside Late-Successional Reserves - 6,245,900 acres

ELEMENTS:
LS/OG1, spotted owl additions, and LS/OG2 within Marbled Murrelet Zone 1.

STANDARDS AND GUIDELINES:
Although owl additions are initially included in the Late-Successional Reserves, they may eventually be reclassified as Managed Late-Successional Areas when spotted owl population performance has been demonstrated and there is additional experience indicating that forest stands can be successfully managed to create late-successional forests. Cutting of trees in Late-Successional Reserves is restricted to restoring late-successional forest attributes, primarily through precommercial and commercial thinning of forest stands less than 50 years old that have been established following logging. Harvest proposals are subject to review by the Regional Ecosystem Office. The Regional Ecosystem Office may develop criteria that would exempt some activities from review. Salvage of dead trees would be limited to stand-replacing disturbance events exceeding 100 acres under guidelines for salvage adapted from the Final Draft Spotted Owl Recovery Plan (see Appendix B5, Recovery Plan Standards and Guidelines).

Other Westside Late-Successional Reserves

ELEMENTS:
Occupied marbled murrelet sites, and protection buffers for other species.

Eastside Cascades Late-Successional Reserves - 1,113,400 acres

ELEMENT:
LS/OG1.

Standards and Guidelines:
Follow provisions adapted from the Final Draft Spotted Owl Recovery Plan for DCAs (Appendix B5, Recovery Plan Standards and Guidelines). This allows treatment of forest stands to reduce risk of fire and insect infestations consistent with an overall objective of providing late-successional forest conditions at landscape scales. The guidelines also address salvage.

Other Eastside Cascades Late-Successional Reserves

Element:
Protection buffers for other species.

Westside Managed Late-Successional Areas - 846,100 acres

Element:
LS/OG2 outside of Marbled Murrelet Zone 1.

Standards and Guidelines:
Silvicultural treatments will only be done within the constraints and objectives for Managed Late-Successional Areas noted under the land allocations section earlier in this chapter. Silvicultural treatments are further constrained as follows:

1. Retention (no cutting) of 50 percent of each LS/OG2 area. Selection of the forest stands to be retained would be based on occupancy by marbled murrelets or northern spotted owls, protection of fish-bearing streams within the area, sites occupied by other old-growth forest species, and identification of the best developed old-growth forest stands. Thirty percent is to be initially selected during preparation of the area management plan. An additional 20 percent of each harvest unit is to be identified during project layout, primarily for protection of intermittent streams.

2. Remaining area would be managed on a 250-year rotation with area and inventory control, and cutting would proceed only if 40 percent of an entire LS/OG2 was in forest stands at least 100 years old (stands identified under number 1 above contribute to this 40 percent if they are over 100 years old). Retention of six of the largest and oldest green trees per acre on the actual harvest unit. These do not count toward the 20 percent retention.

   Salvage is permitted within the area to be managed on 250-year rotation. Salvage consistent with the objectives for Late-Successional Reserves is permitted within the 50 percent to be retained.

Other Westside Managed Late-Successional Areas

Element:
Protection buffers for other species.

Eastside Cascades Managed Late-Successional Areas -
853,600 acres

ELEMENTS:
LS/OG2, owl additions, and Managed Pair Areas for known and future owl pairs and resident singles from the Final Draft Spotted Owl Recovery Plan.

STANDARDS AND GUIDELINES:
Management of the Managed Pair Areas is based on the provisions for such areas adapted from the Final Draft Spotted Owl Recovery Plan (see Appendix B5, Recovery Plan Standards and Guidelines). Management of the LS/OG2s and owl additions has the objective of providing old-growth characteristics. Silvicultural treatments are further constrained as follows:

1. Retention (no cutting) of 50 percent of each LS/OG2 and owl addition area. Selection of the retained stands would be based on occupancy by marbled murrelets (east of the crest of the Cascade Range in Washington) or spotted owls, protection of fish-bearing streams within the area, sites occupied by other old-growth forest species, and identification of the best developed old-growth forest stands. Thirty percent is to be initially selected during preparation of the area management plan. An additional 20 percent of each harvest unit is to be identified from stands of late-successional forests (or the oldest available) left in configurations that will provide protection of intermittent streams.

2. Manage remaining LS/OG2 and owl additions through either uneven-age or even-age timber management or a combination of the two, to reduce the risk of catastrophic fire and insect infestation. Cutting would proceed only if at least 40 percent of an entire LS/OG2 or owl addition was in forest stands at least 80 years old. For mixed-conifer even-age management, a rotation of 250 years would be used. For ponderosa pine or Jeffrey pine areas, rotation would be 350 years. For other mesic series, rotation would be 200 years. For lodgepole pine, rotation would be 100 years. Retain six of the largest and oldest green trees per acre on the actual harvest unit. These do not count toward the 20 percent retention target. The goal of uneven-age management would be to retain and grow large conifer trees.

   Salvage is permitted within the area to be managed on a 250 to 350-year rotation or with uneven-age management. Salvage consistent with the objectives of the Late-Successional Reserves is permitted within the 50 percent to be retained.

Other Eastside Cascades Managed Late-Successional Areas

ELEMENT:
Protection buffers for other species.

Riparian Reserves - 2,134,200 acres

1. Fish-bearing streams - an area on each side equal to two times the height of a site-potential tree or 300 feet (whichever is greater).

2. Permanently flowing nonfish-bearing streams - an area on each side equal to the height of one site-potential tree or 150 feet (whichever is greater).

3a. Intermittent streams in Tier 1 Key Watersheds - an area on each side equal to the height of one site-potential tree or 100 feet (whichever is greater).

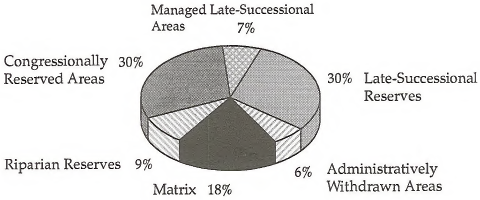
3b. Intermittent streams in all other watersheds - an area on each side equal to half the height of a site-potential tree or 50 feet (whichever is greater).

Administratively Withdrawn Areas - 1,498,700 acres

Matrix - 4,443,200 acres

STANDARDS AND GUIDELINES:
Apply the 50-11-40 rule. Retain 10 percent of the matrix area in late-successional forest stands (or the oldest available) in 5 to 10-acre well-dispersed islands. Count Riparian Reserves and 10 percent retention toward meeting the 50-11-40 rule. On harvest units, retain 4 large green trees per acre, 12 large logs in decay class 1 and 2 (2 to 10 logs in the eastside Cascades), and all logs that are in decay classes 3, 4, and 5. Retain enough snags to support populations of cavity nesters at 40 percent of potential population levels (Neitro et al. 1985). Provide protection buffers for other species.

Figure 2-6. Alternative 3



Alternative 4

24,455,300 acres total federal land

This alternative is designed to protect the most ecologically significant late-successional forests and additional areas identified to protect northern spotted owls. It would maximize protection of forests adjacent to streams to protect fish, and would provide for the retention of some forest cover in areas where timber harvest is allowed.

Congressionally Reserved Areas - 7,320,600 acres

Late-Successional Reserves - 8,066,100 acres

ELEMENTS:
Designated Conservation Areas, Reserved Pair Areas, and Residual Pair Areas from the Final Draft Spotted Owl Recovery Plan; LS/OG1; and LS/OG2 within Marbled Murrelet Zone 1.

STANDARDS AND GUIDELINES:
Cutting of trees, including salvage, would be limited by provisions adapted from the Final Draft Spotted Owl Recovery Plan for DCAs (see Appendix B5, Recovery Plan Standards and Guidelines).

Other Late-Successional Reserves

ELEMENTS:
Occupied marbled murrelet sites, and protection buffers for other species.

Managed Late-Successional Areas - 237,500 acres

ELEMENT:
Managed Pair Areas for known and, on the east side, future, owl pairs andresident singles from the Final Draft Spotted Owl Recovery Plan; and protection buffers for other species.

Riparian Reserves - 2,896,100 acres

1. Fish-bearing streams - an area on each side equal to two times the height of a site-potential tree or 300 feet (whichever is greater).

2. Permanently flowing nonfish-bearing streams - an area on each side equal to the height of one site-potential tree or 150 feet (whichever is greater).

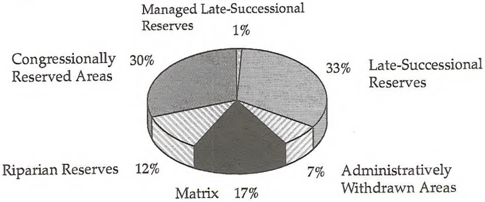
3. Intermittent streams - an area on each side equal to the height of one site-potential tree or 100 feet (whichever is greater).

Administratively Withdrawn Areas - 1,651,500 acres

Matrix - 4,283,600 acres

STANDARDS AND GUIDELINES:
Apply the 50-11-40 rule. Retain green trees, snags, and coarse woody debris at levels specified in the current plans and draft plan preferred alternatives. Provide protection buffers for other species.

Figure 2-7. Alternative 4



Alternative 5

24,455,300 acres total federal land

This alternative is designed to implement the mitigation strategy recommended in the Scientific Analysis Team Report (Thomas et al. 1993). It adds riparian protection, marbled murrelet protection, and endemic species protection to the Final Draft Spotted Owl Recovery Plan, current plans, and draft plan preferred alternatives.

Congressionally Reserved Areas - 7,320,600 acres

Late-Successional Reserves - 6,376,400 acres

ELEMENTS:
Designated Conservation Areas, Reserved Pair Areas, and Residual Pair Areas from the Final Draft Spotted Owl Recovery Plan; LS/OG1; and LS/OG2 within Marbled Murrelet Zone 1.

STANDARDS AND GUIDELINES:
Cutting of trees, including salvage, would be limited by provisions adapted from the Final Draft Spotted Owl Recovery Plan (see Appendix B5, Recovery Plan Standards and Guidelines). Harvest proposals are subject to review by the Regional Ecosystem Office. The Regional Ecosystem Office may develop criteria that would exempt some activities from review.

Other Late-Successional Reserves

ELEMENTS:
Occupied marbled murrelet sites, and protection buffers for other species.

Managed Late-Successional Areas - 381,100 acres

ELEMENTS:
Managed Pair Areas for known and, on the east side, future, owl pairs and resident singles from the Final Draft Spotted Owl Recovery Plan; and protection buffers for other species.

Riparian Reserves - 2,673,800 acres

1. Fish-bearing streams - an area on each side equal to two times the height of a site-potential tree or 300 feet (whichever is greater).

2. Permanently flowing nonfish-bearing streams - an area on each side equal to the height of one site-potential tree or 150 feet (whichever is greater).

3a. Intermittent streams in Tier 1 Key Watersheds - an area on each side equal to the height of one site-potential tree or 100 feet (whichever is greater).

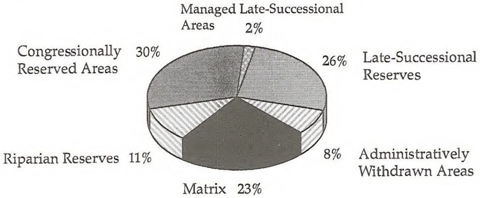
3b. Intermittent streams in all other watersheds - an area on each side equal to half the height of a site-potential tree or 50 feet (whichever is greater).

Administratively Withdrawn Areas - 2,067,000 acres

Matrix - 5,636,500 acres

STANDARDS AND GUIDELINES:
Apply the 50-11-40 rule. Retain green trees, snags, and coarse woody debris at levels specified in current plans and draft plan preferred alternatives. Provide protection buffers for other species.

Figure 2-8. Alternative 5



Alternative 6

24,455,300 acres total federal land

This alternative is designed to protect the most ecologically significant late-successional forests and additional areas determined to be valuable for northern spotted owl population viability according to the Scientific Panel on Late-Successional Forest Ecosystems (Johnson et al. 1991).

Because this alternative is similar to one or more of the other action alternatives, its effects were not analyzed for every parameter presented in Chapter 3&4.

Congressionally Reserved Areas - 7,320,600 acres

Late-Successional Reserves - 7,500,900 acres

ELEMENTS:
LS/OG1, spotted owl additions, and LS/OG2 within Marbled Murrelet Zone 1.

STANDARDS AND GUIDELINES:
Cutting of trees is restricted to restoring late-successional forest attributes, primarily through precommercial and commercial thinning of forest stands less than 50 years old that have been established following logging. Harvest proposals are subject to review by the Regional Ecosystem Office. The Regional Ecosystem Office may develop criteria that would exempt some activities from review. Salvage of dead trees would be limited to stand-replacing disturbance events exceeding 100 acres under guidelines for salvage adapted from the Final Draft Spotted Owl Recovery Plan (see Appendix B5, Recovery Plan Standards and Guidelines).

Other Late-Successional Reserves

ELEMENT:
Occupied marbled murrelet sites.

Riparian Reserves - 2,512,600 acres

1. Fish-bearing streams - an area on each side equal to two times the height of a site-potential tree or 300 feet (whichever is greater).

2. Permanently flowing nonfish-bearing streams - an area on each side equal to the height of one site-potential tree or 150 feet (whichever is greater).

3a. Intermittent streams in Tier 1 Key Watersheds - an area on each side equal to the height of one site-potential tree or 100 feet (whichever is greater).

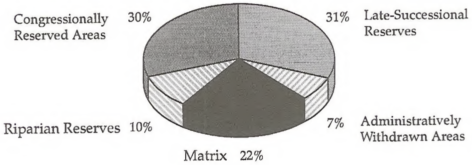
3b. Intermittent streams in all other watersheds - an area on each side equal to half the height of a site-potential tree or 50 feet (whichever is greater).

Administratively Withdrawn Areas - 1,828,400 acres

Matrix - 5,292,900 acres

STANDARDS AND GUIDELINES:
Apply the 50-11-40 rule. Retain at least six large, green trees per acre that exceed the average stand diameter, two large snags per acre, and two large logs per acre.

Figure 2-9. Alternative 6



Alternative 7

24,455,300 acres total federal land

This alternative is intended to reflect the most likely management direction that would have been implemented if the Forest Service and BLM had continued their present land and resource management planning processes as reflected in current plans and draft plan preferred alternatives described earlier in this chapter, and if they had adopted the elements of the *Final Draft Recovery Plan for the Northern Spotted Owl* (USDI unpub.).

Congressionally Reserved Areas - 7,320,600 acres

Late-Successional Reserves - 5,422,800 acres

ELEMENTS:
Designated Conservation Areas, Reserved Pair Areas, and Residual Pair Areas from the Final Draft Spotted Owl Recovery Plan.

STANDARDS AND GUIDELINES:
Cutting of trees, including salvage, would be limited by provisions adapted from the Final Draft Spotted Owl Recovery Plan as interpreted by federal agencies (see Appendix B5, Recovery Plan Standards and Guidelines).

Managed Late-Successional Areas - 380,500 acres

ELEMENT:
Managed Pair Areas for known and, on the east side, future, owl pairs and resident singles from the Final Draft Spotted Owl Recovery Plan.

Riparian Reserves - 622,300 acres

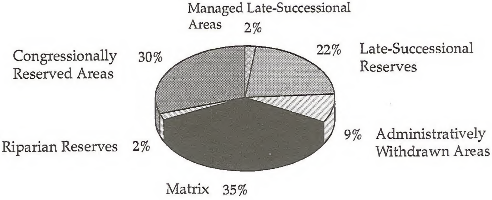
Apply the standards and guidelines of current plans and draft plan preferred alternatives (see Introduction to the Action Alternatives).

Administratively Withdrawn Areas - 2,281,800 acres

Matrix - 8,427,600 acres

STANDARDS AND GUIDELINES:
Apply the 50-11-40 rule, which on lands administered by the BLM would be modified to be met by Connectivity/Diversity Blocks. Retain green trees, snags, and coarse woody debris at levels specified in the current plans and draft plan preferred alternatives.

Figure 2-10. Alternative 7



Alternative 8

24,455,300 acres total federal land

This alternative is designed to protect the most ecologically significant late-successional forests (LS/OG 1) and additional areas determined to be valuable for spotted owl population viability. It provides for a minimum level of protection of forests near streams to protect fish. Retention of forest cover in areas where timber harvest is allowed would be based on current plans and draft plan preferred alternatives.

Congressionally Reserved Areas - 7,320,600 acres

Late-Successional Reserves - 7,500,900 acres

ELEMENTS:
LS/OG1, spotted owl additions, and LS/OG2 within Marbled Murrelet Zone 1.

STANDARDS AND GUIDELINES:
Within Marbled Murrelet Zone 1, cutting of trees is restricted to restoring late-successional forest attributes, primarily through precommercial and commercial thinning of forest stands less than 50 years old that have been established following logging. Harvest proposals are subject to review by the Regional Ecosystem Office. The Regional Ecosystem Office may develop criteria that would exempt some activities from review. Salvage of dead trees would be limited to stand-replacing disturbance events exceeding 100 acres under guidelines for salvage adapted from the Final Draft Spotted Owl Recovery Plan (see Appendix B5, Recovery Plan Standards and Guidelines).

Outside of Marbled Murrelet Zone 1, cutting of trees is permitted in forest stands less than 180 years old to produce or maintain spotted owl habitat. Salvage of dead trees would be permitted provided that current plan and draft plan preferred alternative standards and guidelines for snags and logs were met after logging.

Riparian Reserves - 1,502,600 acres

1. Fish-bearing streams - an area on each side equal to two times the height of a site-potential tree or 300 feet (whichever is greater).

2. Permanently flowing nonfish-bearing streams - an area equal to half the height of a site-potential tree or 75 feet (whichever is greater).

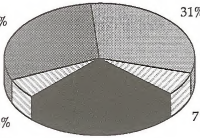
3. Intermittent streams - an area equal to one sixth the height of a site-potential tree or 25 feet (whichever is greater).

Administratively Withdrawn Areas - 1,828,400 acres

Matrix - 6,303,900 acres

STANDARDS AND GUIDELINES:
Retain green trees, snags, and coarse woody debris at levels specified in the current plans and draft plan preferred alternatives.

Figure 2-11. Alternative 8



Alternative 9 - The Preferred Alternative

24,455,300 acres total federal land

This alternative blends a number of recommendations from the four previous efforts to develop a strategy to manage old-growth forests (see Elements from Previous Documents earlier in this chapter). Old-growth and late-successional forests would be protected where they overlap with Key Watersheds. Adaptive Management Areas would be designated to encourage the development and testing of technical and social approaches to achieving desired ecological, economic, and other social objectives. This alternative incorporates all of Appendix B11, Standards and Guidelines Resulting From Additional Species Analysis and Changes to Alternative 9.

Alternative 9 is the preferred alternative for this SEIS. It is the alternative that most closely offers the specific management direction that would put into effect the proposal that President Clinton announced on July 1, 1993, titled "The Forest Plan: For a Sustainable Economy and a Sustainable Environment" (Clinton and Gore 1993).

Congressionally Reserved Areas - 7,320,600 acres

Late-Successional Reserves - 7,430,800

ELEMENTS:
Some or parts of LS/OG1s and LS/OG2s and some or parts of the DCAs from the Final Draft Spotted Owl Recovery Plan in the western portion of the northern spotted owl range as shown on the Alternative 9 map included with this Final SEIS. All LS/OG1 and LS/OG2 within Marbled Murrelet Zone 1, except in the Quinault Special Management Area.

STANDARDS AND GUIDELINES:
Thinning or other silvicultural treatments inside reserves are subject to review by the Regional Ecosystem Office to ensure that the treatments are beneficial to the creation of late-successional forest conditions. The Regional Ecosystem Office may develop criteria that would exempt some activities from review. Activities that would be permitted in the western and eastern portions of the northern spotted owl's range are described separately below. Salvage of dead trees would be based on guidelines adapted from the Final Draft Spotted Owl Recovery Plan (see Appendix B5, Recovery Plan Standards and Guidelines), limited to stand-replacing disturbance events exceeding 10 acres, and subject to review by the Regional Ecosystem Office.

West of the Cascades

There is no harvest allowed in stands over 80 years old. Thinning (precommercial and commercial) may occur in stands up to 80 years old regardless of the origin of the stands (e.g., plantations planted after logging or stands naturally regenerated after fire or blowdown). The purpose of these silvicultural treatments is to be beneficial to the creation and maintenance of late-successional forest conditions. Examples of silvicultural treatments that may be considered beneficial include thinnings in existing even-age stands and prescribed burning. For example, some areas within Late-Successional Reserves are actually young single-species stands. Thinning these stands can open up the canopy, thereby increasing diversity of plants and animals and hastening transition to a forest with mature characteristics.

East of the Cascades and in the Oregon and California Klamath Provinces

Given the increased risk of fire in these areas due to lower moisture conditions and the rapid accumulation of fuels in the aftermath of insect outbreaks and drought, additional management activities are allowed in Late-Successional Reserves. Guidelines to reduce risks of large-scale disturbance are adapted from the Final Draft Spotted Owl Recovery Plan (see Appendix B5, Recovery Plan Standards and Guidelines).

Other Late-Successional Reserves

ELEMENTS:
Occupied marbled murrelet sites, protection buffers for other species.

Managed Late Successional Areas - 102,200 acres

ELEMENTS:
Managed Pair Areas for known owl pairs and resident singles from the Final Draft Spotted Owl Recovery Plan in the California Cascades and Washington Eastern Cascades Provinces. Protection buffers for other species.

Adaptive Management Areas - 1,521,800 acres

Adaptive Management Areas are landscape units identified in, and unique to, Alternative 9. They are designated to encourage the development and testing of technical and social approaches to achieving desired ecological, economic, and other social objectives. Ten areas of federal lands ranging from about 92,000 to nearly 500,000 acres have been identified. The areas are well distributed in the physiographic provinces. Most are associated with subregions that are impacted socially and economically by a reduced federal timber harvest. The areas provide a diversity of ecosystem management challenges, intermixed land ownerships, natural resource objectives, and social contexts.

The overall objective for Adaptive Management Areas is to develop and test new management approaches to integrate and achieve ecological and economic health, and other social objectives. It is hoped that localized, idiosyncratic approaches that may achieve the conservation objectives of the selected alternative can be pursued. These approaches rely on the experience and ingenuity of resource managers and communities rather than traditionally derived prescriptive approaches that are generally applied in managing the federal forests.

The primary social objective of Adaptive Management Areas is the provision of flexible experimentation with policies and management. These areas should provide opportunities for land managing and regulatory agencies, other government entities, nongovernmental organizations, local groups, landowners, communities, and individuals to work together to develop innovative management approaches. Broadly, Adaptive Management Areas are intended to be prototypes of how forest communities might be sustained. For more information, see Appendix B3, Adaptive Management Areas.

STANDARDS AND GUIDELINES:
Standards and guidelines for Congressionally Reserved Areas or Late-Successional Reserves must be followed when they occur within Adaptive Management Areas. However, flexibility is provided, as described in Appendix B3, Adaptive Management Areas, to meet objectives for Riparian Reserves and Key Watersheds. Standards and Guidelines in Appendix B11 applicable to Adaptive Management Areas must be met as described. For the remainder of Adaptive Management Areas, standards and guidelines are to be developed to meet the objectives of the specific Adaptive Management Area and the selected alternative. Further, standards and guidelines within agency plans need to be considered during planning and implementation of activities within Adaptive Management Areas, and they may be modified in Adaptive Management Area plans based on site-specific analysis. Coordination with the Regional Ecosystem Office is required.

Riparian Reserves - 2,627,500 acres

1. Fish-bearing streams - an area on each side equal to two times the height of a site-potential tree or 300 feet (whichever is greater).

2. Permanently flowing nonfish-bearing streams - an area on each side equal to the height of one site-potential tree or 150 feet (whichever is greater).

3. Intermittent streams - an area on each side equal to the height of one site-potential tree or 100 feet (whichever is greater).

Administratively Withdrawn Areas - 1,477,100 acres

Matrix - 3,975,300 acres

STANDARDS AND GUIDELINES:
For National Forests, retain at least 15 percent of the area associated with each cutting unit (stand) except within the Oregon Coast Range and Olympic Peninsula Provinces. On the Mt. Baker-Snoqualmie National Forest, this retention guideline does not apply, but site-specific prescriptions should be developed to maintain biological diversity and ecosystem function, including retention of green trees (singly and in patches), snags and down logs. Exceptions are made for the Oregon Coast Range and Olympic Peninsula because substantial retention is provided by marbled murrelet and riparian protection measures. If, as a

result of watershed analysis or any future delisting of the murrelet, protection is reduced significantly, green tree retention standards and guidelines may be required in these provinces.

Of the total area to be retained, at least 70 percent should be in patches greater than 1 hectare (about 2.5 acres, unit size permitting), with the remainder as single trees or smaller patches dispersed across the cutting unit. To the extent possible, patches should include the largest, oldest live trees, decadent or leaning trees, and hard snags occurring in the unit. Patches should be retained indefinitely. Green tree retention standards exceeding 15 percent in current plans and draft plan preferred alternatives are superseded by the 15 percent retention standard above unless local knowledge indicates such direction must be retained to meet management objectives.

As a minimum, snags are to be retained within the harvest unit at levels sufficient to support species of cavity-nesting birds at 40 percent of potential population levels based on published guidelines and models. The needs of bats should also be considered in these standards and guidelines as those needs become better known.

Over the long term, develop standards and guidelines that apply at both the landscape level and the level of individual cutting units.

For lands administered by the BLM in Oregon north of Grants Pass (see Appendix B10, Grants Pass Line), and including the entire Coos Bay District, provide 640-acre blocks (Connectivity/Diversity Blocks) as currently spaced (see Appendix B9), that are managed on 150-year rotation. When an area is cut, 12 to 18 green trees per acre will be retained. There must be 25 to 30 percent of each block in late-successional forest at any point in time. Late-successional stands within Riparian Reserves contribute toward this percentage. In the remainder of the matrix (General Forest Management Area), retain 6 to 8 green trees per acre (see Appendix B1, Revised Preferred Alternative, and Appendix B9, BLM Spotted Owl Standards and Guidelines)

For lands administered by the BLM in Oregon south of Grants Pass, retain 16 to 25 large green trees per acre in harvest units.

For lands administered by the BLM in California, manage according to existing District Plans which emphasize retention of old growth.

For both agencies, to meet the needs of species and provide ecological function, provide for a renewable supply of down logs well distributed across the matrix landscape as described in Appendix B11. Interim requirements are as follows: Following regeneration harvesting in northern California, follow current plans and draft plan preferred alternatives for down logs. In western Oregon and Washington from the Willamette National Forest north, leave a minimum of 240 linear feet of logs per acre greater than 20 feet long and 20 inches in diameter. South of the Willamette National Forest and in eastern Oregon and Washington, leave a minimum of 120 linear feet of logs per acre greater than 16 feet long and 16 inches in diameter. Existing decay class 1 and 2 logs count toward this requirement. Down logs should reflect the species mix of the original stand.

Survey and protect potential bat roosting sites as described in Appendix B11.

Protect soil and litter-dwelling organisms such as fungi and arthropods by minimizing intensive burning, unless appropriate for certain specific habitats, communities or stand conditions. Prescribed fires should be planned to minimize the consumption of litter and coarse woody debris. Also minimize soil and litter disturbance which may occur as a result of yarding and operation of heavy equipment, and reduce the intensity and frequency of site treatments (see Appendix B11).

Protect all remaining late-successional stands in fifth field watersheds (20 to 200 square miles) which are currently comprised of 15 percent or less late-successional forest as described in Appendix B11. Protection of these stands could be modified in the future when other portions of the watershed have recovered to the point where they could replace the ecological roles of these stands (see Appendix B11).

One hundred acres of the best northern spotted owl habitat will be retained as close to the nest site or owl activity center as possible for all known (as of 1/1/94) spotted owl activity centers in the matrix. Management of these areas will comply with the standards and guidelines for Late-Successional Reserves, and management around these areas will be designed to reduce risk of natural disturbances (see Appendix B11).

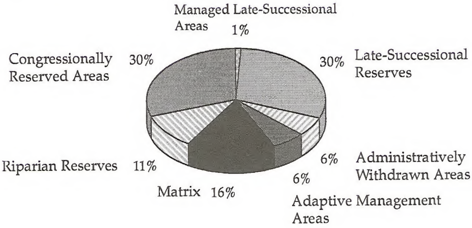
Protect identified mollusks, arthropods, and vascular plants from grazing as described in Appendix B11 by taking all practicable steps to ensure that known and newly-discovered sites of these species will not be impacted.

Survey and manage for those amphibians, bryophytes, mollusks, vascular plants, fungi, lichens, and arthropods that are identified in Appendix B11.

Except as specified in this paragraph or elsewhere in this chapter, other allocations and standards and guidelines of current plans and draft plan preferred alternatives will be applied in the matrix where they provide greater benefits to late-successional forest related species than the provisions of this alternative. However, Administratively Withdrawn Areas that are specified in the current plans and draft plan preferred alternatives to benefit American martens, pileated woodpeckers, and other late-successional species are returned to the matrix unless local knowledge indicates that other allocations and standards and guidelines of this alternative will not meet management objectives for these species.

Provide protection buffers for other species.

Figure 2-12. Alternative 9



Alternative 10

24,455,300 acres total federal land

This alternative is designed to protect the most ecologically significant late-successional forests and additional areas determined to be valuable for northern spotted owl population viability. Retention of forest cover in areas where timber harvest is allowed is described in current plans and draft plan preferred alternatives. This alternative matches Alternative 6 except that the 50-11-40 rule for the matrix is not included.

Because this alternative is similar to one or more of the other action alternatives, its effects were not analyzed for every parameter presented in Chapter 3&4.

Congressionally Reserved Areas - 7,320,600 acres

Late-Successional Reserves - 7,500,900 acres

ELEMENTS:
LS/OG1, spotted owl additions, and LS/OG2 within Marbled Murrelet Zone 1.

STANDARDS AND GUIDELINES:
Cutting of trees is restricted to restoring late-successional forest attributes, primarily through precommercial and commercial thinning of forest stands less than 50 years old that have been established following logging. Harvest proposals are subject to review by the Regional Ecosystem Office. The Regional Ecosystem Office may develop criteria that would exempt some activities from review. Salvage of dead trees would be limited to stand-replacing disturbance events exceeding 100 acres under guidelines for salvage from the Final Draft Spotted Owl Recovery Plan (see Appendix B5, Recovery Plan Standards and Guidelines).

Other Late-Successional Reserves

ELEMENT:
Occupied marbled murrelet sites.

Riparian Reserves - 2,512,600 acres

1. Fish-bearing streams - an area on each side equal to two times the height of a site-potential tree or 300 feet (whichever is greater).

2. Permanently flowing nonfish-bearing streams - an area on each side equal to the height of one site-potential tree or 150 feet (whichever is greater).

3a. Intermittent streams in Tier 1 Key Watersheds - an area on each side equal to the height of one site-potential tree or 100 feet (whichever is greater).

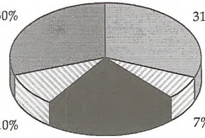
3b. Intermittent streams in all other watersheds - an area on each side equal to half the height of a site-potential tree or 50 feet (whichever is greater).

Administratively Withdrawn Areas - 1,828,400 acres

Matrix - 5,292,900 acres

STANDARDS AND GUIDELINES:
Retain at least six large green trees per acre that exceed the average stand diameter, two large snags per acre, and two large logs per acre.

Figure 2-13. Alternative 10



Alternatives Considered but Eliminated From Detailed Study

The underlying need (see Chapter 1) of providing for late-successional and old-growth forest habitat and minimizing adverse economic effects substantially limited the range of reasonable alternatives available for analysis. Within this focus, the Assessment Team considered as potential alternatives, all recently proposed and published strategies for management of northern spotted owl habitat or management of late-successional and old-growth forest ecosystems. Forty-eight previously developed alternatives were considered, as well as five "hybrid" alternatives containing mixtures of elements from existing plans, and an alternative with long (300 to 350 year) timber harvest rotation with no Late-Successional Reserves (see pages III-1 through III-4 in the FEMAT Report).

After considering this full range of 54 alternatives, and examining them in two selection processes, 46 were not considered for further refined analysis. Of the 8 identified for further analysis, 1 was dropped because it was similar to another alternative, and 3 others were added, resulting in the 10 options in the FEMAT Report which are the 10 alternatives considered in detail in this SEIS.

During the public comment period, a number of ideas for alternatives were suggested. These are noted in Appendix F along with the reasons why they were not considered in detail. They are discussed primarily in the Legal and Process Issues and Silviculture sections of Appendix F.

Comparison of the Effects of the Alternatives

Chapter 3&4 describes in detail the environmental consequences of the alternatives. Under each of the alternatives considered, timber harvests of late-successional and old-growth forests will decline from historical levels. The environmental consequences associated with timber harvest, such as loss of late-successional forest habitat, new road construction, increased stream sedimentation, and water quality degradation, will be proportionately less. Social and economic impacts to timber-dependent communities will be proportionately greater. The preservation of late-successional and old-growth forests will have beneficial consequences to the fish, wildlife and plants associated with them, to water quality, and to ecological diversity. The following discussion summarizes and compares the key impacts identified.

Effects on Late-Successional and Old-Growth Forest Ecosystems

The evaluation of late-successional and old-growth forest ecosystems is expressed as an expected likelihood of achieving long-term past conditions based on three attributes that characterize the quantity and quality of the ecosystem.

The attributes are: (1) abundance and ecological diversity - the acreage and variety of plant communities and environments; (2) processes and functions - the ecological actions that lead to the development and maintenance of the ecosystem and the values of the ecosystem for species and populations; and (3) connectivity - the extent to which the landscape patterns of the ecosystem provide for biological flows that sustain animal and plant populations.

In general, forest plantations, fire suppression, logging, ownership patterns, and human and environmental influences have altered the regional ecosystem on federal lands to the extent that none of the alternatives would provide for a return to conditions that closely match those of previous centuries. Site conditions across all landscapes will not return to their presettlement conditions within the next 100 years. However, all alternatives reverse the management trend of the last 50 years on federal lands, which, if continued, would have resulted in a steep decline in the quantity and quality of late-successional ecosystems and the eventual loss of these ecosystems in many federal planning areas.

Some alternatives provide greater likelihoods than others of maintaining and enhancing late-successional ecosystems at levels that approach typical long-term conditions. Alternatives 1, 3, 4, and 9 received the highest ratings. Alternatives 3 and 4 provide for relatively greater amounts of late-successional forest and strong connectivity through the presence of Riparian Reserves and retention of old-growth components in managed forest matrix. Alternatives 3 and 4 also provide relatively high acreage of low elevation late-successional ecosystems, which are relatively rare throughout the entire region. Although Alternative 1 would provide the highest acreage of Late-Successional Reserves, it did not rate as high as Alternatives 3 and 9 because it lacks restoration silviculture in the reserves.

The Assessment Team assumed that without restoration silviculture, the development of late-successional conditions would be retarded. Alternative 9 achieved a 60 to 80 percent or greater cumulative likelihood of reaching less than long-term average conditions or better in moist provinces. Alternative 9 might have achieved a higher overall rating if it provided for more acreage of late-successional ecosystems in the low elevations of Oregon. The Assessment Team concluded that the opportunities to increase knowledge about ecosystem function and management in the Adaptive Management Areas of Alternative 9 actually increased the likelihood that this alternative would provide late-successional characteristics in the future.

The assessment of maintenance of a functional and interconnected, late-successional forest ecosystem was not revised to reflect the changes described in Appendix B11, Standards and Guidelines Resulting From Additional Species Analysis and Changes to Alternative 9, because the changes to the outcomes as described in this assessment are expected to be relatively minor. Several of these standards and guidelines are likely to enhance the attributes of late-successional and old-growth forest ecosystems. The overall outcomes for the ecosystem are likely to improve at least slightly as a result of the additional standards and guidelines incorporated into Alternative 9.

Effects on Aquatic Ecosystems

The Aquatic Conservation Strategy (Appendix B6) was designed to address all elements of the aquatic and riparian ecosystem, including maintenance of hydrologic function; high water quality; adequate amounts of coarse woody debris; stable, complex stream channels; and riparian areas with suitable microclimate and vegetation. The likelihood of achieving an outcome with sufficient quality, distribution and abundance of habitat to allow riparian-dependent plant and animal species to stabilize, well distributed across federal lands, is lower for Alternatives 2, 3, 5, 6, and 10 than for Alternatives 1 and 4, and Alternative 9 with the standards and guidelines added since the Draft SEIS. However, the Assessment Team determined that all alternatives except 7 and 8 would reverse the trend of degradation and begin recovery of aquatic ecosystems and habitat on federal lands within the range of the northern spotted owl. Even if changes in land management practices and comprehensive restoration are initiated, it is possible that no alternative would completely recover all degraded aquatic systems within the next 100 years. Faster recovery rates are probable for aquatic ecosystems under Alternatives 1 and 4, and Alternative 9 with the standards and guidelines added since the Draft SEIS, than other alternatives. Alternatives 1 and 4, and Alternative 9 with the standards and guidelines added since the Draft SEIS, would reduce disturbance across the landscape due to application of a larger Late-Successional Reserve network and the use of wider Riparian Reserves for intermittent streams throughout the planning area.

Effects on Air and Water Quality and Soil Productivity

Air Quality

All alternatives in this SEIS propose to continue the use of prescribed fire in the planning area. Consequently, all alternatives will have some smoke related impacts, which are the primary source of air quality degradation on federal lands. This SEIS emphasizes the incorporation of ecosystem principles into forest management where fire is valued as a natural and necessary ecosystem process. Under ecosystem management, certain types of prescribed fire, such as understory burning, will be emphasized. Understory burning is designed to approximate natural low-to-moderate intensity wildfires, and generally produces fewer particulate matter emissions than broadcast burning in clearcut harvest units. Total projected emissions aggregated over the planning area, therefore, are lower under all of the alternatives as compared to historical emissions when fire consisted primarily of broadcast burning. While total particulate emissions would be lower under each alternative than historical levels, the shift to lower intensity burning will result in different smoke dispersion characteristics that will need to be closely monitored to minimize air quality impacts.

Estimates of the expected acreage of prescribed fire use were calculated for all federally managed lands for each of the alternatives in this SEIS. Assumptions regarding the ecological need for prescribed burning, the hazard reduction necessary for risk management, and the amount of prescribed burning necessary for site preparation were made at this programmatic level. Results show that Alternative 9 would likely result in the greatest acreage of prescribed fire at about 89,000 acres burned annually, followed by progressively less acres in Alternatives 3, 7, 8, 5, 6, 10, 2, 4, and finally Alternative 1 with about 46,000 acres. All of these acreages are below the 1985 to 1990 average of about 109,000 acres burned each year. Total emissions were estimated based on the acres of expected burning, the type of prescribed burning, and the emissions from each type of fuel consumed. Therefore, emissions by alternative would rank in a pattern similar to acreage burned.

The estimates are very generalized because many of the assumptions about the level of prescribed fire use for each land allocation within each province cannot be validated until watershed or landscape-level analysis or province-level planning are completed. Thus, air quality analysis at lower planning levels is critical in determining the actual amount of prescribed fire that may be needed on the landscape, and even more importantly, the air quality impacts of prescribed burning. The use of prescribed fire may reduce the likelihood of large, high severity wildfire, as well as wildfire emissions. However, emissions tradeoff analyses are essential to document the optimum amount of prescribed burning necessary to offset wildfire emissions.

Water Quality

The effects to water quality under the alternatives vary depending on the acreages and distribution of the various land allocations and the type and location of land-disturbing activities occurring under the alternative. The most significant factors related to potential water quality effects for each alternative are the selected Riparian Reserve scenarios, the amount and location of road building, and the amount and method of timber harvest proposed. Alternatives 1, 4, and 9 would have the greatest benefit to water quality. Alternatives 2, 3, 5, 6 and 10 would not provide as much improvement as Alternatives 1, 4, and 9, primarily because they provide less protection for intermittent streams in Tier 2 Key Watersheds and non-Key Watersheds. Alternatives 7 and 8 have the greatest potential to affect water quality of the 10 alternatives analyzed in this SEIS. Based on the Riparian Reserves scenario and other components of the Aquatic Conservation Strategy, all of the alternatives, except 7 and 8, are expected to maintain or improve water quality, although watershed recovery rates would be quickest under Alternatives 1, 4, and 9. Subsequent environmental effects analysis at the province, watershed, and site-specific levels will be needed to develop and implement water quality protection measures.

Soil Productivity

Alternatives 7 and 8 have the most acres designated as matrix and thus, have the highest potential to adversely affect long-term soil productivity. Land-disturbing activities affect long-term soil productivity by affecting: (1) soil bulk density (untilled skid trails, etc.); (2) soil displacement (road building, skid trails, etc.); (3) erosion (exposure of mineral soil, road placement and drainage); (4) nutrient status (removal of organic material by prescribed burning and intense utilization); and (5) soil biology. Alternatives 1 and 4 would have the least amount of soil disturbance from management actions because they have the most Late-Successional Reserves and thus, would have the highest probability of maintaining long-term soil productivity. Alternatives 2, 3, 5, 6, 9, and

10 would have intermediate levels of disturbance and probability of maintaining long-term soil productivity. These alternatives have fewer acres within reserves and more matrix than Alternatives 1 and 4.

Effects on Threatened and Endangered Species

All of the alternatives provide for the continued existence of threatened and endangered species. In the case of the northern spotted owl and the marbled murrelet, many components of the alternatives were specifically designed to address the needs of these species. There are 39 federally listed and proposed species which may occur within the range of the northern spotted owl. The Fish and Wildlife Service also identified 10 of these species whose habitat use is known to include late-successional forest, or their occurrence is directly associated with such habitat. With this information, 23 of the listed and proposed species were eliminated from detailed discussion in the Final SEIS for one of three reasons: (1) they are not known to occur on federal lands within the planning area, (2) they do not inhabit coniferous forests, or (3) their presence within the spotted owl's range is transitory or unaffected by forest management activities. It has been determined that the alternatives considered in the Final SEIS will have no effect on these species. Four salmon species are included in the narrative discussion to more completely describe the reasons for the determinations. The Fish and Wildlife Service and National Marine Fisheries Service have concurred with these determinations (see Appendix G).

The Fish and Wildlife Service identified six "species that are not restricted to only late-successional forests or that are associated with unique or specialized habitats that may not be considered late successional, but which may be affected by forest management activities." Some of these species were not evaluated by the Assessment Team because of their lack of association with late-successional forests, however, they are addressed in this SEIS to provide a complete accounting. The alternatives in this SEIS are not likely to adversely affect these species.

Four listed or proposed species are associated with late-successional forests: the bald eagle, the Oregon chub, the northern spotted owl, and the marbled murrelet. None of the alternatives is likely to adversely affect the bald eagle. Management of nonfederal lands and cumulative effects are affecting the Oregon chub, and cannot be mitigated by federal land management. The following discussion summarizes the effects of the alternatives on the other two species.

Northern Spotted Owl

The effectiveness of an alternative in providing for northern spotted owl recovery on federal lands relies heavily on the spacing, size and location of the habitat. It was the conclusion of the Assessment Team that Alternatives 1 through 6 and 9 met or exceeded the conservation measures for federal lands in the Final Draft Recovery Plan for the Northern Spotted Owl. Alternatives 7, 8 and 10 were found to have less assurance of owl recovery on federal lands, primarily due to inadequate provision of dispersal habitat. While, in the Draft SEIS, Alternative 9 lacked a specific dispersal habitat provision, other aspects of this alternative were expected to provide adequate dispersal habitat. The additional standards and guidelines of Alternative 9 in the Final SEIS would increase this assessment of adequacy of the alternative. Therefore, selection of Alternatives 1 through 6, or Alternative 9 would provide the federal land allocations and standards and guidelines necessary to achieve recovery of the northern spotted owl.

Marbled Murrelet

In the short term, the alternatives would provide varying degrees of "reserve" protection for the population of murrelets known to occur within the planning area. However, eight alternatives (all but Alternatives 7 and 8) also provide for protection of murrelet sites outside of reserves. The full impact of this protection outside reserves is not known at this time because of the limited surveys conducted for this species.

Alternative 1 provides habitat that would allow a greater than 90 percent likelihood of providing habitat conditions to support a marbled murrelet population well distributed on the federal lands. Alternatives 2, 3, 4, 5, and 6, had ratings of an 84 percent likelihood of a well-distributed population on federal lands, and Alternatives 9 and 10 were rated at 80 percent. The lowest ratings were assigned to Alternatives 7 and 8. Alternative 7 was rated low because of its lack of specific protection for murrelet sites in the matrix, and less protection of old-growth forests in coastal areas. Alternative 8 rated low because of poor protection for murrelet sites in the matrix, and also because of its allowance for timber harvest in stands up to 180 years old.

In the Draft SEIS, Alternative 9 had an 80 percent likelihood of achieving a murrelet population well distributed on federal lands. The modifications made to Alternative 9 added protection for approximately 25,000 additional acres of Late-Successional Reserves in the Olympic Adaptive Management Area. Also, the Finney and Northern Coast Range Adaptive Management Areas have amended direction stating that the allocation of Late-Successional Reserve acreage may be reconsidered during development of the Adaptive Management Area plans, if the proposed actions are consistent with the Endangered Species Act requirements for the marbled murrelet. Other modifications to Alternative 9 that would likely improve the murrelet rating are: adoption of the Riparian Reserve Scenario 1, retention of 100 acres around known spotted owl activity centers in the matrix, institution of survey and manage provisions for a variety of other species, and retention of old-growth fragments in watersheds where little remains. These modifications would result in retention of more marbled murrelet habitat than the standards and guidelines for Alternative 9 described in the Draft SEIS. Based on the relative amount of Late-Successional Reserve acreage in the alternatives, it is likely that a rating of the modified Alternative 9 would fall between the ratings for Alternatives 2, 3, 4, 5 and 6 and the rating for Alternative 1.

Effects on Species not Threatened or Endangered

The Assessment Team determined that 1,116 terrestrial species were closely associated with late-successional and old-growth forests. These species were grouped into bryophytes, fungi, lichens, vascular plants, mollusks, amphibians and reptiles, birds, and mammals. A list of 15 functional groups of arthropods was also considered. Twenty-nine species of fish were determined to occur in streams within late-successional and old-growth forests within the range of the northern spotted owl. Each of the alternatives were evaluated to determine the likelihood of habitat on federal lands to support populations of these species or groups of species. Expert panels were asked to predict a percent likelihood of whether habitat would be of sufficient quality, distribution and abundance for species populations to (a) stabilize, well distributed, (b) stabilize with significant gaps in distribution, (c) continue existence only on refugia, or (d) be at risk of extirpation. The assessment process and the potential outcomes that were predicted are described for each species or group of species in Chapter 3&4.

Additional species analysis was conducted between the Draft and Final SEIS. The additional analysis focused on the likely outcomes for many of the species that were considered in the Draft SEIS. While the analysis focused most directly on responding to public comments on the preferred alternative (Alternative 9), much of it was also pertinent to the remaining nine alternatives.

The results of the original assessments and the additional analysis are summarized in Chapter 3&4, and extensive background material is located in Appendices A and J. Attempts to further summarize these results would be an oversimplification of very complex material and may possibly be misleading. The following is a generalized comparison of the impacts anticipated for the alternatives. It is based on the nature of the changes expected to occur to those habitat components important to the species or groups of species that were analyzed. The relative impacts described for Alternative 9 are those expected to occur with the standards and guidelines added between the Draft and Final SEIS.

Nonvascular Plants and Allies

This includes bryophytes, fungi and lichens. Bryophytes include hornworts, liverworts and mosses. The habitat components important to bryophytes include live, old-growth trees, decaying wood, riparian zones and generally the habitat characteristics achieved by more extensive and interconnected late-successional and old-growth forest conditions. Alternatives 1, 3, and 9 are generally the most favorable to bryophytes because they provide the set of allocations and management practices that best produce the habitat components for bryophytes. Alternatives 4, 5, 7, and 8, respectively, provide less of these habitat conditions. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Fungi are neither plants nor animals but are recognized as a separate kingdom of organisms, both in structure and function. Species diversity of fungi appears highest in late-successional forests because of the diversity of habitat structures and host species, and the abundance of coarse woody debris and standing dead trees. Habitat components important to the fungi include dead, down wood; standing dead trees; and live, old-growth trees; as well as a diversity of host species and microhabitats. Also important for fungi is a well-distributed network of late-successional forest. Small forest fragments can function as refugia where fungi may persist until suitable habitat conditions become available in adjacent stands. Alternatives that retain more of these habitat features generally had higher ratings for species. Alternatives 1, 3, 4, and 9, would generally be the most favorable to bryophytes because they provide the set of allocations and management practices that best produce the habitat components for bryophytes. Alternative 5 would provide intermediate levels of this habitat. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for bryophytes. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Lichens are a conspicuous component of old-growth forest ecosystems where they play an important ecological role. The habitat components important to lichens include live, old-growth trees, decaying wood, riparian zones and extensive and interconnected late-successional and old-growth forest conditions. Alternatives 1, 4, and 9, would generally be the most favorable to lichens because they provide the set of allocations and management practices that best produce the habitat components for lichens. Alternatives 3 and 5 would provide intermediate levels of this habitat. Alternatives 7 and 8 would be similar in their effects, and would provide less favorable habitat conditions for lichens. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Vascular Plants

The largest and most dominant organisms of the late-successional and old-growth forest ecosystem are the vascular plants. Vascular plants are defined as those that contain conducting or vascular tissue. The habitat components important to vascular plants are those that generally increase amounts of late-successional, riparian, and old-growth habitat. Alternative 1 would generally be the most favorable to vascular plants because it provides the set of allocations and management practices that best produce the habitat components for vascular plants. Alternatives 3, 4, 5, and 9 would be similar in providing intermediate levels of these habitat conditions. Alternatives 7 and 8 would be similar in their effects, and would provide less favorable habitat conditions for vascular plants. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Invertebrates

This includes arthropods and their allies, and mollusks. Arthropods include insects, crustaceans, arachnids, and myriapods, and collectively constitute over 85 percent of the biological diversity in late-successional and old-growth forests in the Pacific Northwest. The habitat components important to arthropods include all the features that comprise extensive and interconnected late-successional and old-growth forest conditions, including a diversity of live, old-growth trees; standing dead trees; dead and down wood; canopy structure; and riparian habitats. Alternatives 1, 3, and 4 would generally be the most favorable to arthropods because they provide the set of allocations and management practices that best produce the habitat components for arthropods. Alternatives

5, 7, and 9 would provide intermediate levels of habitat protection. Alternative 8 would provide less favorable habitat conditions for arthropods. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Mollusk species of northwest coniferous forests are comprised of land snails, slugs, aquatic snails and clams. The habitat components important to mollusks include moist forest environments; areas around springs, bogs, and marshes; basalt and limestone talus slopes; diverse vegetative cover; and the habitat characteristics provided in the Riparian Reserves and influenced by the size of Late-Successional Reserves. Alternatives 1, 3, and 9 would generally be the most favorable to land snails because they provide the set of allocations and management practices that best produce the habitat components for land snails. Alternative 4, 5, 7, and 8 would provide less favorable habitat conditions for the land snails. Alternatives 1, 4, and 9 would generally be the most favorable to slugs, freshwater snails and clams because they provide the set of allocations and management practices that best produce the habitat components for these species. Alternatives 3, 5, 7, and 8 would provide less favorable habitat conditions for slugs, freshwater snails and clams. Based on their overall features, Alternatives 2, 6, and 10 would likely have effects on mollusk habitat similar to Alternative 5.

Vertebrates

This includes amphibians and reptiles, birds, mammals and fish. The number of species of amphibians and reptiles in coniferous forests of the Pacific Northwest is not large compared to the number of birds and mammals; however, amphibians and reptiles comprise a distinct and important component of the vertebrate fauna. No reptiles are closely associated with late-successional forests. Habitat components important to amphibians are those that would provide cool, moist old-growth conditions; cool water; reduced sedimentation; protection of headwater streams; and coarse woody debris, riparian zones and more extensive and interconnected late-successional and old-growth forest conditions. For the riparian groups, Alternatives 1, 4, and 9, would generally be the most favorable to amphibians, because they provide the set of allocations and management practices that best produce the habitat components for amphibians. Alternatives 3 and 5 would provide intermediate levels of habitat protection. Alternatives 7 and 8 would be similar in their effects, and would provide less favorable habitat conditions for these amphibians. For the terrestrial groups, Alternatives 1 and 9 are generally the most favorable to amphibians because they provide the set of allocations and management practices that best produce the habitat components for amphibians. Alternatives 3, 4, and 5 would provide intermediate levels of habitat protection. Alternatives 7 and 8 would be similar in their effects, and would provide less favorable habitat conditions for these amphibians. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

The habitat components important to birds are those that would increase large reserves, riparian protection and analysis, and retain green trees, snags, and coarse woody debris within the matrix. Alternatives 1, 3, 4, 5, and 9, would generally be the most favorable to birds because they provide the set of allocations and management practices that best produce the habitat components for birds. Alternatives 7 and 8 would be similar in their effects, and would provide less favorable habitat conditions for birds. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Temperate coniferous forests of the Pacific Northwest provide habitat for a diverse array of mammal species. Habitat components important to mammals other than bats include dead, standing wood; dead and down wood; live, old-growth trees; and riparian zones. Large, decayed logs and snags are important to many mammals as resting and denning sites. Large expanses of live, old-growth trees are important to some mammals such as the fisher because they provide continuous canopy cover. Fisher may be negatively affected by forest fragmentation. Riparian zones provide potential habitat (including large snags and cover) for mammals such as fishers and American martens. In general, those alternatives that would provide for greater amounts of late-successional and old-growth habitat rated higher for mammal species. Alternatives 1, 3, and 9, would generally be the most favorable to mammals because they provide the set of allocations and management practices that best produce the habitat components for mammals. Alternatives 4 and 5 would provide intermediate levels of habitat conditions. Alternatives 7 and 8 would be similar in their effects, and would provide less favorable habitat conditions for mammals. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Bats are a diverse order of mammals. There may be more species of bats in North American temperate forests than any other group of mammals. The habitat components important to bats are those that would increase the amounts of late-successional and old-growth forests, riparian areas, snags and coarse woody debris. Alternatives 1, 3, and 9, would generally be the most favorable to bats because they provide the set of allocations and management practices that best produce the habitat components for bats. Alternatives 4 and 5 would provide intermediate levels of habitat conditions. Alternatives 7 and 8 would be similar in their effects, and would provide less favorable habitat conditions for bats. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

The fish species that were analyzed include resident fish and anadromous fish. There are an estimated 307 anadromous fish stocks at risk within the planning area, 257 of them on federal lands. Habitat loss and degradation are principal factors in the decline of these fish on federal lands. Alternatives 1, 4, and 9 benefit aquatic and riparian habitats more than other alternatives. These benefits are principally due to: (1) the application of Riparian Reserve Scenario 1 to intermittent streams in Tier 2 Key Watersheds and non-Key Watersheds, (2) the highest amounts of Late-Successional Reserves within Key Watersheds and throughout the range of the northern spotted owl, and (3) the least amount of matrix contained within inventoried roadless areas. Aquatic and riparian habitats are expected to recover faster, in part due to these factors under Alternatives 1, 4, and 9. Alternatives 2, 3, 5, 6, and 10 benefit aquatic and riparian habitats to a greater degree than Alternatives 7 and 8, but to a lesser degree than Alternatives 1, 4, and 9. Some of the reasons for the differences are that Alternatives 2, 3, 5, 6, and 10 have less Late-Successional Reserves, include Riparian Reserve Scenario 2, and have more land in the matrix than Alternatives 1, 4, and 9. The opposite is true when comparing the benefits of Alternatives 2, 3, 5, 6, and 10 to aquatic and riparian habitat relative to Alternatives 7 and 8. Even though Alternatives 2, 3, 5, 6, and 10 would benefit aquatic and riparian habitats to a lesser degree than Alternatives 1, 4 and 9, they would reverse the trend of aquatic and riparian habitat degradation and begin recovery of these habitats. The standards and guidelines for Alternatives 7 and 8 would not be adequate to reverse the trend of aquatic and riparian habitat degradation and begin recovery of these habitats. The principal reasons are the lack of explicitly defined Riparian Reserves for Alternative 7, and the application of Riparian Reserve Scenario 3 for Alternative 8.

Effects on Timber Harvest Levels

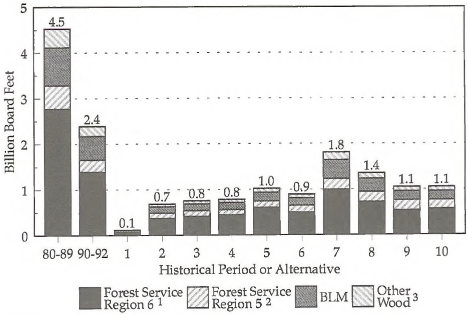
Annual harvest levels from federal forests within the range of the northern spotted owl averaged 4.5 billion board feet during the period 1980 to 1989. The alternatives considered to enhance the habitat of the northern spotted owl and associated late-successional species will restrict timber harvest in these forests, resulting in substantial social and economic costs.

The probable levels of federal timber sales for the first decade for each alternative are summarized in Figure 2-14, First Decade Probable Average Annual Timber Sale Levels (PSQ) by Historic Period and Alternative. The probable sale quantity (PSQ) estimates in Figure 2-14 include "other wood" which is the volume of cull, salvage, and other products that are not normally part of allowable sale quantity (ASQ) calculations. Historically, this has accounted for about 10 percent of the total harvest volume from timber suitable federal lands in the planning area.

The PSQ figures for Alternative 9 have been changed since the Draft SEIS to reflect modifications made to Alternative 9 as a result of public comments and internal review. The overall result of the revisions to PSQ for Alternative 9 between the Draft SEIS and the Final SEIS is a reduction of 92 million board feet per year; from 1,050 million board feet to 958 million board feet per year, not including the "other wood."

Estimated sale levels under all alternatives are below harvest program levels of the 1980s, as well as below the harvest levels of 1990-1992 when most current federal timber sales were enjoined. In 1990-1992, harvests consisted of sales under contract from the 1980's. The sale quantities of the alternatives will not permit 1990-1992 levels of timber harvest in the future. Due to several factors, it is likely that timber sale levels of the selected alternative will take 1 to 3 years to reach the decadal average sales potential.

Figure 2-14. First decade probable average annual timber sale levels (PSQ) by historical period and alternative



[1] Region 6 = Pacific Northwest Region
[2] Region 5 = Pacific Southwest Region
[3] Includes cull, submerchantable material, firewood and other products.

In addition to reduced harvest quantities in the decade ahead, wood quality is also apt to decrease. In the first decade, thinning and other partial harvests would account for a large portion of the volume harvested under the various alternatives. As a result of smaller average tree size, secondary wood products manufacturers may see an even greater decline in raw materials than the probable sale quantities would indicate.

Effects on Regional Economics and Communities

Regional Employment Under all of the alternatives, direct employment in timber harvesting and processing will decline as a result of reduced harvest levels as shown in Table 2-5, Historic and Projected Employment in the Timber Industry in the Next Decade by Subregion and Alternative. The table compares projected employment levels to employment levels in 1990 and estimated employment levels in 1992. The projections imply a range of job displacement from 4,600 to 15,900 jobs, relative to 1992. Compared to 1990, the potential displacement is 24,100 to 35,400 jobs.

The Final SEIS job displacement estimates are higher than the estimates displayed in the Draft SEIS. The differences result from corrections in predicting nonfederal harvest levels and, for Alternative 9, the reduction in PSQ from federal forests between Draft and Final SEIS. The majority of the affected jobs are in Oregon and are concentrated in southwestern Oregon.

Table 2-5. Historical and projected employment in the timber industry in the next decade, by subregion and alternative[1]

State/Owl Region[2]	Actual 1990	Estimated 1992	Alternative 1	2	3	4	5	6	7	8	9	10
			------thousand jobs------									
Washington												
Olympic Peninsula	13.9		11.6	11.7	11.6	11.7	11.7	11.7	11.6	11.2	11.6	11.6
Puget Sound	25.7		20.3	20.4	20.4	20.4	20.3	20.4	20.3	20.5	20.3	20.4
Lower Columbia	14.1		12.4	12.6	12.6	12.6	12.7	12.6	12.7	12.6	12.6	12.6
Central	4.2		3.8	4.0	4.1	4.0	4.0	4.1	4.1	4.3	3.9	4.2
Total	57.9	51.3	48.1	48.7	48.7	48.7	48.7	48.8	48.7	49.0	48.4	48.8
Oregon												
Northwest	21.9		19.8	20.3	20.3	20.4	20.7	20.0	21.6	20.8	20.5	20.5
West-Central	20.9		13.7	14.4	14.5	14.6	15.0	14.3	16.0	15.4	15.0	14.9
Southwest	21.4		10.3	12.0	12.1	12.4	12.8	12.1	15.3	13.8	12.8	12.9
Central	8.9		7.4	8.0	8.0	8.0	8.1	8.0	8.4	8.2	8.1	8.1
Total	73.1	62.8	51.2	54.7	54.9	55.4	56.6	54.4	61.3	58.2	56.4	56.4
California												
Total	13.9	11.3	10.2	10.6	10.7	10.6	10.7	10.8	10.8	10.9	11.1	10.9
3 State Total	144.9	125.4	109.5	114.0	114.3	114.7	116.0	114.0	120.8	118.1	115.9	116.1

[1] Includes self-employed individuals in all solid wood products and pulp and paper sectors. Wage and salary employment is approximately 7.5 percent less than total employment.
[2] Owl Region = The range of the northern spotted owl.

The alternatives presented in this SEIS would have the greatest employment effect on the timber industry sector. In addition to displaced workers, there would be indirect effects caused by fluctuating business expenditures in the region and induced effects caused by changes in personal expenditures in the region. These ripple effects tend to increase the ramifications of job gains or losses in communities or regions. There is roughly one job affected outside the timber industry for every job affected within the timber industry.

Timber-based employment would decline under all alternatives considered as a result of reduced harvests. Subregions characterized as heavily timber dependent are apt to experience the most severe impacts. While service employment in forestry also appears to be faced with job declines, these declines could be offset through investments in reforestation, timber stand improvement, monitoring, inventory, and restoration activities. Some employment gains could be made in recreation and tourism, as well as in special forest products. It may, however, be difficult to absorb displaced loggers and mill workers into these fields due to skill considerations and geographic locations.

In the long run, the alternatives presented in this SEIS may provide an increased supply to commercial fisheries. Yet these gains may not be substantial given the high efficiency of fishing boats and the already high proportion of people currently employed in the commercial fishing industry. Restoration of salmon and trout runs, however, could have positive effects on coastal recreation.

While the net impact of implementation of any of the alternatives is apt to be displacement of natural resource-based jobs, the economy of the region as a whole is predicted to continue to grow. Rural communities will lose jobs and decline economically while the more developed areas will continue to expand.

Rural Communities

Washington, Oregon, and California differ in the pattern, severity, and regional distribution of the effects of a reduced federal timber harvest on communities. The results of the analyses are discussed in terms of the severity and direction of the consequences, the communities' capacity to cope, and the resultant risk to the communities. The Assessment Team conducted a detailed analysis of Alternatives 1, 3, and 7. It found relatively few differences among the effects of the alternatives because the timber harvest levels in Alternatives 1 through 10 are all below recent averages. Impacts associated with Alternative 9 would likely fall between those presented for Alternatives 3 and 7.

Communities with combinations of low capacity to cope with change and negative consequences from the alternatives are "most at risk"; those with high capacity to cope and positive consequences are "least at risk." Using these definitions, Alternatives 1, 3, and 7 would result in about one-third of the 167 surveyed communities falling in the "most at risk" category. In all three alternatives analyzed, however, the changes are great compared to those for the 1985-87 harvest level scenario in which only 3 percent of the communities were so ranked. The majority of the communities "most at risk" in Alternatives 1, 3, and 7 are those highly dependent on the timber industry and on federal forest lands as the source for much of their timber supply. Alternatives 1, 3, and 7 would likely lead to additional mill closures and reduced forest related employment, and to negative impacts to the economic and social infrastructure.

The "most at risk" communities differ from others in significant ways. These communities are smaller (average population 3,000), and they are located in counties with low population density. Isolated communities are more likely to experience negative consequences with Alternatives 1, 3, and to a lesser degree 7, because they have few employment options available locally or in nearby communities, and because of limited access to capital, transportation links, and other resources. Communities that are small, isolated, and lacking in economic diversity are more likely to be "at risk" than others. These communities may find it difficult to mobilize and respond to changing conditions that may affect a variety of groups. These communities are likely to experience unemployment, increased poverty, and social disruption in the absence of assistance.

People Coping With Change

Changes in the management of the federal forests within the range of the northern spotted owl, as administered by the Forest Service and BLM, have effects (impacts) on people and the families, groups, and the communities to which they belong. The social, community, and cultural changes resulting from implementation of any of these alternatives will be disproportionately intense in rural and timber-dependent areas. The social effects of the alternatives stem fairly directly from changes in the federal timber harvest levels of the alternatives. While this is not meant to indicate that timber harvest is the only meaningful link between the Forest Service/BLM and people, it is the most crucial variable among these alternatives.

The changes in timber harvest levels from Alternatives 1 through 6, 9, and 10 will last longer than any company or worker's ability to "wait it out." The changes in timber harvest under Alternative 8 would have less impact than under Alternatives 1 through 6, 9, and 10, but still result in a downturn from Alternative 7. All alternatives will force timber harvest levels lower than experienced in Washington, Oregon, and California in the last two decades. Alternatives 1 through 4, and 6 would reduce the timber harvest levels most, while Alternatives 5, 9, and 10 would have the next lowest levels, and Alternatives 7 and 8 would reflect the least reduction in timber harvest levels. However, this high level is lower than the historical averages of the 1980's and early 1990's.

American Indian People and Cultures

Given both traditional and contemporary links between American Indians and forests, it is clear that tribal members depend on public lands and resources for employment, subsistence, and cultural identity. It is recognized that Indians tribes have an interest in forest resources managed by the Forest Service and BLM, and it is emphasized that the Indian rights and interests are not set aside by this SEIS nor does it impose any extra conservation burden on the tribes or Indian reservations. Timber harvest and management on tribal and Indian owned lands are not controlled or modified by this SEIS. The SEIS has examined the potential to impair or restrict the rights of various tribes and finds that none fall into that category.

Every alternative has some amount of logging and road construction activities on federal forest lands which are potentially disturbing to the land, fisheries, and cultural sites. Yet the amounts of disturbance are well below historical levels. There appears to be little difference in consequences associated with the low levels of land disturbance in Alternatives 1, 2, 3, and 4. The degree of disturbance to vegetation, land, and cultural sites under Alternatives 5, 6, 8, 9, and 10 would be slightly higher, but lower than Alternative 7, which would have the highest ground disturbance. On the other hand, since a large number of archaeological and historical places are discovered while conducting ground searches prior to ground-disturbing activity, there may be fewer total archaeological and culturally important sites discovered under the alternatives that have reduced timber harvest and road construction activities. All alternatives except Alternatives 7 and 8 would reverse the trend of aquatic and riparian habitat degradation and begin recovery of these habitats. Application of the Aquatic Conservation Strategy within the range of the northern spotted owl would improve habitat conditions for stocks of fish important to American Indians.

Chapter 3&4

Affected Environment and Environmental Consequences

Chapter 3&4
Changes Between the Draft and Final SEIS

The following changes were made in Chapter 3&4 between the Draft and Final SEIS. Minor corrections, explanations and edits are not included in this list.

- An analysis of some of the fish, wildlife and plant species was conducted to clarify the Assessment Team's ratings, and to examine possible standards and guidelines and land allocation changes that would benefit those species through improved habitat conditions on federal lands. The process that was used for this analysis is described in the section on Methods of Additional Species Analysis. The revised standards and guidelines incorporated in Alternative 9 are described. The effects on species and species groups due to these revisions and other revisions to Alternative 9 are included.

- An air quality analysis was performed and the results are included.

- Sections on global change, roadless areas, soil productivity, and people coping with change were added.

- The descriptions of physiographic provinces were changed from the aquatic provinces included in the Draft, to the terrestrial provinces. Terrestrial province names are now used consistently throughout the text.

- Data from spotted owl demographic counts from 1992 and 1993 were analyzed, and the results were considered in the Final SEIS.

- A discussion of wetlands was added and the water quality section was expanded.

- The projection of total job losses was changed due to the correction of an error in the analysis performed for the Draft SEIS and revisions to Alternative 9 resulting from the additional species analysis.

- The Native American People and Cultures section was retitled "American Indian People and Cultures," and was expanded.

Chapter 3&4
Affected Environment and Environmental Consequences

Introduction

Chapter 3 (Affected Environment) and Chapter 4 (Environmental Consequences) have been combined in this document to more clearly present information to readers. The description of a resource or environmental component appears just before the description of environmental consequences to that resource or component. Most environmental impact statements place them in separate chapters.

This chapter presents information about those aspects of the environment that are likely to be most directly affected by the management prescribed in the alternatives. It also presents the direct and indirect effects (or impacts) of management under the alternatives. This constitutes a presentation of the cumulative impacts of each alternative. Together these form the scientific and analytic basis for the Comparison of the Effects of the Alternatives section in Chapter 2.

Relationship to the FEMAT Report

Chapter 3&4 in the Draft SEIS relied heavily on the Assessment Team's report *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment* (the FEMAT Report). That complete report is Appendix A of this SEIS. It is part of this SEIS and is an uncirculated appendix. Information on how to obtain a copy of the FEMAT Report is presented in Appendix A of this SEIS.

While Chapter 3&4 in this Final SEIS still relies to a considerable extent on the FEMAT Report, many sections have been revised with additional information and clarifications. This new material is based on new analyses, responses to questions and comments received during the public comment period, and the environmental effects of alternatives modified since the Draft SEIS.

Incomplete or Unavailable Information

There is less than complete knowledge about many of the relationships and conditions of wildlife species, forests, the economy, and communities. The ecology, inventory, and management of large forests is a complex and developing discipline. The biology of the specific species prompts questions about population dynamics and habitat relationships. The interaction among resource supply, the economy, and rural communities is also the subject of an inexact science.

The Assessment Team and the SEIS Interdisciplinary Team examined the data and relationships used to estimate the effects of the alternatives. There is a substantial amount of credible information about the topics of this environmental impact statement; the central relationships and basic data are well established. The best available information was used to evaluate the options and alternatives. When encountering a gap in information, the question implicit in the Council on Environmental Quality (CEQ) regulations on incomplete or unavailable information was posed: Is this information "essential to a reasoned choice among alternatives"? (40 CFR 1502.22 (a)). While additional information would often add precision to estimates or better specify a relationship, the basic data and central relationships are sufficiently well established that any new information would be unlikely to reverse or nullify understood relationships. Though new information would be welcome, no missing information was evaluated to be essential to a reasoned choice among the alternatives as they are constituted.

Nonetheless, the precise relationships between the amount and quality of habitat and the future populations of species are far from certain; there is a certain level of risk inherent in the management of forest lands even to standards based on conservative application of those relationships. For example, if the relationship between habitat and population were significantly different from how it now seems, or if management standards were to be broadly misapplied, the population and long-term viability of affected species would be at greater risk than that generally estimated in this document.

All other things being equal, the lesser the information, the greater the risk attributable to incomplete knowledge. That relationship is an impetus for the monitoring, research and adaptive management that is part of these alternatives. Should there be new scientific information on change in habitat conditions not projected under the selected alternative, there are provisions for changing management of the forest to reflect the new information and the management practices for which it calls. This adaptive management process, which is guided by monitoring, research, and interagency oversight, provides additional assurance of compensating for possible catastrophic changes.

This Final SEIS contains information that was not available at the time of the Draft SEIS. Specifically, the effects of the alternatives on air quality, additional information on 474 species and species groups, and new information on population trends of the northern spotted owl (see Appendix J) are included. All added detail; none significantly modified the central relationships as they were understood at the time the Draft SEIS was prepared.

Cumulative Impacts

"Cumulative impacts" or cumulative effects are those impacts on the environment which result from the incremental effects of a proposal added to other past, present, and reasonably foreseeable future actions regardless of which agency or person undertakes them (see 40 CFR 1508.7).

The analysis and disclosure of cumulative effects are important because they alert decision makers and the public to the context within which effects are occurring, and to the environmental implications of the interaction of the proposed action with other known and likely actions. Similarly, an important function of a programmatic EIS, such as this SEIS, is to provide a program-wide analysis of a large area encompassing many of the environmental interactions that would be disclosed as cumulative effects in more site-specific NEPA documents. The 10 action alternatives analyzed in this SEIS would establish management direction that allows for carrying out a large number of projects on lands administered by the Forest Service and BLM. From a perspective that analyzes the effects of consistent federal actions across the range of the northern spotted owl, these cumulative effects are mitigated through the design and implementation of the alternatives in this SEIS. Yet, from the perspective taken for the subsequent analysis for a site-specific project, local cumulative effects will be important considerations in the design of site-specific alternatives and mitigation.

Cumulative Effects on Federal Forests

In total, there are 57 million acres of land within the range of the northern spotted owl, of which 24.5 million acres (43 percent) are federally managed. Of that 24.5 million acres, 20.6 million acres (84 percent) are forested areas.

The alternatives provide land and resource management direction across the lands administered by the Forest Service and BLM within the range of the northern spotted owl. This consistent management direction, combined with subsequent province-level analysis and planning provides a coordinated land and resource management structure more comprehensive than any attempted before in the Northwest. This subsequent analysis will help to assure that the incremental and interactive effects on more than 24 million acres of this region's ecosystems will continue to be considered in the implementation of the selected alternative. Negative cumulative impacts may further be minimized or avoided through coordination among the agencies as the selected alternative is implemented with watershed and province-level analysis and planning. In light of the extremely broad geographic scope of the proposed action and the level of spatial resolution involved, the analysis does not in most instances address all possible cumulative effects that may result at the site-specific level. However, all ground-disturbing actions will be conducted only after site-specific environmental analysis. This site-specific analysis will also analyze the impacts of the project on adjacent lands and resources within the watershed, enabling managers to design, analyze, and choose alternatives that minimize cumulative environmental effects that cannot be identified at the programmatic level of this SEIS.

Cumulative Effects on Nonfederal Land

For the purpose of this analysis, nonfederal lands include lands owned and/or managed by individuals, corporations, tribes and American Indians, states, counties, and other agencies. It is important to note that the lead agencies here (the Forest Service and the Bureau of Land Management) have no authority to regulate any activities or their timing on lands other than those they administer.

When an action takes place on federal forests, it may cause direct, indirect, or cumulative effects on nonfederal lands. While the alternatives of this SEIS have no discernible environmental effects on nonfederal nonforest lands, there are both environmental and economic interactions with adjacent nonfederal forests. The effects of these interactions, however, vary little by alternative, and can be accurately analyzed only at a more site-specific level.

The principal environmental impacts on nonfederal forest lands with relevance to the effects disclosed in this SEIS are the construction and use of roads and the harvest of timber. The amount and timing of timber harvests can be projected from the age of the timber stands and the anticipated prices for timber. In addition, timber harvest on nonfederal forest lands is controlled by state forest practices acts and a number of state and federal regulations and incentives to protect the productivity and environmental quality of the land, water, air, and biological resources.

Late-successional and old-growth habitat is a small part of nonfederal forest lands. Management activities since settlement by Europeans have changed the forest lands within this ownership group mostly to early and mid-successional forest types. Those nonfederal forests classified as old growth are found primarily in state and county parks and in private ownership as small scattered blocks in selectively logged stands (Bolsinger and Waddell, in press). (The definitions of "old-growth" in Bolsinger and Waddell are different from the definition used elsewhere in this SEIS, so the acreages are not arithmetically comparable.)

The nonfederal forests within the range of the northern spotted owl are predominately forests that have grown back since harvest and are generally even-age stands. They are typically managed as commercial forests, that is, they are managed primarily to produce commercially valuable timber. For nonfederal forests within the range of the northern spotted owl, harvest generally occurs in a stand's fifth or sixth decade. As Table 3&4-1 indicates, these forests generally are now in early and mid-successional stages, with many at or approaching ages and sizes that will predictably result in harvest.

Nonfederal forests will continue to provide habitat primarily for those species whose habitat needs are met with early and mid-successional stage forests. When combined with the early, mid, and late-successional stage forests on federal lands, federal and nonfederal forests together provide a mix of successional stages and a diversity of habitat for the ecosystems within the northern spotted owl's range. Overall, this mix of successional stages is affected by the management direction proposed by the 10 alternatives in this SEIS for federal forests. However, the overall mix of successional stages varies among the alternatives only by the variation on the lands managed by the Forest Service and BLM; the successional mix on nonfederal lands is not expected to be affected by the alternatives in this SEIS.

The future harvest levels on nonfederal lands are also expected to be similar under all alternatives. It is predicted that nonfederal harvest levels would differ by just 3 percent in response to a three-fold variation in projected federal harvest levels (FEMAT Report, Table VI-11, p.VI-21). Reduction in federal harvest levels tends to spur supply responses on the part of nonfederal timber owners in the Pacific Northwest. The supply response, however, is short lived and tempered by the age distribution of the timber on private lands (FEMAT Report, p. VI-20, and Figure VI-4, p. VI-22). The response occurs in the early years of the simulations; by the year 2000, nonfederal harvests should drop below the levels of the 1980's (FEMAT Report, p. VI-20).

The amount and character of timber harvest activity on nonfederal lands in the first decades are similar under all 10 alternatives. Thus, the management of, and the changes in habitat on, nonfederal lands are not expected to be significantly affected by selection of any of the 10 alternatives in this SEIS.

Table 3&4-1. Acreage by age class of non-National Forest timberlands[1] within the range of the northern spotted owl

Age Class	Other Public[2]	Forest Industry	Other Private	Total Non-National Forest
Even-Age Stands				
0-20 yrs	520,000	2,752,000	903,000	4,175,000
20-40 yrs	538,000	2,102,000	762,000	3,402,000
40-60 yrs	638,000	1,670,000	909,000	3,217,000
60-80 yrs	290,000	446,000	533,000	1,269,000
80-100 yrs	138,000	102,000	218,000	458,000
>100 yrs	91,000	165,000	113,000	369,000
Uneven-Age Stands				
<100 yrs	233,000	708,000	1,012,000	1,953,000
>100 yrs	99,000	264,000	239,000	602,000
Totals	2,547,000	8,209,000	4,689,000	15,445,000

[1] "Timberlands" includes only those lands that are growing commercial timber. It does not include state parks or National Parks, or nontimbered areas. These acreages are not arithmetically comparable to other averages reported in this SEIS.

[2] "Other Public" includes lands administered by the BLM and state forests

Sources: MacLean et al. 1992, USDA FS 1993c.

Cumulative Effects From Nonfederal Actions

This SEIS also considers the likely effects of reasonably foreseeable management actions on nonfederal forest land. The sparsity of old-growth forests on nonfederal land, combined with the past and scheduled harvest of old-growth forests on federal lands, were primary factors leading to the listing of the northern spotted owl and the current proposals that federal lands reserve old-growth and late-successional forests. The 10 alternatives in this SEIS are formulated to amend the management direction for federal old-growth and late-successional forests, and, where practicable, to manage for forest types and habitat not generally available or foreseeable on nonfederal lands.

As indicated in Table 3&4-1, harvest activities on nonfederal forest lands generally have occurred before stand size (age) reached 80 years. In addition, as discussed in the previous section, the 10 alternatives in this SEIS are projected to have minimal effect on nonfederal harvest scheduling. This relatively constant response of nonfederal forest managers provides some assurance that the environmental effects from nonfederal lands will not intensify significantly or vary markedly in response to reduced federal timber harvests under any of the alternatives.

There are potentially direct impacts from nonfederal forest management on species that move between federal and nonfederal habitats during the year, or during their life cycle. The role of nonfederal lands was considered in the assessment of the effects of the alternatives on those species and ecosystems, and is presented in the sections later in this chapter that deal with the environmental impacts on specific species or groups of species.

Localized actions on nonfederal forests often impact local environmental conditions on nearby federal forest land and may also affect federal management decisions. For example, nonfederal road construction and harvest in a watershed with both federal and nonfederal lands could result in a decision by federal managers to postpone harvest to avoid further harm to the watershed. An endemic species with range and habitat located on both types of ownership might be forced to rely on the federal portion of its range if the nonfederal portion were altered to the point of unsuitability. To access timber on nonfederal land, a road may need to cross federal land. Each federal action is subject to site-specific environmental analysis before it may occur; cumulative effects of nonfederal conditions and actions are part of that analysis. However, such impacts cannot be accurately identified or mitigated in this SEIS given its programmatic scope.

The Proposal for a Special 4(d) Rule

The recent proposal by the U.S. Fish and Wildlife Service (*Federal Register*, December 29, 1993; 58 FR 69132-69149) to issue a rule pursuant to Section 4(d) of the Endangered Species Act has the potential to alter the type of habitat change expected on some nonfederal forests. The proposal to issue a special rule would revise the federal protective measures for the northern spotted owl on some nonfederal lands in Washington, Oregon, and California. The proposal is intended to complement and be consistent with the protective measures for federal lands provided in the preferred alternative of this SEIS. A separate environmental impact statement (the "4(d) EIS") is being prepared to disclose the impacts of any revised protection measures actually proposed.

The proposed actions subject to analysis differ between this SEIS and the EIS under preparation for the 4(d) rule. The scope of this SEIS encompasses direction concerning late-successional and old-growth forest management activities on federal lands within the range of the northern spotted owl on nonfederal lands. Although different proposed actions are the bases of their preparation, the 4(d) EIS will address, as does this SEIS, effects on the northern spotted owl and/or its habitat. Consequently, to the extent practicable given information currently available, this SEIS addresses at a broad scale the likely effects of adoption of the special 4(d) rule as it is currently described, in assessing the impacts of the proposed action evaluated in the SEIS.

On nonfederal lands in Oregon and Washington, the proposal would require retention of all existing habitat within 1,000 feet (70 acres) of an active northern spotted owl activity center in areas proposed for timber harvest. However, the proposal also identifies 10 Special Emphasis Areas, adjacent to areas where federal habitat is relatively less plentiful or contiguous, for the purpose of retaining a comparatively larger amount (about 40 percent) of a specified home range. (Northern spotted owl home ranges vary from approximately 14,200 acres to 6,700 acres in Washington; and from approximately 4,800 acres to 3,000 acres in Oregon.)

In California, the proposal would recognize the significant conservation benefits to the northern spotted owl of the applicable California laws, and would impose no separate federal restriction beyond those currently practiced under California law.

For forests owned by tribes and American Indians, the proposal for a special 4(d) rule recognizes the conservation contributions of the various Indian Nations. It proposes to defer to tribal resource regulations for timber management activities on these lands. The proposal also would eliminate federal prohibitions against the take of northern spotted owls incidental to timber harvest on such lands. Tribal prohibitions would continue to apply. The proposal solicits comments on lifting incidental take restrictions for tribal and Indian owned lands in Special Emphasis Areas.

Preliminary analysis suggests that, in general, the environmental effects on federal lands of the proposal for a special 4(d) rule will not be significantly different from those expected to occur under current circumstances. This preliminary analysis also suggests that the alternatives in this SEIS do not need to propose additional mitigation measures to reduce or avoid these impacts.

Three elements of the preliminary analysis suggest this minimal difference from current nonfederal land management practices for purposes of the analysis in this SEIS: (1) the management of northern spotted owl habitat on nonfederal forests in California is not likely to be significantly changed by this proposal (the greatest density of northern spotted owls in nonfederal forests are in California); (2) northern spotted owl habitat in the locations most crucial for connectivity with federal reserves is accorded a higher level of protection in the 10 Special Emphasis Areas; and (3) under the Endangered Species Act, this proposal, like other federal actions affecting threatened species, will have to be evaluated and found to be not likely to pose "jeopardy" to the northern spotted owl, marbled murrelet, and other threatened and endangered species before implementation.

The preliminary analysis suggests that, as a result of the proposal, no change is needed in assessing the effects of the alternatives on species with large ranges. Where there is the possibility of an impact to an endemic species, or site-specific concerns exist, the impacts must necessarily be evaluated at a site-specific level and not in this programmatic SEIS. The initial analysis also shows no change in the expected timber harvest levels of nonfederal forests that is discernible at the geographic and temporal scale of this SEIS.

This is a preliminary analysis. A complete, detailed analysis focusing on the nonfederal lands for which the incidental take criteria would be altered is being prepared for the 4(d) EIS, a draft of which may be available in March or April 1994. Also, additional regulatory guidance that define measures to avoid the incidental take of marbled murrelet may be included as an alternative in the 4(d) EIS, though there is no specific proposal as this SEIS goes to press.

Although not presently anticipated, analysis in the 4(d) EIS may indicate that there is a significant difference in the environmental effects likely to occur as a result of the promulgation of a special 4(d) rule from those reasonably assumed in this SEIS. If so, any necessary changes to plans and guides amended by the selected alternative from this SEIS can be proposed, reviewed, adopted and implemented using the adaptive management process presented in the Implementation section in Chapter 2 of this SEIS. In addition, monitoring, including that called for under each alternative, should reveal unanticipated changes in the population and distribution of threatened and endangered species; the adaptive management process will also consider and evaluate new information and provide any needed additional protection for the species.

Cumulative Effects in Previous and Subsequent Environmental Analyses

The environmental impact statements that are supplemented by this SEIS also disclose the cumulative effects of their alternatives on various aspects of the environment. The effects from ground-disturbing activities and human-induced rapid vegetation and habitat changes would be substantially reduced by implementing any of these 10 alternatives because the amount of ground-disturbing activity associated with road construction and timber harvest would be substantially lower than in the alternatives selected and preferred in those EISs being supplemented.

In addition, all ground-disturbing actions are conducted only after site-specific environmental analysis has been completed. This site-specific analysis will also analyze the cumulative impacts of the project alternatives on adjacent lands and resources, and on the watershed. This provides opportunities to detect and minimize cumulative environmental effects that cannot be ascertained at the programmatic level of this SEIS.

Ecosystems and Species

Regional Introduction

Overall Land Ownership Patterns

The planning area for this SEIS, as defined in Chapter 2, includes lands administered by the Forest Service and the Bureau of Land Management within the range of the northern spotted owl. This geographic area includes western Washington, western Oregon, and northwestern California south to Marin County (see Figure 2-1). With the exception of some lowland interior valleys and coastal plains, this area is dominated by mountainous terrain and coniferous forests.

Forest lands within the range of the northern spotted owl are owned or administered by a variety of private, state, and federal entities, including the Forest Service (19 National Forests, 19.4 million acres), Bureau of Land Management (7 Districts, 2.7 million acres), National Park Service, American Indian tribes, state departments of forestry or natural resources, public municipalities, and thousands of private landowners. Some federal lands, especially those administered by the Bureau of Land Management in western Oregon, are intermixed with private lands in a checkerboard pattern of alternating square-mile sections. In contrast, lands administered by the Forest Service tend to be more contiguous, with fewer inclusions of private land.

Brief History of Resource Management in the Pacific Northwest

The first documented human use in the region occurred over 10,000 years ago. American Indian groups occupying the region were primarily hunter-gatherers who had relatively little direct impact on streams or aquatic communities. The major recognized impact on the landscape resulted from American Indian use of fire for maintenance of oak savanna woodland and native prairie grassland ecosystems, particularly in the larger river valleys. The effects of American Indians on forest ecosystems varied, but included the use of fire to maintain the vigor of berry fields and forest underburning to increase forage for wildlife. Subregional effects of activities on the land by American Indians through the use of fire remain in question, but were widespread and locally pronounced.

Cutting the forests in the Pacific Northwest began in the 1800's when the first non-Indian immigrants settled and farmed the interior valleys of western Oregon and the Puget Sound region. Initially, the extensive forests, including riparian areas, that covered much of the landscape were viewed as an impediment to progress, and were cleared and burned to make way for agriculture. Stream and river channelization and the removal of large wood and riparian vegetation helped drain the extensive wetlands and increased the rate of water runoff.

In the late 1800's and early 1900's, commercial extraction of lumber began. Lumber camps were built around the region, especially in areas accessible by river or steam locomotive. Lowland areas close to human population centers were logged first, followed eventually by logging of less accessible areas in more mountainous terrain. Timber was mainly harvested in the riparian or adjoining upslope areas where logs were readily accessible. The only method of moving logs out of the woods was by water. Extensive use was made of streams and rivers to float out large rafts of logs. In some cases, logs were piled in streams and floated out on the next flood. Later, more use was made of splash dams which stored water and released it all at once to carry the logs downstream. Although the use of splash dams declined as other technologies developed, splash dam use persisted into the 1950's.

Logging practices in these early years frequently left behind noncommercial species, large trees with minor defects, and many small diameter trees. Little or no attention was given to replanting. Because of the seemingly inexhaustible supply of trees, and the considerable labor required to fell the trees with hand saws and axes, trees with low commercial value were frequently left standing.

With the invention of the gas-powered chainsaw and improvements in transportation soon after World War II, logging greatly increased on federal lands in the Pacific Northwest. European methods of forest management were gradually adopted on most federal and private lands, including techniques such as clearcutting, removing logs and snags, slash burning, thinning, and planting single species stands on harvested areas. Forest fragmentation was encouraged to increase habitat conditions preferred by deer and elk populations. Extensive road systems were developed to facilitate harvest and to provide easy access for hunting and fishing. Revenues from timber harvest improved local economies and provided substantial funds to the Federal Treasury. It was assumed that forests managed in this manner could be cut and regrown at relatively short intervals (such as 40 to 80 years) without negatively affecting other resources such as water quality, fish, soils, or terrestrial animals.

Transportation networks were typically built in valley bottoms in the riparian zones. As erosion increased, stream conditions declined. Public awareness of these declining stream conditions increased when floods became more frequent. This awareness eventually led to changes in the management of riparian areas, and increased protection for the habitat needs of salmon, trout, and steelhead.

A century of logging and high-intensity wildfires has resulted in a highly fragmented mosaic of recent clearcuts, thinned stands, and young plantations, interspersed with uncut natural stands. The natural stands that remain range from 1,200-year-old forests of large trees to relatively young, even-age stands that resulted from recent wildfires. Because wildfires, windstorms, insects and diseases often killed only some of the trees in a forest, natural stands are frequently characterized by uneven-age trees that survived at least one disturbance event. The event opened the tree canopy, after which younger trees filled in the understory. Stands where many large old trees remain in the overstory are usually referred to as "old-growth forests," while stands where only scattered individuals or patches of large old trees remain, with the majority of the stand consisting of young or mature trees, is referred as to "uneven-age" or "young." Uneven-age stands are particularly common in areas where extensive fires occurred in the 1800's. Uneven-age stands defy categorization - they are not "old growth" in the classical sense (Franklin and Spies 1991, Spies and Franklin 1991), and they are not young even-age stands. It is these mixed-age stands that have led to much emotional and scientific debate over how much "old-growth forest" remains in the Pacific Northwest.

It is important to distinguish between an arbitrary definition of "old growth" and an ecological definition that focuses on ecological functions and processes. Many mixed-age stands that include only scattered individuals or patches of old trees in a matrix of mature trees probably function ecologically much like classical "old-growth" stands that have large numbers of old trees. While the terms "old growth" and "ancient forest" may be useful for defining general concepts based on social values, the two terms are only marginally useful as indicators of differences in ecological processes or functions. Therefore, the terms "late successional" and "old growth" used in this Final SEIS include the successional stages defined as mature and old growth, both of which function as old growth. For a more detailed discussion of the ecological characteristics, functions, and processes of late-successional and old-growth forests, see Appendix B2, Ecological Principles for Management of Late-Successional Forests.

Studies on the ecology of late-successional forests, which include mature and old-growth age classes, began to proliferate in the 1970's and 1980's. It gradually became apparent that a simplistic approach to forest management based on high-yield, short-rotation forestry could not be expected to adequately protect the considerable biological diversity that is present in late-successional forests and their associated aquatic ecosystems. The northern spotted owl was the first species to receive recognition in this regard. The northern spotted owl was followed closely by the marbled murrelet, anadromous fish, and a variety of species that are closely associated with old-growth forests (Thomas et al. 1993). More recently, ecologists, foresters, and the public have begun to recognize that the old-growth forests that remain in the Pacific Northwest are unique ecosystems that, under present climatic and disturbance regimes, will likely never be replicated. The invasion by introduced nonnative species, the construction of engineered structures (such as roads and dams), and the increased growth in rural areas have caused long-term alterations in the natural ecosystem. Changes in public perception and management expectations for federal lands in the Pacific Northwest have led to an increase in the protection of ecosystems, including riparian areas. They have also led to experimentation with methods of "new forestry" which is designed to retain some of the structural features that are found in old-growth forests and more closely imitate natural disturbance.

Description of Terrestrial Forest and Aquatic Ecosystems

Overview of Biological Communities, Ownership Patterns and Current Forest Conditions by Physiographic Province

The physiographic provinces (also referred to as "provinces" or "geoclimatic provinces") incorporate physical, biological and environmental factors that shape broad-scale landscapes. Physiographic provinces reflect differences in geology (such as uplift rates, recent volcanism, and tectonic disruption) and climate (such as precipitation, temperature, and glaciation). These factors result in broad-scale differences in soil development and natural plant communities. Within each province, variable characteristics of rock stability affect the steepness of hill slopes, landforms, soil texture and thickness, drainage patterns, and erosional processes. Thus, physiographic provinces are useful in the description of both terrestrial and aquatic ecosystems, as well as in the management and land-use planning of these ecosystems. The physiographic provinces are used only for analytical purposes in this SEIS. The province-level planning described in Chapter 2 includes the provinces that will be used for implementation of this SEIS.

Rates of harvest and natural disturbance have varied tremendously among the provinces within the range of the northern spotted owl, depending on land ownership patterns, topography, climate, soils, and proximity to centers of human population. As a result, some provinces, such as the Oregon Coast Range and the Washington Western Lowlands, contain relatively little remaining late-successional and old-growth forest, while other provinces, such as the Oregon Cascades, still retain extensive areas of such forests. These patterns have been described in detail (e.g., Franklin and Dyrness 1973, Ruggiero et al. 1991, Thomas et al. 1990, USDI unpub.), and will only be briefly summarized here.

Precipitation enters the hydrologic system primarily as winter storms. The majority of precipitation in the higher elevations falls as snow, while in the lower elevations it falls as rain. Condensation drip is an important source of moisture in the middle elevations and in the coastal provinces. The amount of precipitation increases in a gradient from south to north. The amount of precipitation also increases over the coastal mountains and the Cascade Range, and decreases sharply in the lee of the higher terrain, especially east of the Cascades. The southern provinces have a typical Mediterranean climate of mild, wet winters with warm, dry summers, while the northernmost provinces have much wetter climates and cooler summers. Provinces east of the crest of the Cascade Range have a more continental climate with colder, drier winters broken by late-summer monsoonal rains.

Stream and riparian habitat conditions vary greatly across the range of the northern spotted owl due to both natural and management-related factors. The type and structure of streamside vegetation reflects both the climate and the disturbance regime of the area, determined by hydrology, geologic agents, and other processes such as forest fires. Many of these components of landscape form and function occur in distinctive combinations characteristic of each physiographic province.

One important aspect of the Pacific Northwest riverine and riparian environment is the widespread occurrence of steep, unstable hillslopes. Recent geologic uplift, weathered rocks and soil, and heavy rainfall all contribute to high landslide frequency, and to high sediment loads in many of the region's rivers.

In comparison with the coasts of British Columbia and southeast Alaska, the range of the northern spotted owl has a relatively low shoreline/coastline ratio. As a consequence, there are few well-developed estuaries and other nearshore rearing areas, which are particularly important to fish during periods of unfavorable ocean conditions. Because these rearing areas are limited, fish within the range of the northern spotted owl are more dependent on freshwater habitat than in adjacent areas.

Because terrestrial and aquatic ecosystems within the range of the northern spotted owl are dominated by different biological and physical processes, the Assessment Team's terrestrial and aquatic working groups used different physiographic boundaries for their analyses. Accordingly, there are two classifications of physiographic provinces; both are displayed in Figure 3&4-1.

Aquatic physiographic province boundaries focus on geoclimatic processes such as soil formation, rock weathering, slope processes and changes, and landform development. The Assessment Team's Aquatic/Watershed Group identified eight physiographic provinces. The group then broke these provinces into 15 subprovinces to delineate differences among administrative units; account for differences in current climate, soil development, and ecosystem processes; and to provide continuity with the terrestrial provinces. The aquatic provinces were used in the analysis of distributions of fish species, such as coho salmon in the Olympic Peninsula, the California Coast Range, and the Washington/Oregon Coast Range Provinces. Except where noted, the aquatic physiographic provinces do not constitute the basis for analysis in this SEIS, and are generally not referred to in this text. Therefore, the aquatic physiographic provinces are not described in detail in this SEIS.

Terrestrial physiographic province boundaries are based on vegetation, soils, geologic history, and climate. Political boundaries were incorporated to reflect differences in historical land use and land ownership. The Northern Spotted Owl Recovery Team identified 12 provinces and the Assessment Team later adopted these as the foundation for their work (Figure 3&4-1). Because these terrestrial provinces contain considerably different kinds and amounts of late-successional and old-growth forests, management opportunities vary widely. Many of the terrestrial ecosystem analyses presented in the Forest Ecosystem Management Assessment Team (FEMAT) Report were based on these terrestrial physiographic provinces. Therefore, unless otherwise specified, references in this SEIS refer to terrestrial provinces, and the terrestrial provinces should be used to interpret the data tables in this SEIS.

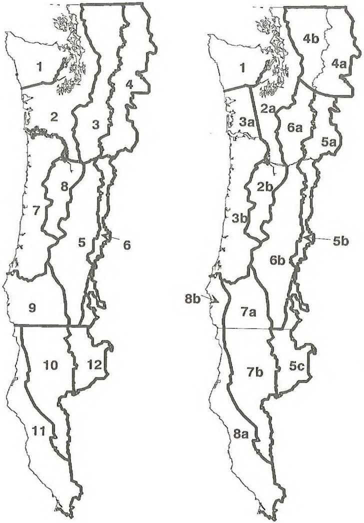
The numbers preceding the terrestrial province names in the following descriptions correspond to those in Figure 3&4-1.

Figure 3&4-1. Terrestrial and aquatic physiographic provinces

Terrestrial Ecosystems
Physiographic Provinces

1. WA Olympic Peninsula
2. WA Western Lowlands
3. WA Western Cascades
4. WA Eastern Cascades
5. OR Western Cascades
6. OR Eastern Cascades
7. OR Coast Range
8. OR Willamette Valley
9. OR Klamath
10. CA Klamath
11. CA Coast Range
12. CA Cascades

Note: Terrestrial ecosystem physiographic provinces are those referred to in tables, figures and text throughout this Final SEIS. Numbers 1 through 12 above correspond with the province descriptions in the text.



Aquatic Ecosystems
Physiographic Provinces

1. Olympic Peninsula
2. Puget /Willamette Trough
   - 2a. Western Washington Lowlands Subprovince
   - 2b. Willamette Valley Subprovince
3. Washington/Oregon Coast Range
   - 3a. Western Washington Lowlands Subprovince
   - 3b. Oregon Coast Range Subprovince
4. North Cascades
   - 4a. Eastern Washington Cascades Subprovince
   - 4b. Western Washington Cascades Subprovince
5. High Cascades
   - 5a. Eastern Washington Cascades Subprovince
   - 5b. Eastern Oregon Cascades Subprovince
   - 5c. Southern Cascades Subprovince
6. Western Cascades
   - 6a. Western Washington Cascades Subprovince
   - 6b. Western Oregon Cascades Subprovince
7. Klamath /Siskiyou
   - 7a. Oregon Klamath Subprovince
   - 7b. California Klamath Subprovince
8. Franciscan
   - 8a. California Coast Subprovince
   - 8b. Oregon Franciscan Subprovince

Descriptions of Terrestrial Physiographic Provinces

1. Olympic Peninsula Province

The Olympic Peninsula in northwestern Washington is a mountainous region isolated on three sides by water and bounded on the fourth side by an extensive region of cutover state and private lands (the Washington Western Lowlands). Streams flow outward from a central core of rugged mountains onto gently sloping lowlands. Landforms have been influenced by glaciation; major rivers flow in broad, U-shaped valleys. Steep slopes developed on resistant rocks are subject to narrow, shallow rapid landslides (debris flows) originating from the heads of stream channels. Debris flows commonly scour steep tributary streams and deposit debris in fans on the valley floors. Unconsolidated glacial deposits are subject to streambank erosion and landslides, and are susceptible to increased peak streamflows.

Vegetation and climate on the peninsula include a mixture of coniferous rain forests on the western slopes of the Olympic Mountains, and relatively dry Douglas-fir forests in the rain shadow on the eastern slopes. The Olympic Mountains have especially high floral diversity and a large number of endemic species. This province is home to many species associated with late-successional and old-growth forests, including northern spotted owls, goshawks, martens, and marbled murrelets. Although only a few nests have been found, large numbers of marbled murrelets reside offshore and apparently nest on the peninsula.

The Olympic National Park occupies the interior of the Olympic Peninsula. It is surrounded by the Olympic National Forest, which is, in turn, surrounded by extensive areas of private land, American Indian or tribal owned lands, and state managed lands. Much of Olympic National Park consists of high-elevation forests and subalpine areas. However, lowland valleys within the Park contain significant areas of late-successional and old-growth forest.

The Olympic National Forest is fragmented by clearcuts, young plantations, and natural forests ranging from young stands to stands more than 500 years old. Fragments of stands well over 1,000 years old remain in portions of the National Forest. The southern edge of the National Forest includes an extensive area referred to as the Shelton Cooperative Sustained Yield Unit, which was largely clearcut between 1960 and 1985. The National Forest also includes small Wildernesses adjacent to Olympic National Park. Most private, state, and American Indian or tribal owned lands on the peninsula have been clearcut within the last 80 years. Some of these areas are now being clearcut for the second time. This province has one of the lowest fire frequencies of Pacific Northwest forest ecosystems, however blowdown is an important agent of disturbance.

2. Washington Western Lowlands Province

Puget Sound is a depressed, glaciated area that is now partially submerged. The coastal section of the Washington Western Lowlands Province includes the Willapa Hills. Unconsolidated deposits of alluvial and glacial materials are subject to streambank erosion and landslides, and are susceptible to increased peak flows.

The Washington Western Lowlands Province was originally covered by a mosaic of primarily lowland coniferous forests, as well as deciduous forests and native prairie grasslands. Although its fire history is not well documented, much of the province was burned in 1701. There is relatively little federally managed land in the Washington Western Lowlands Province, and only small parcels of these lands contain late-successional forests. Land ownership is primarily private, although the State of Washington manages a large amount of land in this province as well. Some small parcels of American Indian and tribal owned lands are also located within this province.

Most of the forest in the Washington Western Lowlands Province has been clearcut within the past 80 years. It is now dominated by a mixture of recent clearcuts and young stands on cutover areas. Forests on cutover areas are dominated by even-age mixtures of Douglas-fir, western hemlock and red alder. This area also includes extensive agricultural and metropolitan areas, as well as major nesting, roosting and foraging habitat for the marbled murrelet in Washington.

3. Washington Western Cascades Province

The Washington Western Cascades Province encompasses the western slopes of the Cascade Range in Washington. The province exhibits extremely high relief in comparison to other provinces. Glaciers have carved deep, steep-sided valleys into both resistant and weak rocks. Tributary channels flow at high angles into rivers that, in turn, flow through broad glaciated valleys, such as the Skagit River Valley. Steep slopes are subject to debris flows from the heads of stream channels. Unconsolidated glacial deposits are subject to accelerated streambank erosion and landslides.

Lower elevation forests of the Washington Western Cascades Province consist primarily of Douglas-fir and western hemlock, while silver fir forests dominate the middle elevations. The higher elevations are dominated by forests of mountain hemlock. Although Mount Rainier and North Cascades National Parks and Wildernesses within this region contain significant areas of mid-elevation, late-successional and old-growth forest, most of these areas are dominated by high elevation areas of subalpine vegetation, as well as ice and rock.

Land ownership and administration patterns include a mixture of lands administered by the Forest Service and National Park Service, as well as American Indian and tribal owned lands, and some state and private lands. A large portion of the known northern spotted owl population and its habitat in Washington occurs in the Washington Western Cascades Province. Old-growth forests on National Forests in the province are also important nesting habitat for marbled murrelets.

In the northern half of the Washington Western Cascades Province, fire frequencies are among the lowest within the range of the northern spotted owl. However, during the historical period numerous large fires occurred in the southern portion of the province, where natural fires and American Indian use of fire were more frequent prior to European settlement. Also, fires tended to become much larger when influenced by winds descending the Columbia River Gorge.

4. Washington Eastern Cascades Province

The Washington Eastern Cascades Province is located along the eastern slopes of the Cascade Range in Washington. The province exhibits extremely high relief in comparison to other provinces. Glaciers have carved deep, steep-sided valleys into both resistant and weak rocks. Tributary channels flow at high angles into rivers that, in turn, flow through broad glaciated valleys, such as that occupied by Lake Chelan. Steep slopes are subject to debris flows from the heads of stream channels. Unconsolidated glacial and volcanic deposits are subject to accelerated streambank erosion and landslides.

The province is dominated by mixed-conifer forests and ponderosa pine forests at mid-to-lower elevations, and by true fir and mountain hemlock forests at higher elevations. Although North Cascades National Park and Wildernesses within this province include significant areas of mid-elevation, late-successional and old-growth forest, most of these areas are dominated by high elevation areas of alpine or subalpine vegetation, as well as rock and ice.

Land ownership and administration patterns include a mixture of lands administered by the Forest Service and National Park Service, as well as American Indian and tribal owned lands, and some state and private lands. Forests in the Washington Eastern Cascades Province are highly fragmented due to a variety of natural factors such as poor soils, high fire frequencies, and high elevations, as well as human-induced factors such as clearcutting and selective harvesting.

Before the advent of fire suppression in the early 1900's, wildfires played a major role in shaping the forests of the province. Intensive fire suppression efforts in the last 60 years have resulted in significant fuel accumulations in some areas, as well as shifts in tree species composition. These changes may have increased forests' susceptibility to large, high-severity fires, and to epidemic attacks of insects and diseases. Management plans for late-successional and old-growth forests in this area must consider fire management and the stability of forest stands (Agee 1993).

5. Oregon Western Cascades Province

The western Cascades are distinguished from the high Cascades by older volcanic activity and longer glacial history. Ridge crests at generally similar elevations are separated by steep, deeply dissected valleys. Complex eruption materials juxtapose relatively stable lava flows with volcanic deposits that weather to thick soils. These soils are subject to large, slow-moving landslides (earthflows). Unconsolidated alluvial and glacial deposits are subject to streambank erosion and landslides, and are susceptible to increased peak flows. Tributary channels flow at steep angles into wide, glaciated valleys.

Forests of this province consist primarily of Douglas-fir and western hemlock at low-to-mid elevations, and silver fir and mountain hemlock at higher elevations. At the drier, southern end of the province forests of Douglas-fir and western hemlock are largely replaced by mixed-conifer forests of Douglas-fir, grand fir and incense cedar.

Land ownership and administration patterns include a mixture of lands administered by the Forest Service and the Bureau of Land Management, and state and private lands. The Bureau of Land Management administers extensive holdings in the Oregon Western Cascades Province. Private and state lands within this area are mostly cutover, whereas lands administered by the Forest Service and the Bureau of Land Management still include numerous (although highly fragmented) areas of late-successional and old-growth forest. A large portion of the known northern spotted owl population and its habitat in Oregon occurs in this province.

This province extends the full length of the Oregon Cascades in western Oregon, and encompasses a wide variety of climates and forest types. The southern half of the province has fire regimes similar to those of the Oregon Klamath Province. Fire frequencies are currently high due to the incidence of lightning, but these were previously supplemented by the use of fire by American Indians (Teensma 1987). The northern half of the province had natural fire regimes that corresponded to those of the southern half of the Washington Western Cascades where fire frequencies are moderate and fire severities are high.

6. Oregon Eastern Cascades Province

The Oregon Eastern Cascades Province consists of volcanic landforms with varying degrees of glaciation. Lava flows formed relatively stable plateaus, capped by the geologically recent Cascade Range volcanoes. Drainages are generally not yet well developed, and precipitation and snowmelt disperse into highly permeable volcanic deposits. Geologically recent volcanic deposits are subject to large debris flows when saturated by snowmelt.

This area is dominated by mixed-conifer forests and ponderosa pine forests at mid-to-low elevations, and by true fir and mountain hemlock forests at higher elevations. Although Crater Lake National Park and Wildernesses within this province include significant areas of mid-elevation late-successional and old-growth forest, most are dominated by high elevation areas of alpine or subalpine vegetation and rock and ice.

Land ownership and administration patterns include a mixture of lands administered by the Forest Service, National Park Service and Bureau of Land Management, as well as private, state, and American Indian and tribal owned lands. Forests in this region are highly fragmented due to a variety of natural factors such as poor soils, high fire frequencies, and high elevations, as well as human-induced factors such as clearcutting and selective harvesting.

Before the advent of fire suppression in the early 1900's, wildfires also played a major role in shaping the forests of this region. Intensive fire suppression efforts in the last 60 years have resulted in significant fuel accumulations in some areas, and shifts in tree species composition. These changes may have made forests more susceptible to large, high severity fires and to epidemic attacks of insects and diseases. Management plans for late-successional and old-growth forests in this province must consider fire management and the stability of forest stands (Agee 1993).

7. Oregon Coast Range Province

This province generally consists of steep slopes with narrow ridges developed on resistant sedimentary rocks. Westward flowing streams erode headward to mountain passes on the east side of the Coast Range. Many of the higher peaks are composed of resistant igneous rocks. Steep, highly dissected slopes are subject to debris flows. Tributary channels join at relatively low angles, which allow debris flows to travel for long distances. In the area drained by the Wilson and Trask Rivers, weaker rocks form gentle slopes with thick soils that are subject to large, thick, slow-moving landslides (earthflows). Earthflows may constrict or deflect stream channels, creating local low-gradient stream reaches upstream.

This province includes the coastal mountains of western Oregon from the Columbia River south to the Middle Fork of the Coquille River. This area is dominated by forests of Douglas-fir, western hemlock and western redcedar. The southern half of the province includes a mixture of private lands and federally administered lands. The northern half is largely in private and state ownership. Heavy cutting and several extensive wildfires during the last century have eliminated most old-growth forests in the northern end of the province. Older forests in the southern half of the province are highly fragmented, especially on lands administered by the Bureau of Land Management. These parcels are typically intermixed with harvested private lands in a checkerboard pattern of alternating square-mile sections. A small amount of American Indian and tribal owned land is located in this province.

Before the advent of fire suppression, this province was subject to relatively infrequent but very large fires, especially in the 1800's and 1900's. As a result, many of the remaining natural forests consist of a mosaic of mature stands and remnant patches of old-growth trees. Because it is isolated and large areas have been harvested, the Oregon Coast Range Province is of concern for northern spotted owls, marbled murrelets, and anadromous fish.

8. Willamette Valley Province

The Willamette Valley includes the lowland valley area between the Coast Range Province and the Oregon Western Cascades Provinces in western Oregon. The province includes a broad geologic depression between the Coast Range and Cascade Range. The Willamette River meanders northward along a very gently sloping valley. Unconsolidated deposits of alluvial and glacial outwash materials are subject to accelerated streambank erosion and landslides.

The Willamette Valley Province, which was originally covered by a mosaic of lowland coniferous and deciduous forests and native prairie grasslands, was mostly cleared in the 1800's and early 1900's and converted to farmland, residential areas and metropolitan areas. Land ownership is mostly private. There is relatively little federally managed land within the Willamette Valley Province, and only small parcels of these lands contain late-successional forests.

9. Oregon Klamath Province

The Oregon Klamath Province includes much of southwestern Oregon. This province is rugged and deeply dissected. Tributary streams generally follow the northeast/southwest orientation of rock structure created by accretion of rocks onto the continent. Variable soil and rock materials on steep slopes are subject to debris flows; materials on gentle slopes are subject to earthflows. Scattered granitic rocks are subject to debris flows and severe surface erosion. High rates of uplift have created steep streamside hillslopes known as "inner gorges," especially near the coast. Hillslope and channel disturbance due to mining activities began in the 1850's and still continues.

This area is dominated by mixed-conifer and mixed-conifer/hardwood forests. Land ownerships include a mixture of public lands administered by the Forest Service and the Bureau of Land Management, land administered by the State of Oregon, and privately owned lands. Forests are highly fragmented by natural factors such as poor soils, dry climate, and wildfires, as well as human-induced factors including timber harvesting and roads. Timber harvest in this area has been by selective cutting as well as clearcutting. As a result, many stands that were logged in the early 1900's now contain a mixture of old trees left after harvest and younger trees that regenerated after harvest. A small amount of American Indian and tribal owned land is located on the coastal portion of this province.

Much of the area within this province is characterized by high fire frequencies, both historically as well as at present. Before the advent of fire suppression in the early 1900's, wildfires played a major role in shaping the forests of this region. Intensive fire suppression efforts in the last 60 years have resulted in significant fuel accumulations in some areas, and shifts in tree species composition and forest stand structure. These changes may have made forests more susceptible to large, high severity fires and to epidemic attacks of insects and diseases. Numerous large and destructive fires have occurred in the province in the past decade. Any management plan for the late-successional and old-growth forests in these areas must consider fire and fuels management (Agee 1993).

10. California Klamath Province

The California Klamath Province includes a large part of northwestern California. This province is rugged and deeply dissected. High rates of uplift have created steep streamside hillslopes in the western portion of the province. Variable soil and rock materials on steep slopes are subject to debris flows; materials on gentle slopes are subject to earthflows. Scattered granitic rocks are subject to debris flows and severe surface erosion. Hillslope and channel disturbance due to mining activities began in the 1850's and continues to this day.

This province is dominated by mixed-conifer and mixed-conifer/hardwood forests. Land ownerships include extensive lands managed by the Forest Service, small and scattered parcels of land administered by the Bureau of Land Management, land administered by the State of California, and privately owned lands. Forests are highly fragmented by natural factors such as poor soils, dry climate, and wildfires, as well as human-induced factors including timber harvesting and roads. Much of the historical timber harvest in this area has been selective cutting rather than clearcutting. As a result, many stands that were logged in the early 1900's now contain a mixture of old trees left after harvest and younger trees that regenerated after harvest.

The California Klamath Province is characterized by very high fire frequencies. Prior to fire suppression, fires were generally more pervasive, but much less severe than they are at present. Wildfires play a major role in shaping the forests of this province. Intensive fire suppression efforts in the last 60 years have resulted in significant fuel accumulations in some areas, and shifts in tree species composition and forest stand structure. These changes may have made forests more susceptible to large, high severity fires, epidemic attacks of insects, and susceptibility to stress from drought. Numerous large and destructive fires have occurred in the province in the past few decades. Management plans for the late-successional and old-growth forests in these areas must consider fire and fuels management (Agee 1993).

11. California Coast Range Province

The California Coast Range Province was formed by accretion of rocks onto the continent. Stream channels generally follow the northwest/southeast orientation of these rocks. Relatively rapid tectonic uplift has caused hillslopes to become highly dissected and incised by stream channels, creating inner gorges. Weak rocks are highly fractured along numerous faults and contacts, and are weathered to deep soils that are subject to extensive earthflows. Sediment yield is among the highest in the world.

This area is dominated by redwood forests and mixed forests of Douglas-fir and hardwoods. Most of the area is privately owned, but lands administered by the Forest Service and the Bureau of Land Management, as well as state and National Parks, are also present. The province also contains some American Indian and tribal owned lands and scattered American Indian allotments.

This province includes a coastal fog belt containing the last remaining stands of old-growth redwoods. Formerly, these redwood stands were subject to frequent underburning. The fire frequency in this province is generally much lower than in the California Klamath Province. Considerable numbers of northern spotted owls inhabit private lands in the area, as well as federally managed lands. In addition, this is an important nesting area for marbled murrelets.

12. California Cascades Province

The California Cascades Province includes the extreme southern end of the Cascade Range. Forests in this region are dominated by mixed-conifer or ponderosa pine associations on relatively dry sites. Ownership is mixed, with some areas of consolidated Forest Service administered lands, and some areas of intermixed Forest Service and private lands. Forests are highly fragmented due to natural factors and harvest activities.

As in a number of other provinces, fire plays an important role in the California Cascades Province in maintaining fire-adapted pine communities. Because of modern fire suppression efforts, mixed-conifer communities have increased, gradually replacing pine-dominated stands. Management of fire-dependent old-growth forests has evolved to include understory thinning and understory burning, both of which are likely to increase on all lands in the future.

Terrestrial Ecosystems

Current Forest Conditions Within the Range of the Northern Spotted Owl

Land Area and Ownership

The range of the northern spotted owl encompasses 57 million acres in the United States, of which 24.5 million acres (43 percent) are federally managed. Of the federally managed lands, 19.4 million acres are administered by the Forest Service, 2.7 million acres are administered by the Bureau of Land Management, and 2.2 million acres are administered by the National Park Service (Table 3&4-2). Other federally managed lands within the range of the northern spotted owl include military installations and national wildlife refuges.

Lands administered by the Forest Service are widely distributed within the range of the northern spotted owl. In contrast, lands administered by the Bureau of Land Management within the range of the northern spotted owl are largely concentrated in western Oregon. Because of historical land grants, lands administered by the BLM in western Oregon tend to be distributed in a checkerboard pattern of alternating square-mile sections of federal and private land.

Nonfederal lands within the range of the spotted owl include a variety of privately owned lands and areas owned and administered by state governments. American Indian and tribal owned lands cover large portions of the range of the owl, especially in the Olympic Peninsula, Eastern Cascades, and Klamath Provinces. Private lands include a multitude of small holdings as well as extensive areas owned by large forest products companies.

Table 3&4-2. Estimated total acres within the range of the northern spotted owl by agency or ownership and physiographic province

State/ Physiographic Province	Acres by Ownership				
	Forest Service	Bureau of Land Management[1]	National Park Service	Other Federal	Nonfederal
Washington					
Eastern Cascades	3,327,100	0	137,100	6,200	2,211,800
Western Cascades	2,955,500	0	759,500	4,400	2,430,500
Western Lowlands	0	0	1,700	124,600	6,344,000
Olympic Peninsula	628,100	0	900,200	1,700	1,501,100
Total:	**6,910,700**	**0**	**1,798,500**	**136,900**	**12,487,400**
Oregon					
Klamath	1,285,100	833,400	500	0	1,881,500
Eastern Cascades	1,447,000	48,900	77,600	0	751,400
Western Cascades	3,720,800	678,300	88,600	400	2,153,500
Coast Range	621,100	788,900	100	1,700	4,359,200
Willamette Valley	0	17,500	0	8,700	2,631,900
Total:	**7,074,000**	**2,367,000**	**166,800**	**10,800**	**11,777,500**
California					
Coast Range	69,400	229,900	150,800	21,200	5,219,400
Klamath	4,366,700	104,000	41,000	0	1,569,200
Cascades	996,900	10,300	300	0	1,494,700
Total:	**5,433,000**	**344,200**	**192,100**	**21,200**	**8,283,300**
3 State Total:	**19,417,700**	**2,711,200**	**2,157,400**	**168,900**	**32,548,200**

[1] No acres tallied for Bureau of Land Management in Washington due to the dispersed nature of the lands under its administration.

Allocation of Federal Lands

Federal lands within the range of the northern spotted owl include 18.5 million acres that are considered capable of growing forests (see FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment). The other 5.9 million acres of federal land include high elevation nonforested areas (such as meadows, shrublands, and lakes) and other nonforested areas. Of the 18.5 million forested acres on federal lands, 5.8 million (32 percent) are in Congressionally Reserved Areas, primarily Wilderness and National Parks. Another 3.3 million acres (18 percent) are Administratively Withdrawn Areas set aside by the managing agencies. Administrative withdrawals occur for a variety of reasons, including protection of fragile soils or watersheds, protection of wildlife or fish, recreation values, and scenic values. Administratively Withdrawn Areas are not necessarily unavailable for timber harvest. However, no regular timber harvest is scheduled for these areas, and they do not contribute to estimates of probable sale quantity (PSQ). These administrative withdrawals are subject to modification when agencies revise their management plans.

Amounts of Late-Successional Conifer Forest on Federal Land

Vegetation on federal lands within the range of the northern spotted owl was categorized into broad structural types based on stand-based inventory data and satellite imagery by Pacific Meridian Resources (under contract to the Forest Service; see FEMAT Report, Chapter II, Overview and Summary of Options and their Evaluation, and Chapter IV, Terrestrial Forest Ecosystem Assessment). These structural classes are:

Small conifer—

This youngest seral category includes stands of trees generally 9 to 21 inches diameter at breast height (dbh). A minority of the stands in this category have scattered large overstory trees that provide late-successional forest characteristics.

Medium/large single-storied conifer—

Stands dominated by conifer trees that are 21 to 32 inches dbh, characterized by only a single canopy layer. These stands qualify as late-successional forest.

Medium/large multistoried conifer—

Stands dominated by conifer trees that are greater than 32 inches dbh, and are characterized by two or more canopy layers. These stands would generally best fit the definition of old-growth forests.

Forests on federal lands within the range of the northern spotted owl currently include approximately 5.4 million acres of multistoried, medium/large conifer forest, 3.2 million acres of single-storied medium/large coniferous forest, and 5.8 million acres of small, single-storied conifers (see FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment). It should be noted that the definition of "small" conifer forests includes some stands that are late successional. Thus, the data cannot be used to develop a total acreage of late-successional forest.

Of the 8.6 million acres of medium/large conifer forest on federally administered lands within the range of the northern spotted owl, 2.5 million acres (29 percent) are Congressionally Reserved Areas, and 1.6 million acres (19 percent) are Administratively Withdrawn Areas (Table 3&4-3). An undetermined proportion of the medium/large conifer forests in both Congressionally Reserved Areas and Administratively Withdrawn Areas are high-elevation forests that are not occupied by spotted owls (Table 3&4-4). Although the latter stand types may not be used by spotted owls, they are important habitat for a variety of plants and animals that occupy late-successional high-elevation forests.

Substantial portions of Congressionally Reserved Areas and Administratively Withdrawn Areas are covered by relatively young forest. Of the 5.8 million forest acres in Congressionally Reserved Areas, for example, 1.6 million acres (28 percent) are in single story stands of small conifers (see FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment). This does not include

Table 3&4-3. Current estimated late-successional conifer forest on federal lands within the range of the northern spotted owl by total acres, acres in Congressionally Reserved Areas, and acres in Administratively Withdrawn Areas, by state and physiographic province

State/ Physiographic Province	Total			Portion in Congressionally Reserved Areas			Portion in Administratively Withdrawn Areas		
	Small Conifer Single Story *	Medium/Large Conifer ** Single Story	Medium/Large Conifer ** Multi-Story	Small Conifer Single Story *	Medium/Large Conifer ** Single Story	Medium/Large Conifer ** Multi-Story	Small Conifer Single Story *	Medium/Large Conifer ** Single Story	Medium/Large Conifer ** Multi-Story
Washington									
Eastern Cascades	829,400	308,000	638,300	285,800	147,500	253,800	164,400	47,500	95,400
Western Cascades	1,008,700	535,600	654,800	372,700	225,800	292,600	175,600	96,500	160,300
Western Lowlands	0	0	0	0	0	0	0	0	0
Olympic Peninsula	488,300	36,800	460,500	276,600	14,900	339,100	32,800	6,000	32,600
Total:	2,326,400	880,400	1,753,600	935,100	388,200	885,500	372,800	150,000	288,300
Oregon									
Klamath	599,200	150,800	553,900	99,600	6,300	63,900	104,700	11,000	95,100
Eastern Cascades	976,700	16,000	275,800	252,500	5,000	86,300	206,800	2,900	63,100
Western Cascades	1,169,200	750,200	1,172,300	280,200	150,900	183,800	190,300	82,200	167,000
Coast Range	530,900	215,600	140,200	18,900	3,000	100	19,600	10,000	11,000
Willamette Valley	4,400	1,300	900	0	0	0	0	0	100
Total:	3,280,400	1,133,900	2,143,100	651,200	165,200	334,100	521,400	106,100	336,300
California									
Coast Range	4,700	25,600	9,800	200	2,600	2,200	2,000	9,600	4,000
Klamath	140,800	947,700	1,318,000	37,600	315,000	374,300	28,100	194,300	470,200
Cascades	38,300	181,400	157,000	1,800	4,700	0	1,300	40,100	34,400
Total:	183,800	1,154,700	1,484,800	39,600	322,300	376,500	31,400	244,000	508,600
3 State Total:	5,790,600	3,169,000	5,381,500	1,625,900	875,700	1,596,100	925,600	500,100	1,133,200

* Stands generally characterized by trees 9.0 to 20.9 inches in diameter at breast height (dbh) - only a portion of these acres are late-successional forest.

** Stands generally characterized by trees 21.0 inches dbh or larger.

Table 3&4-4. Acres of conifer forest on federal lands within the range of the northern spotted owl, by structural class and elevation band

State/ Physiographic Province	Class*	Acres by Elevation Bands (in thousands of feet) 0-2	2-4	4-6	6-8	8-16	Total
Washington							
Eastern Cascades	Total Sm Conifer Single-Story	20,600	297,200	423,700	88,000	0	829,500
	Total M/L Conifer Single-Story	2,500	119,000	172,300	14,100	0	307,900
	Total M/L Conifer Multistory	5,000	257,200	364,900	11,200	0	638,300
Western Cascades	Total Sm Conifer Single-Story	184,000	561,900	258,500	4,300	0	1,008,700
	Total M/L Conifer Single-Story	54,300	291,900	189,100	200	0	535,500
	Total M/L Conifer Multistory	52,600	375,600	226,000	600	0	654,800
Western Lowlands	Total Sm Conifer Single-Story	0	0	0	0	0	0
	Total M/L Conifer Single-Story	0	0	0	0	0	0
	Total M/L Conifer Multistory	0	0	0	0	0	0
Olympic Peninsula	Total Sm Conifer Single-Story	172,100	244,600	71,400	200	0	488,300
	Total M/L Conifer Single-Story	13,200	19,800	3,900	0	0	36,900
	Total M/L Conifer Multistory	197,900	237,900	24,700	0	0	460,500
Washington Total:	Total Sm Conifer Single-Story	376,700	1,103,600	753,500	92,500	0	2,326,300
	Total M/L Conifer Single-Story	70,000	430,700	365,300	14,400	0	880,400
	Total M/L Conifer Multistory	255,500	870,700	615,600	11,800	0	1,753,600
Oregon							
Klamath	Total Sm Conifer Single-Story	188,200	367,700	41,900	1,400	0	599,200
	Total M/L Conifer Single-Story	53,800	82,600	13,600	900	0	150,900
	Total M/L Conifer Multistory	217,200	280,000	52,200	4,600	0	554,000
Eastern Cascades	Total Sm Conifer Single-Story	9,700	226,900	595,200	144,800	0	976,600
	Total M/L Conifer Single-Story	300	6,000	8,500	1,300	0	16,100
	Total M/L Conifer Multistory	1,700	48,300	176,100	49,700	0	275,800
Western Cascades	Total Sm Conifer Single-Story	113,300	502,400	482,000	71,300	0	1,169,000
	Total M/L Conifer Single-Story	99,700	464,800	182,400	3,400	0	750,300
	Total M/L Conifer Multistory	104,800	600,700	432,200	34,000	0	1,171,700
Coast Range	Total Sm Conifer Single-Story	504,700	26,200	0	0	0	530,900
	Total M/L Conifer Single-Story	196,300	19,200	0	0	0	215,500
	Total M/L Conifer Multistory	133,200	7,000	0	0	0	140,200
Willamette Valley	Total Sm Conifer Single-Story	4,300	100	0	0	0	4,400
	Total M/L Conifer Single-Story	1,300	0	0	0	0	1,300
	Total M/L Conifer Multistory	900	0	0	0	0	900
Oregon Total:	Total Sm Conifer Single-Story	820,200	1,123,500	1,119,200	217,500	0	3,280,400
	Total M/L Conifer Single-Story	351,400	572,600	204,400	5,500	0	1,133,900
	Total M/L Conifer Multistory	457,800	936,500	660,600	88,200	0	2,143,100
California							
Coast Range	Total Sm Conifer Single-Story	1,900	3,000	0	0	0	4,900
	Total M/L Conifer Single-Story	12,600	12,900	100	0	0	25,600
	Total M/L Conifer Multistory	5,900	4,000	0	0	0	9,900
Klamath	Total Sm Conifer Single-Story	1,900	67,900	60,700	10,400	0	140,900
	Total M/L Conifer Single-Story	61,600	410,800	409,600	65,700	0	947,700
	Total M/L Conifer Multistory	145,500	641,700	444,700	86,100	0	1,318,000
Cascades	Total Sm Conifer Single-Story	0	5,100	24,100	8,700	300	38,200
	Total M/L Conifer Single-Story	9,200	73,700	76,500	21,700	200	181,300
	Total M/L Conifer Multistory	0	4,500	98,700	53,600	200	157,000
California Total:	Total Sm Conifer Single-Story	3,600	76,000	84,800	19,000	300	183,700
	Total M/L Conifer Single-Story	83,400	497,500	486,200	87,400	200	1,154,700
	Total M/L Conifer Multistory	151,400	650,100	543,400	139,700	200	1,484,800
3 State Total:	Total Sm Conifer Single-Story	1,200,500	2,303,100	1,957,500	329,000	300	5,790,400
	Total M/L Conifer Single-Story	504,800	1,500,800	1,055,900	107,300	200	3,169,000
	Total M/L Conifer Multistory	864,700	2,457,300	1,819,600	239,700	200	5,381,500

* Sm Conifer Single Story = Stands dominated by small conifer trees ranging from 9.0 to 20.9 inches in diameter at breast height (dbh). M/L (Medium/Large) Conifer Single-Story = Stands dominated by conifer trees that are at least 21.0 inches dbh, and characterized by only a single canopy layer. M/L (Medium/Large) Conifer Multistory = Stands dominated by conifer trees that are at least 21.0 inches dbh and characterized by two or more canopy layers.

additional acres that are covered by forests of trees smaller than 9 inches dbh. The considerable acreage of small forests within Congressionally Reserved Areas reflects a long history of fire and other natural disturbances, as well as factors such as poor soils and high elevations, which tend to suppress tree growth.

Patterns of Spatial Distribution

As described in the earlier descriptions of physiographic provinces, most late-successional and old-growth forests within the range of the spotted owl have been harvested from private and state lands. Late-successional stands that remain on private and state lands tend to occur in small islands, surrounded by cutover areas and young stands. In areas where little federal land is present, such as the Washington Western Lowlands Province, old-growth forests have been largely eliminated by harvest and settlement.

On federal lands, old-growth forests tend to be distributed in a highly fragmented mosaic, often intermixed with recently harvested areas and stands of younger trees. Late-successional and old-growth forests in Congressionally Reserved Areas tend to occur in larger blocks than nonreserve areas, but even in these areas there is considerable natural fragmentation of older stands due to historical disturbance patterns and poor growth conditions.

Management Considerations

Retention of Old-Growth Fragments

Old-growth fragments can sometimes serve as the only habitat in a landscape for many lichens, fungi, bryophytes, plants, arthropods, and small-bodied animals that contribute to the biodiversity and productivity of the forest ecosystem. Old-growth fragments may be critical for species that are locally endemic, occur only in very specific conditions of forest structure or soil, or have limited dispersal capabilities.

Arthropods, fungi, lichens, bryophytes, vascular plants, and invertebrate animals are able to inhabit much smaller patches of old-growth forest than vertebrates, and may persist in such patches for a much longer time than vertebrates. Patches of old-growth forests 25 acres or less may provide habitat for a wide variety of these organisms even though edge effects may eliminate fully buffered core habitat. Although some highly sensitive arthropod species may be eliminated in very small fragments of old growth, many less sensitive species may continue to inhabit the patch. Thus, patch size and potential edge effects alone should not exclude small old-growth fragments from management consideration. Recent studies by Chen et al. (1990) suggest that buffers of 300 to 800 feet provide interior habitat conditions for vascular plants. According to Harris (1984), a circular stand of old growth with a radius of 600 feet (26 acres) provides minimal interior conditions, provided the patch is surrounded by at least young forests.

Small fragments of old-growth forest can also be important for pollen vectors and animals that disperse plant seeds. Mycotrophic plant species have symbiotic relationships with fungi and photosynthetic vascular plants, and may require seed dissemination by animals whose diets include fungi. Small fragments may also contribute to the persistence of small animal populations, particularly invertebrates.

Survival of most conifers and flowering plants depends on mycorrhizal associations with fungi for uptake of nutrients and water. Nearly 2,000 mycorrhizal species are associated with Douglas-fir alone (Trappe 1977); species diversity provides seasonal and long-term resilience to the forest (Molina et al. 1992). Small fragments of old-growth forest may provide a source of inoculum for fungi dispersal into adjacent managed stands.

Many arboreal mosses and lichens can persist in small patches of older trees. These species have limited dispersal capability, and spread slowly from such patches. In England, Rose (1988) found that some lichen species persisted in small patches of old-growth forest that had undergone centuries of selective harvest, but were absent in secondary forests regrown after regeneration harvests. In fact, lichen species have been used to index the degree of historical continuity of forest cover of some woodlands (Broad 1989). Some lichens, particularly nitrogen-fixing species, do not become established until stands are several hundred years old.

Small fragments of old growth may act as refugia or centers of dispersal for many organisms, including plants, fungi, lichens (Esseen et al. 1992), and arthropods. Arthropods are key to ecosystem function, and can serve as indicators of forest health (Lattin 1990, Moldenke 1990, Moldenke and Lattin 1990), yet very little is known about the mobility of most species. Isolating a patch of old-growth forest may isolate the arthropod fauna, especially those that are flightless or associated with the soil litter. However, small old growth fragments may also serve as refugia for arthropods, as long as mesic (moderately moist) microhabitats are present. Arthropods that may persist in small fragments include predators that help control insect populations that otherwise might damage foliage in surrounding younger stands. Successful dispersal of some arthropods is dependent on mesic habitats between the patches of old-growth, as well as closed-canopy patches of trees and forests in riparian areas.

Organisms that have the greatest difficulty moving between old-growth patches are understory specialists, usually flightless forms or those with limited dispersal mechanisms. Many insect groups associated with old-growth forests are flightless, especially those found on the forest floor. Distances of 66 feet or less of unsuitable habitat can act as dispersal barriers to some understory invertebrate specialists, including species of bees, wasps, moths, beetles, and millipedes. Roads can also act as barriers to these organisms. These species are likely to be poor dispersers, have restricted habitat requirements, and occur in limited geographic ranges. Many are also sensitive to differences in humidity, soil moisture, and temperature beyond the edge of an old-growth fragment. In particular, amphibians and mollusks have low mobility, specific habitat requirements, and depend on moist environments for at least parts of their life cycle. There is considerable genetic variability among and within species of amphibians. This high degree of variability is probably a result of their specific habitat associations and limited mobility.

Plant populations that have had limited opportunity to interbreed may also become genetically and morphologically distinct. Maintaining genetic diversity is particularly important for isolated, disjunct populations (e.g., *Coptis asplenifolia*). However, artificially limiting the amount of gene exchange in highly-fragmented landscapes may reduce persistence. Plants with limited dispersal capabilities (such as those with ephemeral seeds) may be particularly vulnerable to isolation. Small fragments can serve as genetic reserves for recolonization of adjacent habitat.

Small patches of old-growth forest can provide thermal and mesic refugia for a variety of organisms. Understory habitats in old-growth forests can escape freezing conditions due to the thermal buffering of dense tree canopies. Deer and other vertebrates may rely on these thermal refuges during harsh storms or during dispersal to larger forest stands of suitable habitat. Many invertebrates migrate locally to mesic refugia during summer. During very dry periods in forests east of the Cascade Range, many invertebrates may require dense forest cover and mesic understory habitats to avoid desiccation. This has been shown to be the case for mollusks in the Pacific Northwest (Frest and Johannes 1993). Similarly, during hot, dry summers, coarse woody debris in old-growth fragments provides sites for truffle (fruiting bodies of hypogeous fungi) production, while truffle production in forest plantations does not occur until after the fall rains have increased soil moisture. Mature forest fragments provide truffles and other food for small mammals such as red-backed voles during the dry summer months when such food is unavailable in plantations. During stressful periods, invertebrates and some mammals may need to rely on food resources that are absent or rare in young forests. Deer and small mammals such as flying squirrels often rely on lichens in old-growth forests for food during harsh winter weather when other food types are unavailable (Hodgman and Boyer 1985).

Lower elevation forests have been subject to more intensive forest management than higher elevation forests because a large portion of lands at low elevations are privately owned. Small fragments of old growth are the only remaining representatives of low elevation forests in some areas. Some ecosystems are infrequently found on federal lands within the planning area, particularly low elevation old-growth forests, but also deciduous forests and grasslands. Old-growth forest fragments may be very important to rare and geographically restricted species of mollusks, fungi, lichens, and vascular plants. Among species evaluated for viability by the Assessment Team, rare and locally-distributed species comprised 28 percent of the fungi, and 26 percent of the vascular plant species. Designated areas may provide limited protection for these species, depending on their distribution.

Stand Features - Green Trees and Dead Wood in the Matrix

Residual green trees and dead wood in harvested areas of the matrix function as a bridge between past and future forests. Green trees serve several important functions: they are available for snag recruitment, contribute to multistoried canopies, provide shade and suitable habitat for many organisms in the matrix, and serve as refugia and centers of dispersal.

Patches of green trees of various sizes, ages, and species will promote species diversity of fungi, lichens, plants, and arthropods. Individual leave trees exist in less protected microclimates than trees left in small patches. Many fungi, plants, and arthropods require moist, cool microclimates, and do not tolerate exposed conditions.

Complex canopy structure (especially leaning boles) are beneficial for some lichens, such as pin lichens (*Calcium* spp.) (Esseen et al. 1992). Trees that are asymmetrical promote a diversity of habitat substrates, and often have more lichen and moss epiphytes on large lateral limbs than symmetrical trees. Location of green trees is also important; for example, ridgelines are optimum locations for lichen dispersal.

Large green trees, snags, and coarse woody debris are important for many animals. Thomas et al. (1979) found that 178 vertebrates—14 amphibians and reptiles, 115 birds, and 49 mammals—used coarse woody debris as habitats in northeast Oregon forests. Resting sites for American martens and fishers include cavities and hollow stumps, as well as the underside of logs. Large old trees, snags, and logs that provide protection from predators and thermal protection are used as natal den sites.

Adequate numbers of large snags and green trees are critical for bats: they are used for maternity roosts, temporary night roosts, day roosts, and hibernaculas. Bats compete with primary excavators and other species that use cavity roosts. Migrating bats may roost under bark in small groups. Thermal stability within a roost site is important for bats; large snags and green trees provide this stability. Individual bat colonies may use several roosts during a season as temperature and weather conditions change. Large, down logs with loose bark may also be used for roosting by some bats, including Yuma myotis and little brown bats.

Two species of salamanders are closely associated with coarse woody debris: Oregon slender and clouded salamanders. While the degree to which seven other late-successional associated species of salamanders are dependent on coarse woody debris is not clear, all of these species are expected to benefit from the retention of coarse woody debris. This group includes three species of Pacific giant salamanders (Del Norte, Van Dyke's, and western redback), and Ensatina salamanders.

Coarse woody debris is essential for many species of vascular plants, fungi, liverworts, mosses, and lichens. Truffle production is associated with coarse woody debris in mature forests in southwestern Oregon. This is probably related to the moisture-holding capacity of decayed wood in comparison to surrounding soil that dries and suppresses fruiting of fungi. Maintaining conditions that are favorable for fungi will promote the persistence of invertebrates that are fungivores. Saprobic fungi, such as conks or polypores, are common in mature forests because they grow on coarse woody debris. One lichen, *Cladonia norvegica*, needs coarse woody debris as a substrate. Some bryophytes (many liverworts and some mosses) need saturated logs in shaded environments to exist and will not survive desiccation for even short periods of time. Some vascular plants establish themselves only on large decaying logs ("nurse logs"), and others establish themselves primarily on coarse woody debris (e.g., *Pyrola uniflora*, *Allotropa virgata*). Several species appear to be restricted to decaying wood substrates due to their symbiotic association with fungi. Most orchids and some heaths require specific fungi for germination and growth (Furman and Trappe 1971, Wells 1981). However, coarse woody debris in the matrix may be inferior habitat for these organisms compared to habitat within old-growth fragments due to drier climatic conditions. Microclimate, log decay processes, and fungal associations may be altered by removal of canopy cover. Logs in the matrix will be occupied by different species than those found on coarse woody debris in old-growth fragments.

Arthropods associated with decayed wood include wood-boring beetles, carpenter ants, and termites. Many beetles (including *Buprestidae, Carabidae, Curculionidae,* and *Scolytidae*) attack freshly killed trees and play an important role in exposing down logs to decomposition. Other arthropod groups associated with coarse woody debris include detritivores, fungivores, predators, and parasitoids/parasites that are vital to the nutrient-cycling process.

Methodology for Terrestrial Assessment

Information for the assessment of the effects of the alternatives on terrestrial species and their habitats includes data on forest cover types and species' geographic ranges. Information regarding general forest cover types on lands administered by the Forest Service and National Park Service in Oregon and Washington was obtained through a contract with Pacific Meridian Resources. The cover type data were produced using a combination of 1988 and 1991 Landsat imagery and were classified into vegetation categories based on tree size and stand structure. For lands administered by the Forest Service in California, vegetation data from each of the National Forests were used to develop the forest cover type data set. Because the range of the northern spotted owl includes only small portions of the Modoc and Lassen National Forests, data for these National Forests are not included. Standards and guidelines still apply to these areas, however, as described in Chapter 2. No data were available for lands administered by the National Park Service in California.

Vegetation information for lands administered by the Bureau of Land Management in Oregon was compiled from forest stand description data on tree diameter classes of the dominant overstory trees. This data was developed from aerial photograph interpretation and field surveys. Forest cover type data for lands administered by the Bureau of Land Management in California were derived from the agency's Wildlife Habitat Relationships Theme in a Geographic Information System (GIS).

To combine data from different agencies, the data were generalized to a GIS-based grid with a resolution of 400 by 400 meters square. Data were then restructured to conform to the cover type categories of the Pacific Meridian Resources classification.

The Forest Ecosystem Management Assessment Team obtained specific data sets for northern spotted owl and marbled murrelet habitat for lands administered by the Forest Service in the three states, by the Bureau of Land Management in Oregon, and by the National Park Service in Oregon and Washington. Field offices had previously completed the classification of spotted owl habitat for the Forest Service and Bureau of Land Management. Information on northern spotted owl habitat for National Parks in Oregon and Washington was derived from the Pacific Meridian Resources Landsat cover type data by the Assessment Team. All medium and large conifer acres from the Landsat data that occurred under 4,000 feet elevation in Washington, and under 5,500 feet in Oregon, were tallied as spotted owl habitat. No data were available for either northern spotted owl or marbled murrelet habitat on lands administered by the Bureau of Land Management or the National Park Service in California.

The spotted owl habitat data were also used to identify marbled murrelet habitat on lands administered by the Forest Service within the range of the murrelet in Oregon and California because data specific to marbled murrelet habitat were not available for those lands. In Washington, marbled murrelet habitat was identified for National Forests and National Parks using updated 1989 Landsat data classified by Eby and Snyder (1990). Data for a portion of land in the Puget Sound not covered by the Eby and Snyder data were supplied by the Washington Department of Natural Resources from work by Green et al. (1993). For lands administered by the Bureau of Land Management in Oregon, the Assessment Team used field office classifications of forest stand data designating probable murrelet habitat.

Species range maps developed by Thomas et al. (1993) were refined for this effort by personnel from the Forest Service's Forestry Sciences Laboratory in Olympia, Washington, for those mammal, bird, and amphibian species closely associated with late-successional forest. Data were based on information from field guides, scientific literature, State Natural Heritage Program data base files, state agency records, and reviews by authorities on the species.

Specific location information was plotted for northern spotted owls and marbled murrelets from data compiled by the state wildlife agencies of Washington, Oregon, and California. The spotted owl location data identified points on the landscape where survey data documented nesting by a pair of owls, or continued occupancy of a location by either a pair of owls or a territorial single owl. Data were tallied for owl pairs and territorial single owls that had been verified from 1987 to 1991 for all federal lands, and from 1988 to 1992 for other ownerships where earlier surveys were incomplete or where considerable new data were available. The marbled murrelet location data identified forest stands of variable size where surveys documented murrelet activity in the canopy. Data coverage included all federal lands. Occupied stands verified from 1986 through 1992 were included.

Methods for Assessing the Maintenance of a Functional and Interconnected, Late-Successional Forest Ecosystem

Introduction

Assessments of the likelihood of maintaining a functional and interconnected, late-successional ecosystem were performed for seven of the alternatives by a panel of five experts (as described in Process for Assessing Effects on Species Habitat Sufficiency on Federal Lands later in this chapter). The set of outcomes used by the ecosystem assessment panel differed from the set of outcomes defined for the species assessment panels because an ecosystem perspective requires different evaluation criteria than a species perspective. Species assessments were based on habitats of specific organisms, while the ecosystem assessment was broader, and focused on the diversity, function, dynamics, and spatial patterns of the late-successional and old-growth forest ecosystem. The ecosystem assessment focused on the primary producers of the late-successional ecosystem (i.e., the vegetation), and the processes and functions (i.e., physical, chemical, and biological, including disturbances) associated with the quantity, quality, and dynamics of those primary producers. The effects of the alternatives on late-successional forest ecosystems were evaluated in terms of degrees (Outcomes 1 through 4) of ecosystem quantity and quality (abundance, diversity, processes, functions and connectivity).

Assessment Process

The rating of late-successional ecosystems was based on three attributes that characterize the quantity and quality of components of the ecosystem. The attributes are described as follows:

1. Abundance and ecological diversity - the acreage and variety of plant communities and environments.

2. Processes and functions - the ecological actions that lead to the development and maintenance of the ecosystem, and the values of the ecosystem for species and populations.

3. Connectivity - the extent to which the landscape pattern of the ecosystem provides for biological flows that sustain animal and plant populations.

Abundance and Ecological Diversity

Abundance of late-successional and old-growth communities and ecosystems refers to the total acreage of forest that meets structural, functional, or minimum-age criteria, based on ecological conditions and definitions for each physiographic province. The standards that define forests are based on the extent of three stages of late-successional and old-growth forest. The three stages are the (1) maturation, (2) transition, and (3) shifting, small-gap stages of late-successional and old-growth forest development. A description of these forest development stages is included in Appendix B2, Ecological Principles for Management of Late-Successional Forests. In the central western Cascade Range, one or more of these three stages are typically found in stands over 80 years old. One measure of the ecological diversity of late-successional forest ecosystems is the occurrence of the full range of these late-successional and old-growth stages (as well as variants of these) that can develop following severe disturbance (for a full discussion see Appendix B2). Ecological diversity is also indicated by the distribution of late-successional and old-growth communities on the landscape, and the interrelationships among a variety of geographic, climatic, elevational, topographic, and soil distributions.

The four possible outcomes that characterize different levels of abundance and ecological diversity of late-successional and old-growth forest communities and ecosystems, analyzed in the ecosystem assessment, are shown in Table 3&4-5.

Table 3&4-5. Possible outcomes of the maintenance of abundance and ecological diversity of late-successional and old-growth ecosystems

Outcome 1:	Late-successional and old-growth ecosystem abundance and ecological diversity on federal lands is at least as high as the long-term average (see below for discussion) prior to logging and extensive fire suppression. Long term is defined as a period of at least 200 to 1,000 years, or the time over which the full potential range of late-successional and old-growth communities and ecosystems can develop following severe disturbance. Relatively large areas (e.g., 50,000 to 100,000 acres) would still contain levels of abundance and distribution of late-successional forests which are well below the regional average for long periods. However, within each physiographic province, abundance would be at least as high as province-level long-term averages, which might be higher or lower than the regional long-term average.
Outcome 2:	Late-successional and old-growth ecosystem abundance and ecological diversity on federal lands is less than the long-term average conditions (prior to logging and extensive fire suppression) but within the typical range of conditions that occurred during previous centuries. Abundance and distribution would be at least as high as the long-term average of the centurial-low values (see discussion in text). Ecological diversity is characterized by the presence of a wide range of late-successional stages. Distribution is characterized by presence in all physiographic provinces and elevations, but with larger gaps in distribution than in Outcome 1.
Outcome 3:	Late-successional and old-growth ecosystem abundance and ecological diversity on federal lands is considerably below the typical range of conditions that have occurred during the previous centuries, but some provinces are within the range of variability. The ecological diversity (age-class diversity) may be limited to just the younger stages of late-successional ecosystems. Late-successional and old-growth communities and ecosystems may be absent from some physiographic provinces or elevations within physiographic provinces and/or occur as scattered remnant patches within provinces.
Outcome 4:	Late-successional and old-growth ecosystems are very low in abundance and may be restricted to a few physiographic provinces or elevational bands or localities within provinces. Late-successional and old-growth communities and ecosystems are absent from most physiographic provinces or occur only as small remnant forest patches.

Long-Term Averages and Long-Term Average Lows

The long-term average regional abundance of late-successional and old-growth communities can only be approximated from a few local studies of fire history. Assuming that the average regional natural fire rotation was about 250 years for severe fires (those removing 70 percent or more of the basal area), then 60 to 70 percent of the forest area of the region was typically dominated by late-successional and old-growth forests, depending on the age at which "mature" forest conditions develop (assume a range of 80 to 100 years). Converting this range to a single number, 65 percent, provides an estimate of the long-term average percentage of the regional landscape covered by late-successional forest. This average percentage would certainly vary by physiographic province; for instance, moist, northerly provinces would have higher averages than drier provinces with higher fire frequencies.

The estimate of the natural fire rotation and average coverage of late-successional forest by the Assessment Team approximates values reported in the literature (Franklin and Spies 1984; USDI unpub.). The total percentage of late-successional and old-growth forest would apply to a wide range of patch sizes, from less than 1 acre, to hundreds of thousands of acres. Most of the total percentage (perhaps 80 percent or more) would probably have occurred as relatively large (greater than 1,000 acres) areas of connected forest.

The average of centurial-low coverage (average of the lows that occur in 100-year periods) by late-successional forest is defined as setting the lower limit of the "typical" range. There is no data from which to estimate the average low for the preceding millennium. Consequently, this value was estimated based on the subjective opinions of the ecosystem experts. The Forest Ecosystem Management Assessment Team hypothesized that the average of low amounts might be about 40 percent coverage by late-successional forests, with lower values expected for individual provinces.

Processes and Function

Processes refer to ecological changes or actions that lead to the development and maintenance of late-successional and old-growth ecosystems at all spatial and temporal scales. Examples include: (1) tree establishment, maturation, and death, (2) gap formation and filling, (3) understory development, (4) small and large-scale disturbances such as fire and wind, (5) decomposition, (6) nitrogen fixation, (7) canopy interception of energy and matter, and (8) energy and matter transfers between the forest and atmosphere.

Functions, as used in this assessment, refer to ecological values of the late-successional ecosystem or its components that (1) maintain or contribute to the maintenance of populations of species that use these ecosystems, and (2) contribute to the diversity and productivity of other ecosystems (such as the carryover of large dead trees to early-successional ecosystems, and storage of carbon in the global ecosystem). Examples of ecosystem functions include habitat for organisms, climatic buffering, soil development and maintenance of soil productivity through inputs of coarse woody debris, nitrogen fixation, spread of biotic and abiotic disturbance through landscapes, and nutrient cycles (production, storage, utilization, and decomposition).

The four possible outcomes that characterize different levels of ecological processes and function of late-successional and old-growth forest communities and ecosystems, analyzed in the ecosystem assessment, are shown in Table 3&4-6.

Connectivity

Connectivity is a measure of the extent to which the landscape pattern of the late-successional and old-growth ecosystem provides for biological and ecological flows that sustain late-successional and old-growth associated animal and plant species across the range of the northern spotted owl. Connectivity does not necessarily mean that late-successional and old-growth areas have to be physically joined in space, because many late-successional species can move (or be carried) across areas that are not in late-successional ecosystem conditions. Landscape features affecting connectivity of late-successional ecosystems are (1) distance between late-successional and old-growth areas and (2) forest conditions in areas between late-successional and old-growth areas.

Table 3&4-6. Possible outcomes of the maintenance of ecological processes and function of late-successional and old-growth ecosystems

Outcome 1:	The full range of natural disturbance and vegetative development processes and ecological functions are present at all spatial scales, from microsite to large landscapes.
Outcome 2:	Natural disturbance and vegetative development processes and ecological functions occur across a moderately wide range of scales but are limited at large landscape scales through fire suppression and limits in the availability of areas where late-successional ecosystems can develop.
Outcome 3:	Natural disturbance and vegetative development processes are limited in occurrence to stand and microsite scales. Many stands may be too small or not well developed enough to sustain the full range of ecological processes and functions associated with late-successional and old-growth ecosystems.
Outcome 4:	Natural disturbance and vegetative development processes associated with late-successional and old-growth ecosystems are extremely restricted or absent from most stands and landscapes. Most late-successional and old-growth stands are too small or not well developed enough to sustain the full range of processes and ecological functions associated with late-successional and old-growth ecosystems.

The four possible outcomes that characterize different levels of ecological connectivity of late-successional and old-growth forest communities and ecosystems, analyzed in the ecosystem assessment, are shown in Table 3&4-7. Four overall outcome descriptions for the ecosystem as a whole were obtained by combining the three individual attribute outcomes: (1) abundance and diversity of ecological communities, (2) the degree to which natural processes and functions are maintained or restored, and (3) the connectivity of habitats and ecological communities. The likelihoods of achieving overall outcomes were computed by averaging the likelihoods of individual attribute outcomes.

The assessment of maintenance of a functional and interconnected, late-successional forest ecosystem was not revised to reflect the changes described in Appendix B11, Standards and Guidelines Resulting From Additional Species Analysis and Changes to Alternative 9, because the changes to the outcomes as described in this assessment are expected to be relatively minor. Several of these mitigations, even individually, are likely to enhance the attributes of late-successional and old-growth forest ecosystems. Attributes (1) abundance and diversity, and (3) connectivity, are expected to be strengthened by the application of Riparian Reserve Scenario 1, by protecting additional old-growth forest fragments in the matrix, and by revisions in standards and guidelines in green tree and snag retention and distribution in the matrix. Attribute (2) natural processes and functions, is expected to be enhanced by green tree and snag retention revisions, as well as by coarse woody debris retention. None of the standards and guidelines described in Appendix B11 are expected to have any negative impacts on the outcomes of the ecosystem assessment. Therefore, the overall outcomes for the ecosystem are likely to improve at least slightly as a result of the additional standards and guidelines incorporated into Alternative 9, but are not reflected in the results of the assessment.

Effects of Alternatives on Terrestrial Ecosystems

Amounts of Late-Successional and Old-Growth Forests in Designated Areas

The alternatives are estimated to yield from 5.8 to 8.5 million acres of late-successional forests in the following land allocation categories: Congressionally Reserved Areas, Administratively Withdrawn Areas, Late-Successional Reserves, and Riparian Reserves (Table 3&4-8). This represents 69 to nearly 100 percent of the current late-successional and old-growth forests on federal lands, depending on the alternative (FEMAT Report, Table IV-10, pp. IV-56-65). The degree of protection varies by state, physiographic province and elevation; the highest percentages are protected in the State of Washington and the lowest percentages are protected in Oregon.

The proportion of late-successional forest located within the reserves varies among alternatives because the boundaries of the reserves vary by alternative. From 42 to 53 percent of Late-Successional Reserves would be covered by late-successional forests, depending on the alternative (Table 3&4-8). This illustrates that the Late-Successional Reserves were designated to encompass large areas containing a mixture of age classes. Alternative 1 proposes a higher percentage of late-successional forest in Late-Successional Reserves than the other alternatives because many of its reserves were created by delineating boundaries around small concentrations of late-successional forest (LS/OG3s of Johnson et al. 1991). The remaining area in the reserves is covered by

Table 3&4-7. Possible outcomes of the maintenance of connectivity of late-successional and old-growth ecosystems

Outcome 1:	Connectivity is very strong, characterized by relatively short distances (less than 6 miles on average) between late-successional and old-growth areas. Smaller patches of late-successional and old-growth forest frequently occur. Small patches consist of Riparian Reserves, green tree retention patches and individual lice and dead old-growth tree. The proportion of the landscape covered by late-successional and old-growth conditions of all patch sizes exceeds 6 percent, a threshold when many measures of connectivity increase rapidly. At regional scales, physiographic provinces are connected by the presence of landscapes containing areas of late-successional and old-growth forests.
Outcome 2:	Connectivity is strong, characterized by moderate distances (less than 12 miles on average) between large late-successional and old-growth areas. Smaller patches of late-successional forest occur as described in Outcome 1. At regional scales, physiographic provinces are connected by the presence of landscapes containing areas of late-successional and old-growth forest. The total proportion of landscape in late-successional and old-growth conditions, including smaller patches, is at least 5 percent, so that the late-successional condition is still the dominant cover type.
Outcome 3:	Connectivity is moderate, characterized by distance of 12 to 24 miles between large old-growth areas. There is limited occurrence of smaller patches of late-successional forest in the matrix. The late-successional forest is at least 25 percent of the landscape, and the matrix contains some smaller areas for dispersal habitat.
Outcome 4:	Connectivity is weak, characterized by wide distances (greater than 24 miles) between old-growth areas. There is a matrix in which late-successional and old-growth conditions occur as scattered remnants or are completely absent.

Table 3&4-8. Acreages and percentages of federal land allocations dominated by medium and large conifer forests

Alternative	Total Federal Lands	Congressionally Reserved Areas	Late-Successional Reserves	Administratively Withdrawn Areas	Riparian Reserves	Total Reserve[1]	Managed Late-Successional Areas	Adaptive Management Areas	Matrix
1	8,550,500 (35%)	2,471,800 (34%)	6,058,900 (53%)	0	7,300 (.4%)	8,538,000 (39%)	0	0	12,600 (.5%)
2	8,550,500 (35%)	2,471,800 (34%)	3,780,300 (42%)	426,100 (28%)	623,000 (29%)	7,301,200 (37%)	0	0	1,249,800 (28%)
3	8,550,500 (35%)	2,471,800 (34%)	3,182,100 (43%)	421,100 (28%)	611,100 (29%)	6,686,100 (37%)	642,600 (38%)	0	1,222,500 (28%)
4	8,550,500 (35%)	2,471,800 (34%)	3,462,200 (43%)	449,000 (27%)	853,800 (29%)	7,236,800 (36%)	88,300 (37%)	0	1,225,200 (29%)
5	8,550,500 (35%)	2,471,800 (34%)	2,782,800 (44%)	603,500 (29%)	843,800 (32%)	6,701,900 (36%)	143,500 (38%)	0	1,705,000 (30%)
6	8,550,500 (35%)	2,471,800 (34%)	3,214,400 (43%)	546,100 (30%)	763,000 (30%)	6,995,300 (37%)	0	0	1,554,700 (29%)
7	8,550,500 (35%)	2,471,800 (34%)	2,429,400 (45%)	686,700 (30%)	194,900 (31%)	5,782,800 (37%)	142,900 (38%)	0	2,625,200 (31%)
8	8,550,500 (35%)	2,471,800 (34%)	3,214,400 (43%)	546,100 (30%)	452,900 (30%)	6,685,200 (37%)	0	0	1,864,900 (30%)
9	8,550,500 (35%)	2,471,800 (34%)	3,149,800 (42%)	429,000 (29%)	773,400 (29%)	6,824,000 (36%)	40,100 (39%)	539,100 (35%)	1,147,000 (29%)
10	8,550,500 (35%)	2,471,800 (34%)	3,214,400 (43%)	546,100 (30%)	763,000 (30%)	6,995,300 (37%)	0	0	1,554,700 (29%)

[1] Total Reserve includes Congressionally Reserved Areas, Late-Successional Reserves, Administratively Withdrawn Areas and Riparian Reserves.

smaller, naturally regenerated conifers, conifer plantations, deciduous forests, younger successional stages following logging and natural disturbances, and nonforested areas. Under all alternatives, the Late-Successional Reserves have a higher percentage of late-successional forest than either federally managed lands as a whole or the matrix (Table 3&4-8) .

Projections of Forest Development in Late-Successional and Old-Growth Forests Over Time

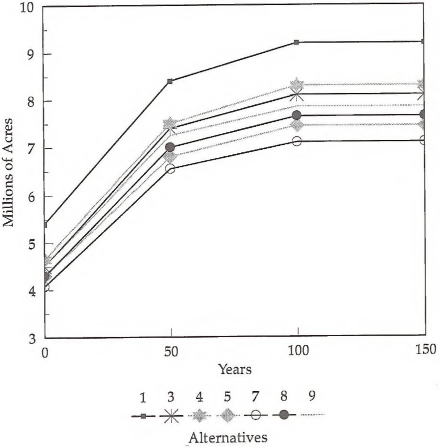
Forests of the Pacific Northwest within the range of the northern spotted owl are dynamic. The Forest Ecosystem Management Assessment Team attempted to project the development of younger, even-age forest into late-successional forest stands over the next 150 years. The proportion of late-successional forest in designated areas is expected to increase over time under all alternatives. The reserves under the proposed alternatives contain 47 to 58 percent of younger, natural forests and plantation forests. Over time, most of these areas will probably develop late-successional characteristics through stand development processes. Future amounts of late-successional and old-growth forest will depend on the frequency of large, severe disturbances and the occurrence of typical stand development processes. The Assessment Team was unable to model future amounts of late-successional forests in designated areas, except under a simple set of assumptions as described below.

A simulation of forest development in the reserves was conducted starting with current conditions estimated from satellite imagery classified for the Forest Service by Pacific Meridian Resources. The simulation was applied to the following land allocations in western Oregon and Washington: Congressionally Reserved Areas, Administratively Withdrawn Areas, and Late-Successional Reserves. The simulation was based on simple assumptions about the typical growth of trees from one forest cover size class into another, and did not include disturbance. It also did not take into account that many dense young plantations within the reserves would probably take longer to develop late-successional conditions, or perhaps not ever develop them. A disturbance correction was later applied to the growth output by assuming that 12.5 percent of the reserves would be subject to severe disturbance over 50 years. This translates to a 400-year natural disturbance rotation. The simulation assumed that partial fire suppression would occur, thus driving the natural disturbance rotation longer than the presettlement regional average of about 250 years. Under these assumptions, about 80 percent of the reserves on average would eventually be covered by forests older than 80 years (Figure 3&4-2).

Results of Assessing the Maintenance of a Functional and Interconnected, Late-Successional Forest Ecosystem

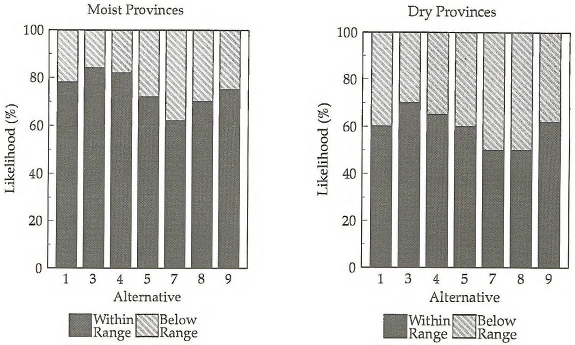
The effects of the alternatives on late-successional ecosystems were evaluated in terms of degrees (Outcomes 1 through 4) of ecosystem quantity and quality (abundance and diversity, processes and functions, and connectivity). The outcomes were characterized, in part, by how they compare to hypothesized long-term averages and typical ranges (for further information, see Methods for Assessing the Maintenance of a Functional and Interconnected, Late-Successional Forest Ecosystem earlier in this chapter). Long-term past conditions (the last 1,000 years) are not necessarily the best standard by which to evaluate future late-successional ecosystems. However, past conditions provide a reference point for current and future conditions, and to facilitate an understanding of the processes that lead to the development and maintenance of current late-successional ecosystems.

Figure 3&4-2. Projected acreage of late-successional forest (stands with dominant trees at least 21 inches in diameter) in Congressionally Reserved Areas, Administratively Withdrawn Areas and Late-Successional Reserves in Oregon and Washington over the next 150 years



During the next 100 years, none of the alternatives provides for a higher than 60 percent likelihood of reaching an outcome in which the quality and quantity of the overall late-successional ecosystem (as defined by the three attributes: abundance and ecological diversity, processes and function, and connectivity) would be at least as high as the hypothesized long-term average condition (Outcome 1). The Assessment Team concluded that a longer timeframe may be necessary for this change to occur. However, Alternatives 3 and 4 in moist provinces attained at least an 80 percent cumulative likelihood of reaching an outcome in which the quantity and quality of the overall late-successional ecosystem would fall within the hypothesized typical long-term range of conditions (Outcomes 1 and 2) (Figure 3&4-3, Table 3&4-9). The other alternatives had a 62 to 77 percent likelihood of reaching Outcomes 1 and 2 combined, in moist provinces. No alternative achieved an 80 percent or higher cumulative likelihood of reaching Outcome 2 or better in the dry provinces (Figure 3&4-3, Table 3&4-9).

Figure 3&4-3. Likelihood of achieving outcomes in which most attributes of the late-successional ecosystem fall within the typical range of variability (Outcomes 1 and 2) and in which most attributes of the late-successional ecosystem fall below the typical range of variability (Outcomes 3 and 4) by moist and dry provinces [1]



[1] For a description of climatic groups of provinces, see the Air Quality Analysis section later in this chapter and Figure 3&4-8.

Table 3&4-9. Likehood of achieving Outcomes 1 and 2 combined for different ecosystem attributes and average of attributes. Shaded numbers represent a likelihood of at least 80 percent. Attributes: A = abundance and diversity; P = process and function; C = connectivity

	Moist Provinces				Dry Provinces			
Alt.	A	P	C	Average	A	P	C	Average
1	86	52	92	77	66	34	76	59
3	92	71	90	85	75	53	78	69
4	93	62	90	82	75	46	76	65
5	80	59	80	73	69	47	66	60
7	66	50	68	62	64	41	51	52
8	69	59	74	68	64	38	53	51
9	76	75	80	77	69	53	66	63

On a more specific level, none of the alternatives achieved a likelihood of 80 percent or greater for Outcome 1 for any of the individual attributes (see the FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment). However, Alternatives 1, 3, 4, 5, and 9 had at least one attribute that had an 80 percent or greater cumulative likelihood of achieving Outcomes 1 and 2 combined (Table 3&4-9). For the processes and function attribute, none of the alternatives achieved an 80 percent or greater cumulative likelihood for Outcomes 1 and 2 combined (Table 3&4-9). This is primarily because Outcomes 1 and 2 under this attribute describe a condition in which larger scale landscape disturbance processes such as fire follow long-term natural behavior, which is unlikely. In the dry provinces, no alternative achieved an 80 percent or greater likelihood for Outcomes 1 and 2 combined for any attribute (Table 3&4-9). In the moist provinces, Alternatives 3, 4, and 9 achieved a 62 to 93 percent cumulative likelihood rating for Outcomes 1 and 2 combined under all three attributes (Table 3&4-9). In the dry provinces, no alternatives achieved a 60 percent or greater likelihood rating for Outcomes 1 and 2 under all attributes (Table 3&4-9).

The results indicate that none of the alternatives had a 60 percent or greater likelihood of producing a late-successional and old-growth ecosystem with attributes that approximate at least long-term average conditions (Outcome 1) over a timeframe of 100 years. This occurs primarily because 100 years is not long enough for cutover landscapes to return to late-successional conditions that approximate prelogging conditions. Many late-successional attributes require 200 to 500 years to develop. In addition, many larger scale disturbance processes, such as severe wildfires, will probably not occur under any of the alternatives, at least not to the extent that they would in an environment that was not influenced by humans.

Some alternatives have an 80 percent or greater cumulative likelihood of achieving an overall ecosystem condition at 100 years that is hypothesized to fall within the typical range of conditions that have occurred over previous centuries (Outcomes 1 and 2 combined). This does not mean, however, that all attributes and stands would meet this condition. Many young forest plantations within reserves are not developing along typical pathways, and fire suppression has and will alter stand and landscape-level processes that are typical in these ecosystems. In general, high rates of logging, forest plantations, fire suppression, ownership patterns, and human population and environmental influences have altered the regional ecosystem on federal lands to the extent that none of the alternatives can provide for a return to conditions that closely match those of previous centuries. Also, it is not expected that all ecosystem processes, such as wildfire, will be allowed to perform their natural functions across the landscape. Site conditions across all landscapes will not return to their presettlement conditions within the next 100 years. However, all of the alternatives reverse the pattern of timber harvest on federal lands over the last 50 years, which, if continued, would have resulted in a steep decline in the quantity and quality of the late-successional ecosystem, and its eventual loss in many federal planning areas.

Some of the alternatives provide greater likelihoods than others of maintaining and enhancing the late-successional ecosystem at levels that approach typical long-term conditions. Alternatives 1, 3, 4, and 9 received the highest ratings

(Figure 3&4-3). Alternatives 3 and 4 provide for relatively high amounts of late-successional forest and strong connectivity through the presence of Riparian Reserves and retention of old-growth components in managed matrix. Alternatives 3 and 4 also provide relatively high acreage of low elevation (sea level to 4000 feet) late-successional ecosystems, which are relatively rare throughout the region (see the FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment). Although Alternative 1 provides for the highest acreage of Late-Successional Reserves, it did not achieve an 80 percent or greater likelihood because it lacks restoration by silvicultural treatments in the reserves. The Assessment Team asserted that without restoration silviculture, late-successional conditions would be retarded in development. Alternative 9 achieved a 60 to 80 percent or greater likelihood rating for the overall ecosystem for Outcomes 1 and 2 combined in moist and dry provinces (Table 3&4-9). Alternative 9 might have achieved a higher overall rating if it provided for more acreage of late-successional ecosystems in the low elevations in Oregon. The Assessment Team stated that the opportunities to enhance knowledge about ecosystem function and management in the Adaptive Management Areas of Alternative 9 actually increased the likelihood that this alternative would provide late-successional characteristics in the future.

Other reasons for not achieving 80 percent or greater likelihoods for Outcome 1 alone, or Outcomes 1 and 2 combined, as well as possible mitigation measures to address these issues include:

Inherent Dynamics of the Ecosystems and Environment

The probabilities of large-scale disturbances and other environmental changes during the next 100 years are high. The forests within the range of the northern spotted owl have historically been subjected to large fires and, in coastal areas, to wind disturbances that could substantially reduce the area and character of late-successional and old-growth forest ecosystems in Late-Successional Reserves. Although fire suppression will continue to be practiced, it may not be sufficient to prevent loss of large portions of late-successional and old-growth forests. The risk of large scale change in Late-Successional Reserves is particularly high in the Washington and Oregon Eastern Cascade Provinces, the California Cascades Province, and drier portions of the Oregon and California Klamath Provinces. The higher risk of large scale change in these provinces is the primary reason why none of the alternatives achieved an 80 percent or greater cumulative likelihood of Outcomes 1 and 2 combined, in the Eastern Cascades and Klamath Provinces (Table 3&4-9). Additionally, climate change is projected by many climatologists to occur as a result of increasing carbon dioxide levels in the atmosphere during the next century (see Effects of the Alternatives on Global Climate Change later in this chapter). Climate change and disturbances such as fire and wind could have widespread direct and indirect effects on ecosystem processes, functions, and stability (Franklin et al. 1991).

Possible Mitigation Measures to Address Inherent Dynamics of the Ecosystem and Environment

Eastern Cascades and Klamath Provinces:
Use active fire and fuels management, including thinning and prescribed fire, to reduce risk of large scale loss of late-successional and old-growth forests and restore fire-dependent types of old-growth species. Manage the entire federal land base to achieve late-successional and old-growth objectives at a landscape scale rather than at the restricted scale of designated reserves (Swanson et al. 1993). Allow for more dynamic and less stable levels of late-successional and old-growth habitat to reflect the dynamic character of the landscape. These mitigation measures could increase the ratings for Outcomes 1 and 2 combined to at least 60 to 79 percent.

Effects of Land-Use History and Ownership Patterns

Past management practices, current ownership patterns, and land-use objectives contribute to the relatively low likelihood for Outcome 1. Given the nature of the disturbance regime and the possibility of climate change, none of the alternatives provides broad latitude for large scale change. Federally managed lands alone may be adequate in area to maintain late-successional ecosystems in the face of large scale change. From a regional perspective, the current area and diversity of late-successional and old-growth forest ecosystems has been reduced to less than 20 percent of the landscape (public and private land). Some late-successional and old-growth forest types, such as fire-dependent ponderosa pine, have been reduced to a small fraction of historical levels. Some community and ecosystem types in low elevations and valley margins have been totally lost. Stand-level management practices that have created dense young plantations within the proposed reserves have altered the typical pathways by which stands develop into old growth. Artificially created, overly dense, young plantations may not develop late-successional conditions such as multiple canopy layers for long periods. In addition, plantations may be more susceptible to insect, disease, and fire disturbances that could threaten existing late-successional forests within reserves. Without silvicultural practices to correct or restore stand development conditions in plantations, current and future late-successional ecosystems are at a relatively high risk of loss or inadequate development. This is the primary reason why Alternative 1, which reserves the largest area for late-successional forest, did not achieve an 80 percent or greater cumulative likelihood rating for Outcomes 1 and 2 combined (Table 3&4-9). The Assessment Team stated that the absence of restoration silviculture in reserves under Alternative 1 reduces the likelihood of achieving Outcomes 1 and 2 combined, to below 80 percent.

Possible Mitigation Measures to Address Land-Use History and Ownership Pattern Effects

Moist Provinces:
Promote management for late-successional and old-growth ecosystems or components of late-successional and old-growth ecosystems on state and private lands in provinces where federal lands occupy a small percentage of the land base, such as the California and Oregon Coast Range Provinces, and in areas where private and federal lands are interspersed in a checkerboard pattern. State lands in southwest Washington and the northern Oregon Coast Range offer significant opportunities to fill gaps in the regional late-successional ecosystem. Careful application of restoration silviculture in young plantations to promote development of late-successional and old-growth forests would probably improve the rating of Alternative 1 to at least an 80 percent cumulative likelihood of reaching Outcomes 1 and 2 combined.

Eastern Cascades and Klamath Provinces:
Past history of fire exclusion through active fire suppression has altered ecosystem structure and function, and resulted in a loss of fire-dependent ecosystem communities, such as ponderosa pine. Reintroducing fire or a suitable substitute, such as thinning and reducing fuels, could mitigate this loss.

Lack of Scientific Information

The relatively low likelihood ratings for Outcomes 1 and 2 combined for most alternatives reflect, in part, lack of information about: processes and functions of late-successional and old-growth ecosystems; the nature, role, and importance of landscape-level ecological processes including disturbance; the role and relationship of species diversity and ecosystem functions such as productivity, nutrient cycling, and decomposition; and the effects of climate change. In addition, scientific uncertainty led to differences in opinions among panel members about particular outcomes and resulted in reduced likelihood scores for all outcomes under all alternatives.

POSSIBLE MITIGATION MEASURES TO ADDRESS LACK OF SCIENTIFIC INFORMATION

All provinces:
Continue to increase the number of basic studies of ecosystem structure, function, and dynamics at multiple spatial and temporal scales (e.g. Swanson et al. 1993). Conduct monitoring and long-term studies of processes associated with late-successional and old-growth and related ecosystems. Additional information from these studies might either increase or decrease the ratings of future ecosystem assessments, and support changes to standards and guidelines that would increase the probability of meeting ecological and resource objectives.

General Mitigation Measures

Modifications to standards and guidelines in the context of adaptive management may be considered. These may result from watershed/landscape-level and province-level analysis, and from analysis preceding preparation of Late-Successional Reserve plans, and will be subject to NEPA requirements. Standards and guidelines added to the Final SEIS are included in Appendix B11, Standards and Guidelines Resulting From Additional Species Analysis and Changes in Alternative 9.

A few examples of the standards and guidelines that have broad-ranging benefits are described here. These standards and guidelines will benefit a much larger range of species than those for which they were designed. Green trees that are retained in harvest units in the matrix can be left in patches rather than as dispersed individuals. These patches serve as connectivity for some species, and as refugia for other species. Some large snags and green trees can also be well distributed throughout the matrix. Diversity of tree structure can be considered when leave trees are selected.

Standards and guidelines that benefit arthropods, fungi, and plants may include providing a full spectrum of species and sizes of trees for retention as coarse woody debris in the matrix. While this promotes species diversity among all of these organisms, it is especially important for those that are host or substrate specific.

Application of Riparian Reserve Scenario 1 in the intermittent streams would benefit a wide variety of terrestrial and aquatic species by providing additional habitat. These species include the northern spotted owl, coho salmon, amphibians, small mammals, and some vascular plants. Connectivity of the ecosystem would also be improved.

Past land use and forestry practices have altered the condition of stands and landscapes within the proposed reserves. As much as 40 percent of the Late-Successional Reserves currently in young plantations were established for timber production. Typically, the plantations are densely stocked with young Douglas-fir trees, and are unlikely to follow natural stand development pathways toward late-successional conditions. Consequently, late-successional forest development in these plantations may be retarded or may not occur at all. In addition, young plantations often increase the occurrence of human-caused wildfires, as well as increase the rate of spread and extent of fire and other disturbances across landscapes. The presence of young plantations in Late-Successional Reserves, thus, may increase the risk of loss of intermingled late-successional forests. This is especially true in the high elevations of the Cascade Range and dry parts of the California and Oregon Klamath Provinces, where fire suppression has led to the development of dense understories of shade-tolerant species that increase the potential for severe fire impacts in the reserves. For further information, see Appendix B2, Ecological Principles for Management of Late-Successional Forests, and Appendix B5, Recovery Plan Standards and Guidelines.

Large areas of very dense undercanopy vegetation are not optimum spotted owl habitat; are often at high risk of large, severe fires; are not natural to forest ecosystems within the planning area; and are often an indication of poor ecosystem health. The Final Draft Spotted Owl Recovery Plan (USDI unpub.) states that the risks of inaction outweigh the risks associated with restoration silviculture activities in the Late-Successional Reserves, especially in the drier physiographic provinces. Standards and guidelines in this Final SEIS provide for the retention of coarse woody debris in the reserves, as well as in all other land allocations. A fire management standard and guideline section has been added to this Final SEIS as Appendix B8.

Given past land use activities in the reserves, and their potential impact on natural processes, restoration activities may be needed to maintain and enhance late-successional ecosystem processes. Restoration could include activities such as thinning, cutting to create canopy gaps (to reduce the density of young stands), underplanting of conifers to reintroduce natural species compositions, increase structural and compositional heterogeneity of stands, and reduce the risk of severe fire. Roads could be removed or blocked to reduce the negative impacts of their use on the ecosystem. Roads are human-caused disturbances which may alter hydrologic processes, facilitate the spread of nonnative organisms, and increase the level of further human activity on the landscape, including the incidence of human-caused fire.

Effects of Alternatives on Global Change

Global change is anticipated during the 21st century; however, there is scientific uncertainty about the rates and magnitudes of changes, as well as the ecological and social implications of these changes (Solomon and Cramer 1993). Global climatic warming is only one of the anticipated changes. Another anticipated change is a shift in precipitation patterns. A report of the Intergovernmental Panel on Climate Change states that temperature increases could range from 1 to 5 degrees celsius by the year 2100 (Schneider 1991). The primary factor leading to the expected global climate warming is the substantial increase in atmospheric carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, and other trace gases attributed to human activities.

Proposed land management activities in the planning area would primarily affect the quantity of carbon dioxide released to the atmosphere. However, effects under any alternative would result in only a very slight increase in global atmospheric carbon dioxide levels.

The effect of timber harvest and forest regrowth on the amount of carbon dioxide in the atmosphere is a primary concern because carbon is stored by trees and by coarse woody debris in the forest ecosystem which, therefore, acts as a carbon "sink." Forests, however, store different amounts of carbon depending on a number of factors. For instance, one analysis shows forests managed on rotations less than 100 years would store less than half the amount of carbon stored in old-growth stands (Harmon et al. 1990). Analysis indicates that about 42 percent of timber harvested in the northwestern United States enters long-term storage in products (Harmon et al. 1990). One factor that would complicate a detailed analysis of carbon storage is the substitution of wood products from forests outside the northwestern United States.

It is estimated that every 1 million acres of old-growth forest harvested in the northwestern United States would add less than 0.1 percent to the total carbon currently in the global atmosphere (Harmon et al. 1990). Although young, fast-growing trees store less carbon in total, they are expected to absorb more carbon from the atmosphere than older trees (Schneider 1989). Fertilization and vegetation management enhance this effect by increasing tree growth rates, however, the benefits may be offset by their release of carbon dioxide. The uptake of carbon dioxide by forest stands offsets the release from decomposition when a stand reaches the stage of canopy closure (Alaback 1989). In mature and old-growth stands, release and absorption of carbon dioxide tend to be in balance.

Logging, especially clearcutting, releases carbon dioxide through decomposition of coarse woody debris on the forest floor. This is accelerated by slash burning after logging. Slash burning can create up 1.5 tons of carbon dioxide per ton of fuel consumed by combining carbon with oxygen in the combustion process. Half of the released carbon dioxide would remain in the atmosphere (Schneider 1989); the rest would be reabsorbed into oceans and vegetation. Wildfires have effects similar to logging, but over a shorter period of time.

Harvest of old-growth forests and prescribed burning would have an adverse effect on the global atmospheric carbon dioxide balance. However, under each of the alternatives, the cumulative effect on the earth's climate would be very slight. Harvest methods have shifted from clearcutting to include greater retention of green trees, snags, and other coarse woody debris. Under any of the alternatives, there would not be more than approximately 100,000 acres of forest harvested per year, including areas not in old-growth condition. Based on the area subject to timber harvest, Alternative 7 would have the largest effect on the global atmospheric carbon balance, and Alternative 1 would have the least effect. The overall impact on the global atmospheric carbon dioxide balance would be much less than 0.01 percent of the total, even under Alternative 7, the alternative with the greatest potential impact.

Large areas, especially in the dry provinces, have marked accumulations of fuels, and dense fire-prone understories. An analysis using a forest development model predicts that temperature changes alone would not change the ability of forests in the Pacific Northwest to store carbon (Dale and Franklin 1989). However, changes in precipitation patterns and the resultant changes in insect and fire disturbance regimes were not included in that analysis. Fire suppression delays the release of stored carbon dioxide, but large, high intensity wildfires will eventually occur across many landscapes in the drier provinces. The restoration silviculture permitted under Alternatives 3 and 9 (see The Alternatives section in Chapter 2; Appendix B2, Ecological Principles for Management of Late-Successional Forests; and Appendix B5, Recovery Plan Standards and Guidelines), including prescribed underburning, may reduce forest susceptibility to large, stand-replacing fires. Thinning of small diameter trees in Late-Successional Reserves will accelerate the carbon dioxide absorption of the younger forest stands. Watershed/landscape-level emission trade-off analyses, as described in the following Air Quality Analysis, can determine an optimal level of fuel treatment to reduce carbon dioxide emissions. Thus, it is likely that Alternatives 3 and 9 would have the least impact on the global carbon dioxide balance in spite of having larger harvest levels than some of the other alternatives.

Aquatic Ecosystems

Current Aquatic Conditions

There are thousands of miles of rivers and streams within the range of the northern spotted owl and aquatic ecosystems within this area vary greatly. They comprise large river systems such as the Skagit, Rogue, and Klamath Rivers; small headwater streams originating from glaciers in the Cascade Range; coastal rain-influenced streams; many lakes and ponds; and wetlands associated with rivers, streams, lakes, ponds, seeps, and springs. The aquatic ecosystems differ based on past disturbances, topography, geomorphology, latitude, elevation, and physiographic province, as well as local geologic, hydrologic, and climatic factors.

The diversity of aquatic ecosystems within the range of the northern spotted owl supports an abundant and diverse flora and fauna. Many areas contain endemic populations of plants or animals, some of which are limited to specific springs, wetlands or stream segments.

The aquatic conditions of the Pacific Northwest provide suitable habitat for salmonids, in particular anadromous salmonids. Anadromous salmonids occur throughout the range of the northern spotted owl and occupy a diversity of aquatic habitat types from headwater streams to large rivers.

A fully functioning aquatic ecosystem is characterized by diverse and complex habitats. These consist of floodplains, banks, riparian vegetation linked to surface and subsurface water, channel structure such as pools and riffles, water columns, and subsurface waters nested within a watershed. These characteristics are created as a result of the flow of water over rocks and coarse woody debris, and the interaction of the water with the floodplain. Sediment and coarse woody debris are supplied from upslope areas as well as from disturbances such as landslides and floods. Stream systems depend on disturbances to maintain and create a diversity of habitat characteristics. To maintain aquatic community viability throughout a large basin, it is necessary to maintain features of the natural disturbance patterns. The frequency, duration and magnitude of natural disturbances contribute to the maintenance of a diversity of species, populations and communities that may be uniquely adapted to these specific structures and processes.

Aquatic ecosystems within the range of the northern spotted owl show signs of degradation and ecological stress. Recent studies report the loss of natural complexities of habitat in streams. The 1993 assessment of westside Cascade streams on lands administered by the Forest Service in Oregon and Washington generally showed that the number of pools per mile and the length of stream riparian area in a late-successional forested condition was below the estimated historical natural range for these variables (USDA FS 1993a). Habitat degradation to streams and floodplains have occurred for longer periods of time in the lower elevations, particularly along larger rivers. Filling wetlands in floodplains for roads, campgrounds and other facilities and channelization of rivers and streams for flood control and transportation systems have been a major cause of habitat degradation, especially in the lower elevations. Approximately 55 percent of the 27,700 stream miles examined throughout the State of Oregon are either severely or moderately impacted by nonpoint source pollution (see the section on Water Quality later in this chapter) (Edwards et al. 1992). Nonpoint source pollution problems include siltation and increased water temperatures. The degradation of aquatic and riparian habitats is one of the reasons for the decline of some native freshwater and anadromous fish species and stocks, many of which now require special management considerations (Nehlsen et al. 1991).

The Oregon Department of Environmental Quality 1988 water quality assessment evaluated about 24,000 miles of the 100,000 miles of the perennial streams throughout Oregon. About 2,100 miles of the 24,000 miles of streams evaluated occur on federal lands within the range of the northern spotted owl in Oregon (Oregon Dept. of Env. Quality 1992). Ninety percent or 1,900 stream miles of streams examined on federal lands within the range of the northern spotted owl in Oregon are moderately or severely impaired. "Impaired" signifies impacts on beneficial uses such as habitat for fish and is often due to increases in water temperature and sedimentation.

Large river basins are a mosaic of terrestrial "patches" and smaller watersheds linked by stream, riparian, and subsurface networks. These networks are critical to aquatic ecosystem function. Within basins, links among headwater tributaries and downstream channels are important paths for water, sediment, and disturbances. Links among floodplains, surface water, and ground water systems (hyporheic zones) act as exchange areas for water, sediment and nutrients. Aquatic and riparian-dependent species require unobstructed physical and chemical paths, and connections among basins to allow for movement between refugia.

Healthy watersheds and high quality fish habitat require maintaining the connectivity of all parts of the aquatic ecosystem. First and second-order streams, which generally include permanently-flowing nonfish-bearing streams and seasonally-flowing or intermittent streams, often comprise over 70 percent of the cumulative channel length in mountain watersheds in the Pacific Northwest. These streams are sources of water, nutrients, wood, and other vegetative material for streams inhabited by fish and other aquatic organisms. The loss of this stream network can result in the disruption and loss of functions and processes necessary for creating and maintaining habitat required by fish, amphibians, and other riparian and aquatic-dependent plants and animals.

Wetlands and riparian areas are often treated as synonymous in general discussions, and indeed their position in the landscape, interposed between aquatic and upland ecosystems, is frequently similar and overlapping. However, many riparian areas do not meet currently accepted technical criteria for wetlands, nor are they inventoried as wetlands under projects such as the National Wetland Inventory of the Fish and Wildlife Service.

The combination of hydrology, soils, and vegetative characteristics are the primary factors influencing the development of wetland habitats. There must be the presence of surface water or saturated soils to significantly reduce the oxygen content in the soils to zero or near zero concentrations. These low or zero soil oxygen conditions must persist for sufficient duration to promote development of plant communities that have a dominance of species adapted to survive and grow under these conditions. These wetland characteristics apply when defining wetlands for regulatory jurisdiction (Dept. of the Army 1987) or for technical analysis when conducting inventories or functional assessments.

Wetlands within the range of the northern spotted owl vary considerably in size, form and distribution on the landscape. Wetlands can be large open wet meadows and bogs; seasonally inundated floodplains; narrow seasonally-flooded areas associated with lakes, ponds, and reservoirs; and small seeps and springs. Vegetated wetlands within the range of the northern spotted owl represent a small portion of the landscape, perhaps as little as 1 percent. Presence of narrow linear wetlands associated with small streams would increase this somewhat. This small segment of the landscape provides habitat requirements for a disproportionately large number of plant and animal species, some of which are unique to specific wetland types (e.g., plant and animal species associated with peat systems). Wetlands protect water quality and mediate stream flows in addition to supporting a disproportionately large number of plant and animal species.

The significance of these wetlands is heightened by their relative rarity in a pristine state. In Washington, over one-third of the state's wetlands have been lost (Dahl 1990) and 90 percent of the remaining wetlands are in a degraded condition (Wash. Dept. of Wildlife 1992). Incidence of wetland loss and degradation is much greater in floodplains at low elevations, particularly in urban areas. Thus, the forests not only provide habitat for the northern spotted owl but also function as reservoirs of intact wetlands. Some of these are older wetlands dominated by western red cedar or Sitka spruce and specialized wetlands that are several thousand years old.

Habitat Components

A primary factor influencing the diversity of stream biota, in particular fish communities, is habitat complexity. Diverse aquatic habitats include a variety and range of conditions such as water depths and velocities, water quantity, the size of wood, the type and relative composition of habitat, and the variety of substrates. More diverse aquatic habitats support more diverse aquatic communities. Habitat diversity can also mediate competition and predation among species.

The loss of habitat complexity may result from timber harvest activities. Reduction of the amount of wood in a channel, either from present or past activities, generally reduces pool quantity and quality. Constricting naturally unconfined channels with bridge approaches or streamside roads reduces stream meandering and changes the frequency and magnitude of overbank flows in riparian areas. This alteration in the natural interaction between stream and riparian areas decreases the number and size of pools formed by stream meanders and undercut banks, and decreases the amount and distribution of off-channel habitat. In Pacific Northwest streams, habitat simplification resulting from timber harvest and associated activities has led to a decrease in the distribution and diversity of the anadromous salmonid complex.

Hydrology

The cause of changes in hydrologic processes can be grouped into two classes. One class consists of changes resulting from removal of forest vegetation. Natural disturbances such as fire and wind events and management related disturbances such as timber harvest thinning stands remove vegetation. The effects of timber harvest to hydrology are sometimes substantial in the watersheds containing the harvest area, and are most evident immediately following harvest. The effects on hydrology from natural or management related causes, in part, depend on the area where vegetation was removed, the quantity of original vegetation removed, the location in a watershed, and the distribution of the devegetated areas within a watershed. Timber harvest tends to create a number of openings throughout a watershed and compounds the effects to the hydrology. The changes to hydrology gradually diminish over time as vegetation returns. Natural processes such as rain or snow interception, fog drip, transpiration, and snow accumulation and melt depend on the amount and size of forest vegetation. These processes increase the quantity and frequency of water arriving at the soil surface, and subsequently, the amount of water flowing from a watershed that has been harvested. The duration of changes in these processes brought about by timber harvest is generally three to four decades and is related to vegetation characteristics such as tree height, leaf area, canopy density, and canopy closure.

A second class of changes in hydrologic processes consists of those that control infiltration and the flow of surface and subsurface water. This class is dominated by the effects of forest roads. Federal lands within the range of the northern spotted owl contain approximately 110,000 miles of road (Table 3&4-10). Table 3&4-10 does not include road mileages from the portions of the Lassen and Modoc National Forests within the range of the northern spotted owl. The amount would be minimal because of the small amount of area within the Forests that occurs with the range of the northern spotted owl. This extensive network has the potential to significantly affect the hydrology of many streams within this range. The relatively impermeable surfaces of roads cause surface runoff that bypasses longer, slower subsurface flow routes. Where roads are insloped to a ditch, the ditch extends the drainage network, collects surface water from the road surface and subsurface water intercepted by roadcuts, and transports this water quickly to streams. The duration of changes in hydrologic processes resulting from forest roads is as permanent as the road. Until a road is removed and natural drainage patterns are restored, the road will likely continue to affect the routing of water through watersheds. To a lesser extent, skid trails affect the hydrology in a similar manner if soil compaction is extensive.

In watersheds varying in size from 20 to 200 square miles, increased peak flows have been detected after road building and clearcutting. Higher flows result from a combination of wetter, more efficient water-transporting soils following reduced evapotranspiration, increased snow accumulation and subsequent snowmelt during rainfall, surface runoff from roads, the extension of drainage networks as a result of roadside ditches, and possibly the loss of habitat complexity due to debris removal and salvage logging in riparian areas. Changes to the hydrology can have positive and negative effects. Many of the negative effects are discussed above. The extent to which positive effects of short-term increase in summer flows are offset by the detrimental effects of increased peak flows and resultant scour is unknown.

Water Quality

For aquatic and riparian communities, high water quality is essential for the survival, growth, reproduction, and migration of species. Water temperatures need to be within a range that corresponds to the migration and emergence needs of fish and other aquatic organisms. Most stream organisms, such as fish, amphibians and insects, do not regulate their body temperatures. Within the range of the northern spotted owl most of these organisms require an abundance of cool (generally less than 68ºF), well-oxygenated water year-

Table 3&4-10. Summary of road development on lands administered by the Forest Service and BLM within the range of the northern spotted owl

National Forest or BLM District	Total Road Miles	ML 1[1] Miles	ML 1 %	ML 2[2] Miles	ML 2 %	Public[3] Road Miles	Public Road %	Native[4] Surface Miles	Native Surface %	Gross Area minus Wilderness (sq. mi.)	Net Roaded Area[5] (sq. mi.)	% of Non-Wilderness in Roadless	Road Density (mi./sq. mi.)
Deschutes NF	8,722	469	5	7,535	86	718	8	7,009	80	2,179	2,009	8	4.34
Mt. Hood NF	3,818	443	12	2,236	59	1,139	30	845	22	1,428	1,211	15	3.15
Rogue River NF	2,782	90	3	1,830	66	862	31	1,055	38	837	711	15	3.92
Siskiyou NF	2,949	300	10	2,092	71	557	19	689	23	1,343	899	33	3.28
Siuslaw NF	2,540	220	9	1,625	64	695	27	115	5	910	868	5	2.92
Umpqua NF	4,880	1,276	26	2,447	50	1,157	24	1,132	23	1,498	1,325	12	3.68
Willamette NF	6,424	700	11	3,757	58	1,967	0	380	6	2,023	1,768	13	3.63
Winema NF	6,221	1,848	30	3,111	50	1,262	20	5,374	86	1,488	1,451	2	4.29
Coos Bay BLM	1,924										511		3.76
Medford BLM	5,628										1,436		3.92
Eugene BLM	19,35										492		3.94
Roseburg BLM	2,924	Road maintenance level and surfacing data not available for lands administered by the BLM									655		4.46
Salem BLM	2,636										622		4.23
Arcata BLM	135										277		0.49
Redding BLM	350										387		0.90
Gifford Pinchot NF	4,341	569	13	2,777	64	995	23	719	17	1,861	1,525	18	2.85
Mt. Baker-Snoqualmie NF	2,988	615	21	968	32	1,405	47	94	3	1,565	934	40	3.20
Okanogan NF	2,665	477	18	1,158	43	1,030	39	1,615	61	1,688	1,226	27	2.17
Olympic NF	2,463	556	23	1,207	49	701	28	1,446	59	872	738	15	3.34
Wenatchee NF	5,069	840	17	3,214	63	1,015	20	3,362	66	2,067	1,198	42	4.23
Klamath NF	4,656	895	19	2,478	53	1,284	28	3,295	71	1,477	1,100	26	4.23

Table 3&4-10. (continued)

National Forest or BLM District	Total Road Miles	ML 1[1] Miles	ML 1 %	ML 2[2] Miles	ML 2 %	Public[3] Road Miles	Public Road %	Native[4] Surface Miles	Native Surface %	Gross Area minus Wilderness (sq. mi.)	Net Roaded Area[5] (sq. mi.)	% of Non-Wilderness in Roadless	Road Density (mi./sq. mi.)
Shasta-Trinity NF	6,528	981	15	3,914	69	1,633	25	4,939	76	2,690	2,255	16	2.89
Mendocino NF	2,486	619	25	1,402	56	465	19	2,422	97	1,477	1,255	16	1.10
Six Rivers NF	2,489	648	26	1,192	48	649	26	0	0	1,304	1,085	17	2.29
Totals	**87,554**	**11,547**	**13**	**42,941**	**49**	**17,534**	**20**	**34,491**	**39**	**26,707**	**25,940**		**3.38**
adjusted by 1.25[6]	109,443												4.22

[1] ML 1 = Maintenance Level 1 are roads that are closed but still considered part of the transportation system.
[2] ML 2 = Maintenance Level 2 are roads that are suitable for high-clearance vehicles only.
[3] Public Road refers to roads that are designed and maintained for normal-clearance vehicles (Forest Service Maintenance Levels 3, 4 and 5).
[4] Native refers to roads with crushed rock or composted soils.
[5] Derived by subtracting Inventoried Roadless Area acreage from gross acreage without Wilderness.
[6] Estimated adjustment for nonsystem roads.

round that is free of excessive amounts of suspended sediments and other pollutants that could limit species production and abundance. High water temperatures increase the metabolic rate of cold blooded organisms such as fish, amphibians and insects, causing increased stress. Higher temperatures also lead to reduced oxygen in the water which, together with higher metabolic rates, can increase disease and mortality. Chronic high or low temperatures approaching the upper and lower lethal limits of tolerance are detrimental to the growth, survival, and reproduction of these cold blooded organisms.

Increased levels of sedimentation often have adverse effects on fish habitats and riparian ecosystems. Fine sediment deposited in spawning gravels can reduce the survival of eggs and developing alevins. Primary production, production of invertebrates (e.g., insects, snails, worms) in the stream substrate, and subsequent food availability for fish, amphibians, birds, and mammals may be reduced as sediment levels increase. Increased levels of sediment can also disrupt social interactions of fish and their feeding behavior, and may cause the loss of pools.

Aquatic insects such as mayflies stoneflies, caddisflies and midges are important sources of food for most fish; amphibians; birds such as water ouzels, swallows, and Harlequin ducks; and bats. The aquatic environment's ability to support the animals that principally prey on the insects is, in part, directly related to the diversity and abundance of these organisms. The diversity and abundance of aquatic insects can be adversely affected by increases in stream sedimentation and losses of organic material. Many insects live in the streambed and in the substrate under the floodplain where water flows (the hyporheic zone). These insects thrive in a maze of underground channels that flow among the gravels, sands, and rocks that underlie many streams, rivers and floodplains.

Accelerated rates of erosion and sedimentation are a consequence of many forest management activities. Road networks in many upland areas of the Pacific Northwest are the primary sources of management-accelerated sediment delivery to anadromous fish habitat. Sedimentation from this source is often much greater than from all other land management activities combined, including log skidding and yarding. Large storms can result in road-related landslides, surface erosion and stream channel diversion. Storms deliver large quantities of sediment to streams, both chronically and catastrophically. Roads have unavoidable effects on streams no matter how well they are designed, located or maintained. Many older roads with poor locations and inadequate drainage pose higher risks to erosion and sedimentation of stream habitats. The effects of roads on streams can be minimized by the design, location, construction technique employed and the intensity of road maintenance.

As discussed above, there are 110,000 miles of roads on federal lands within the range of the northern spotted owl (Table 3&4-10). Table 3&4-10 does not include road mileages from the portions of the Lassen and Modoc National Forests within the range of the northern spotted owl. The amount would be minimal because of the small amount of area within the Forests that occurs within the range of the northern spotted owl. Much of this network constitutes current and potential sources of damage to riparian and aquatic habitats, mostly through sedimentation.

Roads modify natural hillslope networks, accelerate the erosion process, and possibly lead to changes in streamflow patterns and substrate composition, the configuration of channel banks and beds, and the stability of slopes located adjacent to streams. These changes can have significant biological consequences that affect virtually all components of stream ecosystems.

Culverts in the roads have also negatively affected aquatic habitat and the distribution of fish. Clogged culverts cause water to flow over roads which at a minimum increases the erosion of the road surface, potentially leading to erosion of considerable portions of the roadbed. Culvert failures account for sediment delivery to stream channels. As discussed previously for road related effects, the frequency of culvert failures depends on design, construction, and maintenance levels for these culverts. In addition, improperly designed and placed culverts block fish access to historical natal streams.

Riparian

Riparian areas are particularly dynamic portions of the landscape. The vegetation in riparian areas regulates the exchange of nutrients and material from upland forests to streams. Fully functioning riparian ecosystems within the range of the northern spotted owl contain large conifers or a mix of large conifers and hardwoods along all streams in the watershed, including those not inhabited by fish. Riparian vegetation also moderates stream temperatures and levels of sunlight which influence ecological processes. Streambanks contain shrubs and other low-growing woody vegetation. Their root systems stabilize banks, allow development and maintenance of undercut banks, and protect bank structure during large stream flows. Riparian vegetation contributes leaves, twigs and other forms of fine litter that are an important component of the aquatic ecosystem food base. Figures 3&4-4 and 3&4-5 depict effects of vegetation on ecological functions and microclimate attributes in riparian areas.

Disturbances characteristic of upland ecosystems, such as fire and windthrow, as well as disturbance processes unique to stream systems, such as channel erosion, peakflow, floods, and debris flows, influence riparian areas. Floodplain riparian areas may contain highly diverse plant communities. Interactions between groundwater and riparian vegetation include extensive hydrologic and nutrient cycling.

Riparian vegetation provides shade along fish-bearing streams and smaller tributary streams that supply cold water to fish-bearing streams. Removal of streambank vegetation, largely from timber harvest in riparian areas, is often linked to increases in water temperatures. Assessments by the Environmental Protection Agency found that many streams on lands administered by the Forest Service and Bureau of Land Management within the range of the northern spotted owl are either moderately or severely impacted by increases in water temperature and sedimentation (Edwards et al. 1992). On federal lands throughout the state of Oregon, 55 percent of the 27,700 stream miles examined for nonpoint source pollution such as water temperature and

Figure 3&4-4. Generalized curves indicating percent of riparian ecological functions and processes occurring within varying distances from the edge of a forest stand

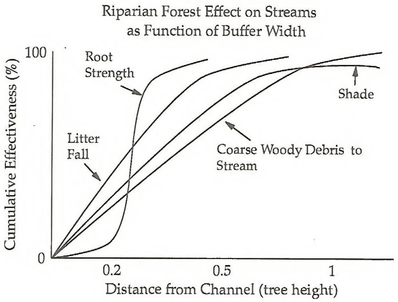
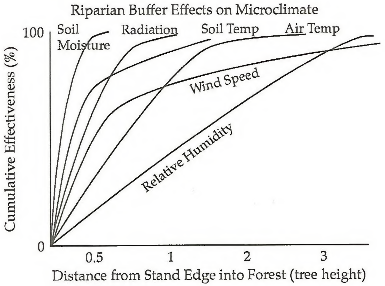


Figure 3&4-5. Generalized curves indicating percent of microclimate attributes occurring within varying distances from the edge of a riparian forest stand (after Chen 1991)



sedimentation are moderately or severely impacted (Edwards et al. 1992). On lands administered by the Forest Service and Bureau of Land Management, 4,900 and 7,300 miles of streams, respectively, have water temperature problems. An additional 8,000 to 11,000 miles of streams have problems with turbidity, erosion, and bank stability (FEMAT Report, Appendix V-D).

Riparian areas are widely considered to be important wildlife habitat. Cool air temperatures due to the presence of cool and turbulent surface waters, typically dense vegetative canopy cover, and their location in the lowest portions of watersheds combine to maintain a distinct microclimate along stream channels and in the adjacent riparian area. Maintaining the integrity of the vegetation in these areas is particularly important for riparian-dependent species of amphibians, arthropods, mammals, birds, and bats. Many species of amphibians, birds, and mammals use late-successional and old-growth riparian areas, including associated streams, ponds and wetlands, for reproducing, foraging, roosting, and as travel corridors (Table 3&4-11). The many wildlife species, along with lichens, mosses, vascular plants and mollusks, listed in Table 3&4-11 depend on diverse and complex riparian and aquatic habitats.

Coarse Woody Debris

Large quantities of down logs are an important component of many streams. Coarse woody debris influences the form and structure of a channel by affecting the profile of a stream, pool formation, and channel pattern and position. The rate at which sediment and organic matter are transported downstream is controlled in part by storage of this material behind coarse woody debris. Coarse woody debris also affects the formation and distribution of habitat, provides cover and complexity, and acts as a substrate for biological activity. Coarse woody debris in streams comes directly from the adjacent riparian area, from tributaries that may not be inhabited by fish, and from hillslopes.

In the past, the amount of coarse woody debris in streams has been reduced due to a variety of timber harvest practices and associated activities. Many riparian areas on federal lands are inadequate long-term sources of wood. Riparian area widths have been reduced by timber harvest activities. Frequently, narrow strips of riparian vegetation designed to protect the streams remained following harvest of adjacent areas. Subsequent partial harvest and salvage logging of these strips have reduced the ability of these areas to contribute coarse woody debris to streams. Riparian areas are susceptible to wind events due to the edge effect created by the removal of surrounding vegetation by timber harvest, and shallow rooted vegetation resulting from the high water table. Wind frequently blows down portions of a riparian area. Individual logs or pockets of logs resulting from windthrow that lie in the riparian areas and in streams are frequently salvage logged. Also, absence of protection for riparian areas for nonfish-bearing streams has reduced the amount of wood that these streams could deliver to fish-bearing streams. Coarse woody debris in the nonfish-bearing streams also functions to control the rate and quantity of sediment delivered to fish-bearing streams downstream. Debris flows and floods resulting from natural processes or timber harvest activities may remove coarse woody debris from channels. The

Table 3&4-11. Species associated with late-successional and old-growth forests using streams, wetlands, and riparian areas. Vascular plants, lichens, mosses, and mollusks are exclusively associated with aquatic, wetland, or riparian habitats. Vertebrate species significantly use riparian areas for foraging, roosting, and travel if late-successional, old-growth forest conditions are present (derived from Chapter IV of the FEMAT Report)

Species	
Vascular Plants	29
Lichens	
Aquatic	3
Riparian	9
Bryophytes (mosses)	
Aquatic	3
Splash zone[1]	5
Floodplain	13
Mollusks	
Freshwater snails	54
Freshwater clams	3
Amphibians	
Salamanders	12
Frogs	1
Birds	38
Mammals	18
Bats	11
Total	**199**

[1] Splash zone refers to the area along flowing waters on rocks just above the level of mean (low) summer flows, in small to large fast-flowing streams, or in the spray zone of rapids and waterfalls.

floods can be caused by the release of large volumes of water from water stored behind blocked culverts or landslides. These events can also remove riparian vegetation from streambanks on one portion of a drainage and deposit this material downstream.

Methodology for Aquatic Assessment

The aquatic assessment considered: (1) abundance of late-successional habitat represented by acres of Late-Successional Reserves, Riparian Reserves, Key Watersheds and roadless areas contained within them; (2) ecosystem processes and functions represented by Riparian Reserve widths, Key Watersheds, and watershed restoration; and (3) connectivity represented primarily by Riparian Reserves and supported by the other land allocations. The aquatic assessment did not explicitly rate the same attributes of abundance and ecological diversity of habitat, ecosystem processes and functions, and the connectivity of the habitat as in the late-successional forest ecosystem assessment.

The Aquatic Conservation Strategy (Appendix B6) was designed to incorporate all elements of the aquatic and riparian ecosystem necessary to maintain the natural disturbance regime. These elements include maintenance of hydrologic function, high water quality, adequate amounts of coarse woody debris, complex stream channels that provide a diversity of aquatic habitat types, and riparian areas with suitable microclimate and vegetation. Aquatic and riparian habitat was treated differently than terrestrial habitat because the Aquatic Conservation Strategy creates a connected system of aquatic and riparian habitats throughout the range of the northern spotted owl.

The other assessments of riparian and aquatic-dependent species considered the components of the Aquatic Conservation Strategy, particularly Riparian Reserves and Key Watersheds. These assessments were partially based on the Aquatic Conservation Strategies' capability to provide aquatic and riparian habitat elements required by the particular species considered. Alternative 7 does not include the Aquatic Conservation Strategy. Alternative 7 defers to current plan and draft plan preferred alternative riparian management schemes.

The Assessment Team emphasized the width of the Riparian Reserves during the assessments for fish and other riparian and aquatic-dependent species (for a complete description of Riparian Reserve widths see Table 3&4-12 later in this chapter). The assessments used three scenarios based on varying amounts of protection for intermittent streams. The ability of a given scenario to provide the ecosystem process and functions of naturally occurring riparian habitats was based, in part, on the information displayed in Figures 3&4-4 and 3&4-5. The principal difference between scenarios is the width of Riparian Reserves along intermittent streams outside Tier 1 Key Watersheds.

> Scenario 1 has a Riparian Reserve width equal to the height of one site-potential tree for all intermittent streams.
>
> Scenario 2 has a Riparian Reserve width equal to half the height of one site-potential tree for intermittent streams outside Tier 1 Key

Watersheds, and the width equal to the height of one site-potential tree for intermittent streams within Tier 1 Key Watersheds.

Scenario 3 has a Riparian Reserve width equal to one-sixth the height of one site-potential tree on all intermittent streams, and the width equal to the height of one site-potential tree for perennial, nonfish-bearing streams.

Assessments were conducted on species or groups of species of plants and animals that use aquatic and riparian habitat. The results of these assessments, in part, represent the ability of the Aquatic Conservation Strategy to provide the quantity, quality, and distribution of aquatic and riparian habitats required by the target species. The assessments assumed adoption of the entire Aquatic Conservation Strategy for all alternatives except Alternative 7, including watershed analysis and a comprehensive program of watershed restoration.

Watershed conditions, in part represented by the abundance and quality of late-successional habitat, affect the quality of aquatic habitat. The amount of late-successional forest and Late-Successional Reserves affects the recovery of riparian and aquatic ecosystems by reducing the risk of management-related disturbances. Watershed restoration programs, initially concentrated in the Key Watersheds, would build off of the natural recovery centered around existing late-successional forests and Late-Successional Reserves, and help accelerate recovery of riparian and aquatic ecosystems associated with these areas and other watersheds. Key Watersheds and the allocations contained within them, such as acres of Late-Successional Reserves and roadless areas, are also important in terms of maintaining and restoring ecosystem processes and functions throughout the range of the northern spotted owl.

The Assessment Team treated the Riparian Reserves differently than late-successional forests in the late-successional forest ecosystem assessment. Riparian Reserves are a contiguous, connected landscape component that occur on all rivers and streams, whereas late-successional forests are well-distributed areas throughout the range of the northern spotted owl. Riparian Reserves around wetlands, lakes, and ponds could be isolated from adjacent Riparian Reserves if they occur within the matrix and are not connected to Riparian Reserves for streams or rivers. In those cases, the Riparian Reserves for wetlands, lakes, and ponds would be similar to the juxtaposition of Late-Successional Reserves. The contiguous and linear nature of Riparian Reserves functions to connect the Late-Successional Reserves and Key Watersheds. The other allocations such as Congressionally Reserved Areas and Adaptive Management Areas strengthen that connectivity.

Effects of Alternatives on Aquatic Ecosystems

The following effects analysis is based on the determination of the sufficiency, quality, distribution, and abundance of habitat to allow species populations to stabilize across federal lands. The Assessment Team used seven races/species/groups of anadromous and resident salmonids to determine the outcomes.

In evaluating the alternatives, the Assessment Team considered five factors: (1) assessments of habitat conditions for the individual races/species/groups made by the assessment panel, (2) amount of Riparian Reserves and type and level of land management activity allowed within them, (3) extent of other reserves (such as Congressionally Reserved Areas and Late-Successional Reserves) and type and level of land management activity allowed within them, (4) presence of a watershed restoration program, and (5) management prescriptions within the matrix.

Each of the alternatives in this SEIS includes Late-Successional Reserves. Total area in Late-Successional Reserves varies from 5.4 to 11.4 million acres (Table 2-3) depending on the alternative. In addition, the amount of late-successional and old-growth forest (medium/large conifer) incorporated within the Late-Successional Reserves varies from about 6 million acres under Alternative 1 to 2.5 million acres under Alternative 7 (Table 3&4-8). Therefore, much of the Late-Successional Reserves already include late-successional and old-growth forest habitat. The amount of Late-Successional Reserves incorporated into each alternative is an indicator of the amount of late-successional and old-growth forest habitat retained by alternative. For example, Alternative 1 includes 11.4 million acres of Late-Successional Reserves and has the most late-successional and old-growth forest habitat within the reserves. Conversely, Alternative 7 has the least amount of Late-Successional Reserves and the least amount of late-successional and old-growth related habitat contained within the reserves.

Late-Successional Reserves will be managed to protect and restore habitat for late-successional and old-growth related species. While these reserves were not derived as part of the Aquatic Conservation Strategy, they benefit aquatic ecosystems. Late-Successional Reserves provide two major benefits to fish habitat and aquatic ecosystems. First, the standards and guidelines under which the reserves are managed significantly reduce activity in these areas, thereby reducing the risk of management-related disturbances and providing increased protection for all stream types. Second, because these reserves possess late-successional characteristics, they tend to be located in relatively undisturbed areas, although some management and natural disturbance events may have taken place in them. Some reserves offer core areas of high quality stream habitat that act as refugia in predominantly degraded landscapes and serve as centers from which degraded areas can be recolonized as they recover. Streams in the Late-Successional Reserves may be particularly important for endemic or locally-distributed fish species and stocks.

The likelihood of achieving an outcome of sufficient quality, distribution and abundance of habitat to allow fish populations to stabilize, well distributed when measured against their historic ranges across federal lands, is lower for Alternatives 2, 3, 5, 6, and 10 than for Alternatives 1, 4, and 9. Alternative 9's standards and guidelines would provide a level of habitat protection comparable to Alternative 4 because of the incorporation of Riparian Reserve Scenario 1 discussed in this chapter. However, the Assessment Team concluded that all alternatives except Alternatives 7 and 8 will reverse the trend of degradation and begin recovery of aquatic ecosystems on federal lands within the range of the northern spotted owl. Even if changes in land management practices and comprehensive restoration programs are initiated, it is possible that no alternative will completely recover all degraded aquatic systems within the next 100 years. The ecosystem assessment shows that the likelihood of attaining a functional and interconnected late-successional and old-growth forest ecosystem in the next 100 years is reduced because some characteristics of terrestrial ecosystems will not be obtained for at least 200 years. Similarly, the Assessment Team expected that degraded aquatic ecosystems will not be fully functional in 100 years. Faster recovery rates are probable for aquatic ecosystems under Alternatives 1 and 4, and Alternative 9 which includes the standards and guidelines added since the Draft SEIS, than under the other alternatives (Figure 3&4-6). Alternatives 1 and 4 and, Alternative 9 with the standards and guidelines incorporated since the Draft SEIS, would reduce management-related disturbance across the landscape because of application of a larger Late-Successional Reserve network and use of the more protective Riparian Reserve Scenario 1, which requires wider Riparian Reserve widths for intermittent streams in Tier 2 Key Watersheds and non-Key Watersheds.

Riparian Areas

All riparian areas for rivers, streams, wetlands, lakes and ponds on lands administered by the Forest Service and BLM within the range of the northern spotted owl are included within Riparian Reserves under all alternatives except Alternative 7 (Table 3&4-12). All alternatives, except 7 and 8, include either Riparian Reserve Scenario 1 or 2. Alternative 8 includes Riparian Reserve Scenario 3 which prescribes Riparian Reserves for permanently flowing, nonfish-bearing and intermittent streams that are substantially narrower under

Figure 3&4-6. Qualitative depiction of the rate of recovery for Tier 1 Key Watersheds as compared to other federal land watersheds. Faster recovery is due to the area of reserved lands, Riparian Reserves, and priority for restoration efforts.

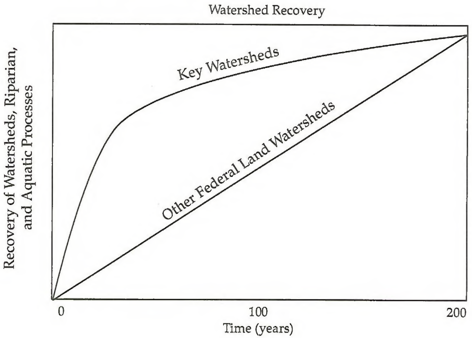


Table 3&4-12. Minimum widths of Riparian Reserves for fish-bearing, permanently flowing nonfish-bearing, and intermittent streams, expressed as whichever slope distance is greatest. In addition, Riparian Reserves must include the 100-year floodplain, inner gorge, and unstable and potentially unstable areas. See Appendix B6 for other criteria used to determine Riparian Reserve widths for these streams and lakes, ponds, and wetlands. Riparian Reserve scenarios by alternative are also listed.

Riparian Reserve Scenario	Stream Class	Tier 1 Key Watershed	Tier 2 Key Watershed	All Other Watersheds
Riparian Reserve 1 Alternatives 1, 4, 9	Fish-bearing streams	Average height of two site-potential trees or 300 feet	Average height of two site-potential trees or 300 feet	Average height of two site-potential trees or 300 feet
Riparian Reserve 1 Alternatives 1, 4, 9	Permanently flowing nonfish-bearing streams	Average height of one site-potential tree or 150 feet	Average height of one site-potential tree or 150 feet	Average height of one site-potential tree or 150 feet
Riparian Reserve 1 Alternatives 1, 4, 9	Intermittent streams	Average height of one site-potential tree or 100 feet	Average height of one site-potential tree or 100 feet	Average height of one site-potential tree or 100 feet
Riparian Reserve 2 Alternatives 2, 3, 5, 6, 10	Fish-bearing streams	Average height of two site-potential trees or 300 feet	Average height of two site-potential trees or 300 feet	Average height of two site-potential trees or 300 feet
Riparian Reserve 2 Alternatives 2, 3, 5, 6, 10	Permanently flowing nonfish-bearing streams	Average height of one site-potential tree or 150 feet	Average height of one site-potential tree or 150 feet	Average height of one site-potential tree or 150 feet
Riparian Reserve 2 Alternatives 2, 3, 5, 6, 10	Intermittent streams	Average height of one site-potential tree or 100 feet	Half the average height of one site-potential tree or 50 feet	Half the average height of one site-potential tree or 50 feet
Riparian Reserve 3 Alternative 8	Fish-bearing streams	Average height of two site-potential trees or 300 feet	Average height of two site-potential trees or 300 feet	Average height of two site-potential trees or 300 feet
Riparian Reserve 3 Alternative 8	Permanently flowing nonfish-bearing streams	Half the average height of one site-potential tree or 75 feet	Half the average height of one site-potential tree or 75 feet	Half the average height of one site-potential tree or 75 feet
Riparian Reserve 3 Alternative 8	Intermittent streams	One-sixth the average height of site-potential tree or 25 feet	One-sixth the average height of site-potential tree or 25 feet	One-sixth the average height of site-potential tree or 25 feet

Scenarios 1 and 2. Riparian management under Alternative 7 defers to current plans and draft plan preferred alternatives and, thus, does not equate to Riparian Reserve management proposed for the other alternatives. The amount of land designated to Riparian Reserves status varies among alternatives from 0.62 to 2.88 million acres (Table 2-3).

Riparian Reserve widths on all permanently-flowing streams are wide enough to provide a full array of ecological functions by including the floodplain, inner gorges, and unstable and potentially unstable lands within the reserves. For Tier 2 Key Watersheds and non-Key Watersheds, reserve widths on intermittent streams for Scenario 1 equal the height of one site-potential tree, and for Scenario 2 equal half the height of a site-potential tree. Although the prescribed widths for Scenarios 1 and 2 were estimated to be fully effective for maintaining and restoring the natural disturbance regime and the full array of ecological functions, the Assessment Team assumed that there would be a greater risk to aquatic ecosystems with the narrower reserve widths (Figure 3&4-4). The greater risk to aquatic and riparian habitat from the narrower reserve widths is because watershed analysis is required only in inventoried roadless areas and Key Watersheds before initiating management actions. In non-Key Watersheds management activities can occur outside the prescribed Riparian Reserve boundary until watershed analyses are completed and the boundaries are adjusted. The risk is that potential Riparian Reserve trees would be harvested prior to completing the watershed analysis and their possible subsequent inclusion within the adjusted Riparian Reserve. This could negatively affect the aquatic habitat and could delay achieving full function and processes of that particular riparian area and aquatic habitat. In addition, the recovery rate may be slower in non-Key Watersheds than in Key Watersheds due to less area allocated to Late-Successional Reserves, Congressionally Reserved Areas, and Riparian Reserves, combined with the fact that Key Watersheds have the highest priority for restoration efforts.

Appendix B6 describes the standards and guidelines that regulate activities within Riparian Reserves. These standards and guidelines are intended to prohibit and/or regulate activities that retard or prevent attainment of the Aquatic Conservation Strategy objectives. Regulating management within Riparian Reserves is an integral part of the Aquatic Conservation Strategy. The Aquatic Conservation Strategy institutes a new comprehensive policy for managing aquatic ecosystems within the range of the northern spotted owl. The overall intent of the Aquatic Conservation Strategy is to restore and maintain the ecological function and processes of watersheds and aquatic ecosystems within natural disturbance regimes. Proposed projects must meet Aquatic Conservation Strategy objectives and will be approved based on the restoration and maintenance criteria.

The existing conditions and physical and biological processes operating within a watershed will be the baseline to consider project proposals. Province, river basin, and individual watershed analyses will provide the baseline information and frame the context of the natural disturbance regime. Decision makers will use the information developed during a watershed analysis to support decisions and to determine if a proposed project meets Aquatic Conservation Strategy objectives. This is a new approach; in the past, proposed projects were considered from the context of what effects (positive and negative) a proposed project would have on the conditions and functions and processes of a watershed. Frequently, mitigation was used to attempt to neutralize the negative effects on riparian-dependent resources. Implementing a project placed the risk on the mitigation measure, which might not achieve the desired results. For example, a proposed road expansion would potentially eliminate riparian vegetation by widening the right-of-way. Mitigation for this could include placing in-channel structures as a substitute for changing the design of the road. Mitigation or planned restoration, such as placement of in-channel structures, should not be used as a substitute for preventing habitat degradation. Under the Aquatic Conservation Strategy, a project cannot have a negative effect, in the long term, on riparian-dependent resources. The risk has been shifted under the Aquatic Conservation Strategy because each project must meet the maintenance and restoration criteria by maintaining or restoring the physical and biological processes required by riparian-dependent resources within a watershed.

Key Watersheds

The Assessment Team indicated that riparian, aquatic and watershed processes in all watersheds will recover under all alternatives except Alternatives 7 and 8 due to the management approaches proposed in this SEIS. However, riparian and aquatic habitats within Key Watersheds should recover at a faster rate than others (Fig. 3&4-6). The recovery rate for Key Watersheds is increased as a result of (1) allocating a large percentage of Key Watersheds in Late-Successional and Congressionally Reserved Areas, (2) Riparian Reserve widths equal to the height of one site-potential tree on intermittent streams in Tier 1 Key Watersheds, and (3) identification of Key Watersheds as priority sites for restoration.

The Assessment Team identified a network of 164 Key Watersheds on federal lands throughout the range of the northern spotted owl. The 143 Tier 1 Key Watersheds were selected specifically for contributing directly to the conservation of habitat for at-risk anadromous salmonids, bull trout, and resident fish species. The 21 Tier 2 Key Watersheds are important sources of high quality water (Appendix B6, Table B6-3). The Key Watersheds are delineated on the Alternative 9 map distributed with this Final SEIS. The boundaries and amount of area covered by Key Watersheds do not vary by alternative except for Alternative 7 which does not include Key Watersheds. Rather, the alternatives vary by the mix of land allocations within the Key Watersheds. The Key Watershed network occupies 37 percent of the federal land within the range of the northern spotted owl, or about 9 million acres for all alternatives except Alternative 7 (Table 3&4-13 and 14).

The amount of acreage in reserve status contained within Key Watersheds varies by alternative (Table 3&4-13 and 14). Given the constant locations and boundaries of Key Watersheds throughout the range of the northern spotted owl, a higher proportion of one allocation results in a reduction of other allocations. Those alternatives with more Late-Successional Reserves would have less matrix, and, thus, aquatic ecosystems would benefit more than alternatives with less Late-Successional Reserves. Tier 1 Key Watersheds include 3.9 million and 3.1 million acres of Late-Successional Reserves for Alternatives 1 and 9, respectively (Table 3&4-13). Late-Successional Reserves and Congressionally Reserved Areas, excluding Riparian Reserves, make up between 70 and 86 percent of the 143 Tier 1 Key Watersheds (Table 3&4-13). Between 62 and 82 percent of the 21 Tier 2 Key Watersheds occur in reserve status, excluding Riparian Reserves (Table 3&4-14). Conversely, Tier 1 Key Watersheds include 671,800 acres in the matrix for Alternative 1, and 917,600 acres in Alternative 9 (Table 3&4-13). Matrix accounts for 8 to 20 percent of Tier 1 Key Watersheds depending on the alternative (Table 3&4-13). The implication is that higher proportions of matrix equates to increased management and higher risk of management-related disturbances.

Throughout the range of the northern spotted owl, Tier 1 Key Watersheds range from 42 percent of Late-Successional Reserves under Alternative 9, to 34 percent of Late-Successional Reserves under Alternative 1, excluding Riparian Reserves (Table 3&4-15). Similarly, Tier 1 Key Watersheds range from 26 percent of the matrix under Alternative 8, to 22 percent of the matrix under Alternative 3. Key Watersheds include a high proportion of reserves which reduces the risk from management-related disturbances. This further supports the concept of Key Watersheds serving as a focus for the maintenance and recovery of the at-risk stocks of anadromous salmonids within the range of the northern spotted owl.

The Key Watershed network encompasses 176 of the 257 at-risk fish stocks from streams on federal lands within the range of the northern spotted owl (Table B6-5, Appendix B6). Of the 82 at-risk stocks not covered by Key Watersheds, 68 occur on Forest Service administered watersheds, 9 on BLM administered watersheds and 5 on National Park Service administered watersheds. Also, 11 of the 82 are chum salmon that use streams downstream of federal lands. While the network does not necessarily include entire watersheds where the fish stocks occur, it does include streams or stream segments within the watersheds containing habitat that is important to the life history of these fish. The network of Key Watersheds is intended to serve as refugia of high quality habitat either currently or in the future. The maintenance and recovery of habitat within Key Watersheds will function to maintain and support the recovery of at-risk stocks of anadromous salmonids and resident fish species. Fish from these areas will be the sources for recolonizing habitats historically used by the fish.

Although the Key Watershed network does not include all at-risk fish stocks, the network is extensive enough to cover most potential stocks on federal lands within the range of the northern spotted owl that would qualify for listing under the Endangered Species Act. Key Watersheds would play an important role in the recovery of fish stocks listed under the Endangered Species Act where they overlap with the listed species.

Management activities in inventoried roadless areas may increase the risk of aquatic and riparian habitat damage, and potentially impair the capacity of Key Watersheds to function as intended and contribute to achieving Aquatic Conservation Strategy objectives. To protect the highest quality habitat in Key Watersheds, all alternatives except 7 and 8 stipulate that no new roads will be constructed in inventoried roadless areas within Key Watersheds, and that watershed analysis must be completed for all watersheds containing inventoried roadless areas before management activities can proceed.

Table 3&4-13. Acres of Tier 1 Key Watersheds by forest management allocation by alternative, state and physiographic province. Alternative 7 does not include Key Watersheds.

			Alternative 1				Alternative 2			
			Acres of Tier 1 Key Watershed in:				Acres of Tier 1 Key Watershed in:			
State/ Physiographic Province	Total Acres Federal Land	Congressionally Reserved Areas	Late-Successional Reserves	Admin. Withdrawn Areas	Riparian Reserves	Matrix	Late-Successional Reserves	Admin. Withdrawn Areas	Riparian Reserves	Matrix
Washington										
Eastern Cascades	3,470,400	719,000	552,100	103,300	83,200	171,500	452,800	121,400	110,400	225,500
Western Cascades	3,719,400	541,600	691,500	80,900	60,400	94,500	613,500	115,500	76,900	121,400
Western Lowlands	126,300	0	0	0	0	0	0	0	0	0
Olympic Peninsula	1,530,000	153,600	129,200	1,200	16,300	15,900	126,300	1,400	17,600	17,200
Total:	8,846,100	1,414,200	1,372,800	185,400	159,900	281,900	1,192,600	238,300	204,900	364,100
Oregon										
Klamath	2,118,900	44,100	432,500	13,200	41,000	55,000	377,600	18,100	60,800	85,300
Eastern Cascades	1,573,600	60,400	170,000	19,100	21,900	47,200	152,500	23,300	24,900	57,400
Western Cascades	4,488,100	323,600	780,800	17,500	98,400	119,300	617,600	29,300	163,900	205,300
Coast Range	1,411,900	21,900	273,500	500	24,600	23,300	260,200	500	30,900	30,300
Willamette Valley	26,200	0	0	0	0	0	0	0	0	0
Total:	9,618,700	450,000	1,656,800	50,300	185,900	244,800	1,407,900	71,200	280,500	378,300
California										
Coast Range	471,300	11,100	43,100	2,400	4,800	8,500	38,600	2,700	6,400	11,100
Klamath	4,511,700	852,700	861,500	88,800	107,700	136,600	548,700	186,700	204,200	255,100
Cascades	1,007,500	0	0	0	0	0	0	0	0	0
Total:	5,990,500	863,800	904,600	91,200	112,500	145,100	587,300	189,400	210,600	266,200
3 State Total:	24,455,300	2,728,000	3,934,200	326,900	458,300	671,800	3,187,800	498,900	696,000	1,008,600

Table 3&4-13. (Tier 1 Watersheds continued)

State/ Physiographic Province	Total Acres Federal Land	Congressionally Reserved Areas	Alternative 3 — Acres of Tier 1 Key Watershed in: Late-Successional Reserves	Alternative 3: Managed Late-Successional Areas	Alternative 3: Admin. Withdrawn Areas	Alternative 3: Riparian Reserves	Alternative 3: Matrix	Alternative 4 — Acres of Tier 1 Key Watershed in: Late-Successional Reserves	Alternative 4: Managed Late-Successional Areas	Alternative 4: Admin. Withdrawn Areas	Alternative 4: Riparian Reserves	Alternative 4: Matrix
Washington												
Eastern Cascades	3,470,400	719,000	255,100	247,800	114,500	95,300	197,400	389,900	59,400	128,300	107,300	225,200
Western Cascades	3,719,400	541,600	590,700	22,800	115,500	76,900	121,400	605,700	45,100	97,600	71,900	107,000
Western Lowlands	126,300	0	0	0	0	0	0	0	0	0	0	0
Olympic Peninsula	1,530,000	153,600	126,300	0	1,400	17,600	17,200	129,700	0	900	16,100	15,800
Total:	8,846,100	1,414,200	972,100	270,600	231,400	189,800	336,000	1,125,300	104,500	226,800	195,300	348,000
Oregon												
Klamath	2,118,900	44,100	357,000	20,600	18,100	60,800	85,300	381,500	3,200	16,100	59,400	81,700
Eastern Cascades	1,573,600	60,400	125,000	37,900	20,700	23,600	50,800	138,600	10,800	21,800	28,800	58,000
Western Cascades	4,488,100	323,600	483,600	134,000	29,300	163,900	205,300	505,900	100	32,600	209,700	267,700
Coast Range	1,411,900	21,900	260,200	0	500	30,900	30,300	274,500	2,900	300	23,100	21,100
Willamette Valley	26,200	0	0	0	0	0	0	0	0	0	0	0
Total:	9,618,700	450,000	1,225,800	192,500	68,600	279,200	371,700	1,300,500	17,000	70,800	321,000	428,500
California												
Coast Range	471,300	11,100	38,600	0	2,700	6,400	11,100	42,900	0	2,500	5,400	8,000
Klamath	4,511,700	852,700	502,700	45,900	186,700	204,200	255,100	517,300	5,500	184,600	217,300	269,900
Cascades	1,007,500	0	0	0	0	0	0	0	0	0	0	0
Total:	5,990,500	863,800	541,300	45,900	189,400	210,600	266,200	560,200	5,500	187,100	222,700	277,900
3 State Total:	24,455,300	2,728,000	2,739,200	509,000	489,400	679,600	973,900	2,986,000	127,000	484,700	739,000	1,054,400

Table 3&4-13. (Tier 1 Watersheds continued)

State/ Physiographic Province	Total Acres Federal Land	Congressionally Reserved Areas	Alternative 5 — Acres of Tier 1 Key Watershed in: Late-Successional Reserves	Managed Late-Successional Areas	Admin. Withdrawn Areas	Riparian Reserves	Matrix	Alternatives 6 & 10 — Acres of Tier 1 Key Watershed in: Late-Successional Reserves	Admin. Withdrawn Areas	Riparian Reserves	Matrix
Washington											
Eastern Cascades	3,470,400	719,000	276,000	60,600	190,100	122,200	261,200	361,100	149,000	130,700	269,300
Western Cascades	3,719,400	541,600	546,600	56,100	113,900	86,500	124,200	572,300	133,900	87,600	133,500
Western Lowlands	126,300	0	0	0	0	0	0	0	0	0	0
Olympic Peninsula	1,530,000	153,600	129,700	0	900	16,100	15,800	126,300	1,400	17,600	17,200
Total:	8,846,100	1,414,200	952,300	116,700	304,900	224,800	401,200	1,059,700	284,300	235,900	420,000
Oregon											
Klamath	2,118,900	44,100	330,000	10,700	23,000	76,100	102,000	352,800	22,300	68,900	97,800
Eastern Cascades	1,573,600	60,400	57,400	15,000	57,700	40,400	87,600	133,500	24,300	32,400	67,900
Western Cascades	4,488,100	323,600	307,000	100	51,300	289,100	368,600	471,400	41,400	221,200	282,000
Coast Range	1,411,900	21,900	257,700	19,700	300	23,100	21,100	260,200	500	30,900	30,300
Willamette Valley	26,200	0	0	0	0	0	0	0	0	0	0
Total:	9,618,700	450,000	952,100	45,500	132,300	428,700	579,300	1,217,900	88,500	353,400	478,000
California											
Coast Range	471,300	11,100	42,900	0	2,500	5,400	8,000	38,600	2,700	6,400	11,100
Klamath	4,511,700	852,700	444,100	5,500	203,000	240,600	301,400	476,100	213,400	224,500	280,800
Cascades	1,007,500	0	0	0	0	0	0	0	0	0	0
Total:	5,990,500	863,800	487,000	5,500	205,500	246,000	309,400	514,700	216,100	230,900	291,900
3 State Total:	24,455,300	2,728,000	2,391,400	167,700	642,700	899,500	1,289,900	2,792,300	588,900	820,200	1,189,900

Table 3&4-13. (Tier 1 Watersheds continued)

			Alternative 8				Alternative 9					
			Acres of Tier 1 Key Watershed in:				Acres of Tier 1 Key Watershed in:					
State/ Physiographic Province	Total Acres Federal Land	Congressionally Reserved Areas	Late-Successional Reserves	Admin. Withdrawn Areas	Riparian Reserves	Matrix	Late-Successional Reserves	Adaptive Management Areas	Managed Late-Successional Areas	Admin. Withdrawn Areas	Riparian Reserves	Matrix
Washington												
Eastern Cascades	3,470,400	719,000	361,100	149,000	61,500	338,500	435,000	46,400	55,100	97,200	91,800	184,600
Western Cascades	3,719,400	541,600	572,300	133,900	45,900	175,200	643,900	7,200	0	76,200	83,300	116,600
Western Lowlands	126,300	0	0	0	0	0	0	0	0	0	0	0
Olympic Peninsula	1,530,000	153,600	126,300	1,400	11,500	23,300	140,100	21,700	0	200	300	300
Total:	8,846,100	1,414,200	1,059,700	284,300	118,900	537,000	1,219,000	75,300	55,100	173,600	175,400	301,500
Oregon												
Klamath	2,118,900	44,100	352,800	22,300	35,800	130,900	363,800	42,800	0	10,600	53,700	70,900
Eastern Cascades	1,573,600	60,400	133,500	24,300	14,000	86,300	125,800	0	0	20,500	35,700	76,100
Western Cascades	4,488,100	323,600	471,400	41,400	98,200	405,000	580,700	26,800	0	35,600	157,200	215,800
Coast Range	1,411,900	21,900	260,200	500	16,000	45,100	282,600	10,100	0	100	13,400	15,800
Willamette Valley	26,200	0	0	0	0	0	0	0	0	0	0	0
Total:	9,618,700	450,000	1,217,900	88,500	164,000	667,300	1,352,900	79,700	0	66,800	260,000	378,600
California												
Coast Range	471,300	11,100	38,600	2,700	2,800	14,700	43,100	0	0	2,200	5,400	8,100
Klamath	4,511,700	852,700	476,100	213,400	106,100	399,100	536,700	73,100	0	165,300	190,200	229,400
Cascades	1,007,500	0	0	0	0	0	0	0	0	0	0	0
Total:	5,990,500	863,800	514,700	216,100	108,900	413,800	579,800	73,100	0	167,500	195,600	237,500
3 State Total:	24,455,300	2,728,000	2,792,300	588,900	391,800	1,618,100	3,151,700	228,100	55,100	407,900	631,000	917,600

Table 3&4-14. Acres of Tier 2 Key Watersheds by forest management allocation by alternative, state and physiographic province. Alternative 7 does not include Key Watersheds.

			Alternative 1				Alternative 2			
			Acres of Tier 2 Key Watershed in:				Acres of Tier 2 Key Watershed in:			
State/ Physiographic Province	Total Acres Federal Land	Congressionally Reserved Areas	Late-Successional Reserves	Admin. Withdrawn Areas	Riparian Reserves	Matrix	Late-Successional Reserves	Admin. Withdrawn Areas	Riparian Reserves	Matrix
Washington										
Eastern Cascades	3,470,400	11,500	25,500	600	8,000	7,600	24,300	700	6,600	10,000
Western Cascades	3,719,400	93,500	109,000	8,000	5,100	6,200	99,500	10,900	6,100	11,900
Western Lowlands	126,300	0	0	0	0	0	0	0	0	0
Olympic Peninsula	1,530,000	36,200	53,100	600	8,500	8,300	52,700	600	7,100	10,100
Total:	8,846,100	141,200	187,600	9,200	21,600	22,100	176,500	12,200	19,800	32,000
Oregon										
Klamath	2,118,900	72,000	0	0	0	0	0	0	0	0
Eastern Cascades	1,573,600	98,000	96,200	13,200	25,200	36,600	91,400	14,100	18,900	46,800
Western Cascades	4,488,100	0	208,200	11,900	19,800	38,500	165,100	16,100	22,200	74,900
Coast Range	1,411,900	0	0	0	0	0	0	0	0	0
Willamette Valley	26,200	0	0	0	200	200	0	0	100	200
Total:	9,618,700	170,000	304,400	25,100	45,200	75,300	256,500	30,200	41,200	121,900
California										
Coast Range	471,300	0	0	0	0	0	0	0	0	0
Klamath	4,511,700	0	0	0	0	0	0	0	0	0
Cascades	1,007,500	0	0	0	0	0	0	0	0	0
Total:	5,990,500	0	0	0	0	0	0	0	0	0
3 State Total:	24,455,300	311,200	492,000	34,300	66,800	97,400	433,000	42,400	61,000	153,900

Table 3&4-14. (Tier 2 Watersheds continued)

			Alternative 3					Alternative 4				
			Acres of Tier 2 Key Watershed in:					Acres of Tier 2 Key Watershed in:				
State/ Physiographic Province	Total Acres Federal Land	Congressionally Reserved Areas	Late-Successional Reserves	Managed Late-Successional Areas	Admin. Withdrawn Areas	Riparian Reserves	Matrix	Late-Successional Reserves	Managed Late-Successional Areas	Admin. Withdrawn Areas	Riparian Reserves	Matrix
Washington												
Eastern Cascades	3,470,400	11,500	6,200	18,100	700	6,600	10,000	37,700	0	200	2,000	1,900
Western Cascades	3,719,400	93,500	88,900	10,600	10,900	6,100	11,900	89,700	0	11,100	13,100	14,500
Western Lowlands	126,300	0	0	0	0	0	0	0	0	0	0	0
Olympic Peninsula	1,530,000	36,200	52,700	0	600	7,100	10,100	53,400	0	600	8,400	8,200
Total:	8,846,100	141,200	147,800	28,700	12,200	19,800	32,000	180,800	0	11,900	23,500	24,600
Oregon												
Klamath	2,118,900	72,000	0	0	0	0	0	0	0	0	0	0
Eastern Cascades	1,573,600	98,000	50,800	40,500	14,100	18,900	46,800	61,700	0	24,300	34,500	50,700
Western Cascades	4,488,100	0	125,500	39,600	16,100	22,200	74,900	134,800	0	16,500	43,700	83,500
Coast Range	1,411,900	0	0	0	0	0	0	0	0	0	0	0
Willamette Valley	26,200	0	0	0	0	100	200	0	0	0	200	200
Total:	9,618,700	170,000	176,300	80,100	30,200	41,200	121,900	196,500	0	40,800	78,400	134,400
California												
Coast Range	471,300	0	0	0	0	0	0	0	0	0	0	0
Klamath	4,511,700	0	0	0	0	0	0	0	0	0	0	0
Cascades	1,007,500	0	0	0	0	0	0	0	0	0	0	0
Total:	5,990,500	0	0	0	0	0	0	0	0	0	0	0
3 State Total:	24,455,300	311,200	324,100	108,800	42,400	61,000	153,900	377,300	0	52,700	101,900	159,000

Table 3&4-14. (Tier 2 Watersheds continued)

			Alternative 5					Alternatives 6 & 10			
			Acres of Tier 2 Key Watershed in:					Acres of Tier 2 Key Watershed in:			
State/ Physiographic Province	Total Acres Federal Land	Congressionally Reserved Areas	Late-Successional Reserves	Managed Late-Successional Areas	Admin. Withdrawn Areas	Riparian Reserves	Matrix	Late-Successional Reserves	Admin. Withdrawn Areas	Riparian Reserves	Matrix
Washington											
Eastern Cascades	3,470,400	11,500	35,600	0	700	2,100	3,200	24,300	700	6,600	10,000
Western Cascades	3,719,400	93,500	49,000	0	18,100	23,600	37,700	86,700	13,200	10,300	18,200
Western Lowlands	126,300	0	0	0	0	0	0	0	0	0	0
Olympic Peninsula	1,530,000	36,200	53,400	0	600	6,900	9,700	52,700	600	7,100	10,100
Total:	8,846,100	141,200	138,000	0	19,400	32,600	50,600	163,700	14,500	24,000	38,300
Oregon											
Klamath	2,118,900	72,000	0	0	0	0	0	0	0	0	0
Eastern Cascades	1,573,600	98,000	21,500	0	34,200	32,700	82,800	56,600	29,300	24,500	60,800
Western Cascades	4,488,100	0	111,600	0	17,500	35,100	114,200	123,100	18,500	32,000	104,900
Coast Range	1,411,900	0	0	0	0	0	0	0	0	0	0
Willamette Valley	26,200	0	0	0	0	100	200	0	0	100	200
Total:	9,618,700	170,000	133,100	0	51,700	67,900	197,200	179,700	47,800	56,600	165,900
California											
Coast Range	471,300	0	0	0	0	0	0	0	0	0	0
Klamath	4,511,700	0	0	0	0	0	0	0	0	0	0
Cascades	1,007,500	0	0	0	0	0	0	0	0	0	0
Total:	5,990,500	0	0	0	0	0	0	0	0	0	0
3 State Total:	24,455,300	311,200	271,100	0	71,100	100,500	247,800	343,400	62,300	80,600	204,200

Table 3&4-14. (Tier 2 Watersheds continued)

			Alternative 8				Alternative 9					
			Acres of Tier 2 Key Watershed in:				Acres of Tier 2 Key Watershed in:					
State/ Physiographic Province	Total Acres Federal Land	Congressionally Reserved Areas	Late-Successional Reserves	Admin. Withdrawn Areas	Riparian Reserves	Matrix	Late-Successional Reserves	Adaptive Management Areas	Managed Late-Successional Areas	Admin. Withdrawn Areas	Riparian Reserves	Matrix
Washington												
Eastern Cascades	3,470,400	11,500	24,300	700	4,600	12,000	4,500	0	0	2,100	18,000	17,000
Western Cascades	3,719,400	93,500	86,700	13,200	7,200	21,400	66,800	37,300	0	8,600	6,100	9,600
Western Lowlands	126,300	0	0	0	0	0	0	0	0	0	0	0
Olympic Peninsula	1,530,000	36,200	52,700	600	5,700	11,500	47,000	23,300	0	0	100	100
Total:	8,846,100	141,200	163,700	14,500	17,500	44,900	118,300	60,600	0	10,700	24,200	26,700
Oregon												
Klamath	2,118,900	72,000	0	0	0	0	0	0	0	0	0	0
Eastern Cascades	1,573,600	98,000	56,600	29,300	15,000	70,300	56,700	0	0	23,800	36,600	54,100
Western Cascades	4,488,100	0	123,100	18,500	19,200	117,600	104,100	0	0	20,200	52,700	101,400
Coast Range	1,411,900	0	0	0	0	0	0	0	0	0	0	0
Willamette Valley	26,200	0	0	0	100	200	0	0	0	0	200	200
Total:	9,618,700	170,000	179,700	47,800	34,300	188,100	160,800	0	0	44,000	89,500	155,700
California												
Coast Range	471,300	0	0	0	0	0	0	0	0	0	0	0
Klamath	4,511,700	0	0	0	0	0	0	0	0	0	0	0
Cascades	1,007,500	0	0	0	0	0	0	0	0	0	0	0
Total:	5,990,500	0	0	0	0	0	0	0	0	0	0	0
3 State Total:	24,455,300	311,200	343,400	62,300	51,800	233,000	279,100	60,600	0	54,700	113,700	182,400

Table 3&4-15. Percent of land allocation within Tier 1 and Tier 2 Key Watersheds on federal land within the range of the northern spotted owl. Alternative 7 does not include Key Watersheds.

Tier 1 Key Watersheds:	Alternative									
	1	2	3	4	5	6	7	8	9	10
Congressionally Reserved Areas	37.3	37.3	37.3	37.3	37.3	37.3	0.0	37.3	37.3	37.3
Late-Successional Reserves	34.5	35.6	37.2	37.0	37.5	37.2	0.0	37.2	42.4	37.2
Adaptive Management Areas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.0	0.0
Managed Late-Successional Areas	0.0	0.0	29.9	53.5	44.0	0.0	0.0	0.0	53.9	0.0
Administratively Withdrawn Areas	30.3	33.1	32.7	29.3	31.1	32.3	0.0	32.2	27.6	32.3
Riparian Reserves	24.4	32.2	31.8	25.5	33.6	32.6	0.0	26.1	24.0	32.6
Matrix	24.2	22.4	21.9	24.6	22.9	22.5	0.0	25.7	23.1	22.5

Tier 2 Key Watersheds:	Alternative									
	1	2	3	4	5	6	7	8	9	10
Congressionally Reserved Areas	4.3	4.3	4.3	4.3	4.3	4.3	0.0	4.3	4.3	4.3
Late-Successional Reserves	4.3	4.8	4.4	4.7	4.3	4.6	0.0	4.6	3.8	4.6
Adaptive Management Areas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.0
Managed Late-Successional Areas	0.0	0.0	6.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Administratively Withdrawn Areas	3.2	2.8	2.8	3.2	3.4	3.4	0.0	3.4	3.7	3.4
Riparian Reserves	3.6	2.8	2.9	3.5	3.8	3.2	0.0	3.4	4.3	3.2
Matrix	3.5	3.4	3.5	3.7	4.4	3.9	0.0	3.7	4.6	3.9

Over 3 million acres of inventoried roadless areas exist in the National Forests within the range of the northern spotted owl. Over 50 percent of this area is in Key Watersheds; approximately 48 percent occurs in Tier 1 Key Watersheds.

The potential disturbance to Key Watersheds from activities in inventoried roadless areas can be estimated by calculating the acreage where timber harvesting could occur within inventoried roadless acres in the matrix. The percentage of the total inventoried roadless area in the matrix varies by alternative from 8 percent for Alternative 1, to 25 percent for Alternative 7. The percentage of the total roadless area in the matrix that is suitable for timber harvest ranges from 4 percent for Alternative 1, to 17 percent for Alternative 7. If it is assumed that half of the acreage of inventoried roadless areas in the matrix is within Key Watersheds and may be harvested, then there are an estimated 69,000 acres in inventoried roadless areas in Alternative 1, increasing to about 256,000 acres in inventoried roadless areas in Alternative 7 in Key Watersheds, where timber harvest may occur.

Most roadless areas available for harvest can be harvested either directly from existing roads at the periphery or by using helicopters. Two miles is considered to be the economically operable distance for helicopter logging at today's lumber prices. Under Alternative 9, between 5,000 and 10,000 acres of matrix available for harvest in all inventoried roadless areas are farther than 2 miles from a road. Thus, less than 10,000 acres of roadless area within the matrix would be considered not economically feasible based on the 2-mile distance criteria. The Assessment Team estimated that there were no suitable acres for timber harvest in inventoried roadless acres within Key Watersheds that were farther than this distance from existing roads. Thus, the requirement that no new roads will be constructed in inventoried roadless areas within Key Watersheds should have no impact on total probable sale quantity (PSQ) for the planning area. If all inventoried roadless acres available for harvest remain unroaded in Alternative 9, the estimated reduction for the total regional PSQ is less than 0.2 percent.

The effects of the alternatives on aquatic and riparian habitats are a function of:

- the Riparian Reserve scenario adopted for intermittent streams outside Tier 1 Key Watersheds
- the amount of land allocated to Late-Successional Reserves
- the amount of land in Key Watersheds
- allocations of land contained within Key Watersheds
- road mileage restrictions within Key Watersheds
- restriction on road construction in inventoried roadless areas in Key Watersheds
- amount of inventoried roadless areas in the matrix
- the inclusion of a comprehensive watershed restoration program

Alternatives 1 and 4, and Alternative 9 which includes the standards and guidelines incorporated since the Draft SEIS, benefit aquatic and riparian habitats more than the other alternatives. These benefits are principally due to: (1) the application of Riparian Reserve Scenario 1 to intermittent streams in Tier 2 Key Watersheds and non-Key Watersheds, (2) the highest amounts of Late-Successional Reserves within Key Watersheds and throughout the range of the northern spotted owl, and (3) the least amount of the matrix contained within inventoried roadless areas. Aquatic and riparian habitats are expected to recover faster under Alternatives 1, 4 and 9, in part, due to these factors.

Alternatives 2, 3, 5, 6, and 10 benefit aquatic and riparian habitats to a greater degree than Alternatives 7 and 8, but to a lesser degree than Alternatives 1 and 4 and Alternative 9, which includes the standards and guidelines incorporated since the Draft SEIS. Some of the reasons for these differences are that Alternatives 2, 3, 5, 6, and 10 have less Late-Successional Reserves, include Riparian Reserve Scenario 2, and have more land in the matrix than Alternatives 1, 4, and 9. The opposite is true when comparing the benefits of Alternatives 2, 3, 5, 6, and 10 to aquatic and riparian habitat relative to Alternatives 7 and 8. Even though Alternatives 2, 3, 5, 6, and 10 benefit aquatic and riparian habitats to a lesser degree than Alternatives 1, 4, and 9, they would reverse the trend of aquatic and riparian habitat degradation and begin recovery of these habitats.

The standards and guidelines for Alternatives 7 and 8 are not adequate to reverse the trend of aquatic and riparian habitat degradation and begin recovery of these habitats. The principal reasons are the lack of explicitly defined Riparian Reserves for Alternative 7, and the application of Riparian Reserve Scenario 3 for Alternative 8.

The above analysis was based on outcomes from assessments using seven races/species/groups of anadromous and resident salmonids. Other assessments discussed in this SEIS support the above analysis on the sufficiency, quality, distribution, and abundance of habitat to allow large numbers of species populations dependent on aquatic and riparian habitats to stabilize across federal lands. Riparian Reserves are important for maintaining aquatic-associated arthropods, mollusks, bryophytes, vascular plants, and amphibians, and as dispersal corridors for many these species and mammals and birds. The results of assessments for these groups, in general, followed the same trends as those resulting from the fish assessments.

The assessments of riparian-dependent amphibians illustrate the similarity of the other assessments to the results of the fish assessments. The outcomes fell into three similar categories. Alternatives 1 and 4 had the highest outcomes, Alternatives 7 and 8 the lowest, and the rest of the alternatives fell in between. The standards and guidelines for Alternative 9 would provide a level of habitat protection comparable to Alternative 4. The principal factor influencing the outcomes for amphibians related to the width of Riparian Reserves.

The Aquatic Conservation Strategy, in particular the Riparian Reserves, would reverse the trend of aquatic and riparian habitat degradation and begin recovery of these habitats for all alternatives except Alternatives 7 and 8. For the planning area, the improvements in riparian and aquatic habitats under all alternatives except Alternatives 7 and 8 would benefit riparian-dependent arthropods, mollusks, bryophytes, vascular plants, amphibians, fish and riparian areas within the range of the northern spotted owl.

To protect remaining high quality habitat, no new roads would be constructed in inventoried roadless areas in Key Watersheds under all alternatives except 7 and 8. The Assessment Team recommended that there be a reduction in existing system and nonsystem road mileage within Key Watersheds. If sufficient funding does not become available for this reduction, there would be no net increase in road mileage in Key Watersheds. That is, if a mile of new road is constructed, at least 1 mile of road shall be decommissioned, with priority for removing roads that pose the greatest risks to riparian and aquatic ecosystems. Watershed analysis must be conducted in all non-Key Watersheds that contain inventoried roadless areas before any land management activities can occur within that roadless area.

Possible Mitigation Measures

Later in this chapter, the section titled "Range of Mitigation Measures Considered" lists the mitigation measures developed during the additional species analysis. Appendix B11 lists the measures incorporated as standards and guidelines into Alternative 9. Three mitigation measures were developed during the additional species analysis to protect watersheds but were not incorporated into the alternatives. These measures propose to: (1) designate all Tier 1 Key Watersheds as Late-Successional Reserves, (2) prohibit constructing new roads in Tier 1 Key Watersheds, and (3) designate all inventoried roadless areas as Late-Successional Reserves. These measures would provide additional benefits to aquatic and riparian-dependent species by decreasing risks from management-related disturbances in Key Watersheds and roadless areas. This would particularly benefit the at-risk anadromous fish stocks. The benefits accrue due to ensuring that the refugia system established by Key Watersheds and high quality habitat contained within roadless areas is subjected to limited disturbance from timber harvest and related activities (e.g., road and landing construction). The measures would be particularly valuable in the short term, since the relatively small amount of high quality habitat remaining is predominantly found in Key Watersheds and within inventoried roadless areas. These measures would strengthen the integrity of the refugia system contained within Key Watersheds and roadless areas.

Cumulative Effects Including the Role of Nonfederal Lands

The Aquatic Conservation Strategy is a habitat-based approach to maintaining and restoring aquatic and riparian habitats and watersheds on federal lands within the range of the northern spotted owl. The success of the strategy does not depend on actions on nonfederal lands. Many of the federal watersheds occur upstream of nonfederal watersheds. Thus, the strategy can succeed at maintaining and restoring the aquatic and riparian habitats independent of actions on nonfederal lands. This statement is less applicable in multiownership watersheds, particularly for lands administered by the BLM that are juxtaposed between nonfederal parcels.

There are two major differences between current state requirements and proposed federal requirements. First, the states allow harvest within the riparian management areas. Second, riparian protection widths are smaller in state programs. This is particularly true for intermittent and smaller perennial streams. None of the states require protection of riparian areas for intermittent streams.

Air and Water Quality and Soil Productivity

Air Quality Analysis

Introduction

Smoke emissions from any source, whether from industry, woodstoves, prescribed fire, or wildfire, can result in reduced visibility, unpleasant odors, and even health effects. All of the alternatives in this SEIS propose to continue the use of prescribed fire within the planning area. Consequently, all alternatives will have some smoke related impacts. This SEIS emphasizes incorporating ecosystem principles into forest management, where fire is valued as a natural and necessary ecosystem process. Under ecosystem management, certain types of prescribed fire, such as understory burning, will be emphasized. Understory burning is designed to approximate natural low-to-moderate intensity wildfires, and generally burns with fewer emissions. Total projected emissions aggregated over the planning area, therefore, are lower for all alternatives than historic emissions when fire use consisted of primarily broadcast burning in clearcut harvest units.

Affected Environment

The Role of Fire in Ecosystem Management

Fire is the major natural agent of disturbance within the planning area. The distributions, abundance, and dominance of the major plant communities are strongly affected by the frequency, intensity, and extent of wildfire events. Fire has both direct and indirect effects on the forest environment. These effects vary depending on individual forest stand and plant community conditions and composition, as well as fire intensity.

The long-term frequency, intensity, and extent of fire events (known as the "fire regime") depend largely on climate and weather patterns. Fire characteristics also depend upon the available fuel which is related to past forest management practices, including the use of prescribed fire and the effectiveness of wildfire suppression (i.e., wildfire exclusion). Smoke emissions from wildfires are also dependent upon stand history and weather conditions.

The Relationship Between Fire and Forest Health

Interruption of natural fire regimes has a direct effect on ecosystem species composition, and sometimes on species persistence. The near exclusion of natural, low-to-moderate intensity wildfires has resulted in a proliferation of fire-intolerant and shade-tolerant species (e.g., true fir species and hardwoods), which are replacing ponderosa pine and Douglas-fir forest types within the dry provinces. Changes in long-term soil productivity, stand structure and function, forest health, and biological diversity are also occurring due to the exclusion of fire. The mortality of trees due to insects and disease makes forests more susceptible to high-intensity, stand-replacing fires.

The exclusion of fire as an ecosystem process has contributed to conifer mortality within the Eastern Cascades Provinces of Washington and Oregon, the Oregon and California Klamath Provinces, and the California Cascades

Province. The exclusion of fire has increased competition for moisture and light among conifer, brush, and shrub species, and has changed species composition. Insect and disease outbreaks often precede high-intensity, stand- replacing wildfires. In stands dominated by late-successional species, the exclusion of fire has reduced ecological stability, increased susceptibility to wildfire, and reduced floral and faunal diversity. Prescribed fire can promote ecosystem health by restoring natural ecological processes.

The Role of Fire as a Silvicultural Tool

Silvicultural practices to enhance stand development may reduce the risk of high severity wildfires. Underburning reduces the amount of fuel, also known as fuel loadings. Wildfires in underburned stands are generally less severe, consequently less intrusive fire suppression methods may be effective. Underburning should be reintroduced across large areas over a period of time to create a mosaic of stand conditions. Silvicultural treatments to reduce wildfire risk may include thinning, underburning, and establishing fuelbreaks.

Silvicultural systems within the matrix and Adaptive Management Areas contribute to management of late-successional forests. Fire management practices within the matrix and Adaptive Management Areas should focus on reducing the risk of fire that could spread into the reserves. Large-scale, high intensity wildfire events have caused many forest stands within the dry and intermediate provinces to return to early-successional conditions. High severity wildfires have also provided conditions that allowed brush and hardwood species to dominate some sites for several decades or longer. Dense, even-age plantations may be more susceptible to insect, disease, and fire disturbances that could threaten nearby late-successional forests within the reserves.

The Role of Fire in the Maintenance of Habitat for the Northern Spotted Owl

The primary objective for any proposed activity within the habitat of the northern spotted owl is to improve habitat and to prevent large-scale, high severity wildfires. The risk of catastrophic loss of habitat due to wildfire is considered to be low for the moist provinces, moderate for the intermediate provinces, and high for the dry provinces (Agee and Edmonds unpub.). In the moist provinces, natural fire return intervals are quite long, often over 500 years. However, even in the moist provinces, fire has been an important ecosystem process in particular microclimates. The role of prescribed burning within these provinces is generally limited to specific resource objectives. The role of fire in the Western Cascades Province of Oregon is well documented. Natural fire return intervals in the intermediate provinces are generally within a range of 95 to 145 years (Agee and Edmonds unpub., Morrison and Swanson 1990, Teensma 1987). Natural wildfire disturbance events have generally not resulted in complete mortality of stands; surviving trees became important elements of remnant multistoried old-growth stands.

The risk of large-scale wildfires in northern spotted owl habitat is greatest within the dry provinces. The elevated risk is principally due to fire suppression. Vegetative changes as a result of proactive fire and fuels management, including thinning and prescribed fire, will reduce the risk of large-scale loss of late-successional and old-growth forests and restore fire-dependent old-growth species.

The Use of Prescribed Fire for Plants With Limited Distributions

Some plant species require canopy gaps that may have been historically maintained by fire. Fire reduces understory competition, increases light, provides nitrogen, and stimulates germination of some fire-adapted species. The role of fire in the life history of some species warrants further investigation because fire is necessary for the persistence of some species. Underburning may improve habitat for some fire-adapted species. Site-specific treatments are more appropriate than broader scale treatments because some species with limited distributions are fire intolerant. Without resuming underburning, biological diversity would be diminished by the loss of many native plant species and some plant communities.

The Use of Prescribed Fire for Hazard Reduction

Fuel reduction to mitigate wildfire risk should be considered in province-level, watershed and landscape-level, and site and project-specific planning (see Appendix B8, Fire Management Standards and Guidelines, for additional guidance on the use of fire for hazard reduction). The reduction of fuels near populated areas, high recreation use areas, and in high resource value areas is essential for effective and efficient wildfire suppression. Prescribed fire may also be used to avoid the use of herbicides, and where mechanical or manual methods of fuels management are not practical. Reduction of wildfire potential within fire-dependent communities is most important in the dry and intermediate provinces.

The Clean Air Act

The federal Clean Air Act, as amended in 1990, is designed to reduce air pollution, protect human health, and preserve the Nation's air resources. To protect air quality, the Clean Air Act requires federal agencies to comply with all federal, state and local air pollution requirements (Section 118).

Several federal air quality programs under the Clean Air Act regulate prescribed burning and other activities. The National Ambient Air Quality Standards (NAAQS) are set to protect human health and welfare. Pollutant concentrations that exceed the NAAQS endanger public health. Air pollutants for which federal NAAQS have been established are called "criteria" air pollutants. They include particulate matter (PM10), sulfur dioxide, nitrogen dioxide, ozone, carbon monoxide and lead.

State Implementation Plans

The Clean Air Act requires each state to develop, adopt, and implement a State Implementation Plan (sometimes referred to as a SIP) to ensure that the NAAQS are attained and maintained for the criteria pollutants. These plans must contain schedules for developing and implementing air quality programs and regulations. State Implementation Plans also contain additional regulations for areas that have violated one or more of the NAAQS. These areas are called "nonattainment areas." If states fail to submit State Implementation Plans, or fail to adhere to schedules therein, the Environmental Protection Agency has the authority to impose federal sanctions or federal implementation plans.

Prevention of Significant Deterioration (PSD) and Visibility Programs

The Clean Air Act established the Prevention of Significant Deterioration program which prevents areas that currently have clean air from being degraded. This program defines three area classifications based on air quality: Class I, Class II, and Class III. Class I areas are subject to the most limiting restrictions regarding how much additional pollution can be added to the air while still protecting air quality. All National Parks and some Wildernesses within the planning area for this SEIS are designated Class I; all lands administered by the Forest Service and Bureau of Land Management within this planning area are Class II. There are no Class III areas within the planning area.

As a national goal, the Clean Air Act also sets the protection of visibility in Class I areas. The visibility protection program provides for remedying existing, and preventing future, impairment to visibility. Figure 3&4-7 shows the federal Class I areas and the federal PM10 nonattainment areas within the range of the northern spotted owl.

Air Quality Related Values (AQRVs)

The Clean Air Act gives federal land managers of Wildernesses (Class I areas) the affirmative responsibility to protect Air Quality Related Values from adverse impacts of air pollution (Section 165(d)). These are values within Class I areas, such as visibility, biological diversity, and water quality, that are necessary to protect.

Air Quality Programs and Prescribed Fire

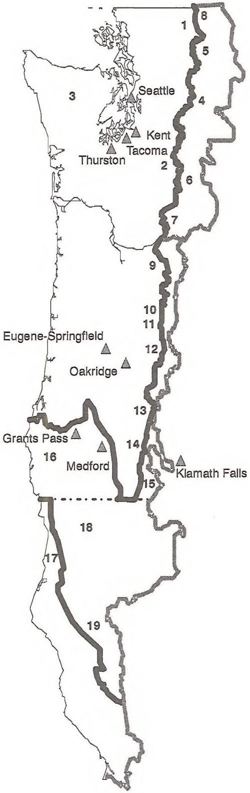
State and local governments have the authority to adopt their own air quality rules and regulations. These rules can be incorporated into the State Implementation Plan if they are equal to, or more protective than, federal requirements. For example, some states have incorporated smoke management provisions for prescribed burning into their plans.

All three states within the planning area have State Implementation Plans that have been approved by the Environmental Protection Agency which regulate the criteria pollutants emitted from prescribed burning. Washington and Oregon's plans address particulate matter (PM10), visibility, and smoke management. California's State Implementation Plan addresses PM10, but does not include visibility or smoke management components; these programs are implemented by local air pollution control districts.

Conformity

The conformity provisions of the Clean Air Act (Section 176(c)), prohibit federal agencies from taking any action that causes or contributes to a new violation of the NAAQS, increases the frequency or severity of an existing violation, or delays the timely attainment of a standard. Section 176(c) specifically states that federal agencies must ensure that their actions conform to the applicable State Implementation Plan. The Environmental Protection Agency is required to promulgate criteria and procedures for demonstrating and ensuring conformity of federal actions to a State Implementation Plan. The Environmental Protection Agency finalized these regulations on November 30, 1993 (58 FR 63214). Because prescribed fire emissions affect air quality, conformity determinations must be made at subsequent planning levels, such as National Forest or BLM District planning, province-level planning, watershed and landscape-level analyses, and site-specific analyses.

Figure 3&4-7. Federal Class I areas and federal PM10 nonattainment areas



Federal Class I Areas

Washington

1. North Cascades National Park
2. Mount Rainier National Park
3. Olympic National Park
4. Alpine Lakes Wilderness
5. Glacier Peak Wilderness
6. Goat Rocks Wilderness
7. Mount Adams Wilderness
8. Pasayten Wilderness

Oregon

9. Mount Hood Wilderness
10. Mount Jefferson Wilderness
11. Mount Washington Wilderness
12. Three Sisters Wilderness
13. Diamond Peak Wilderness
14. Mountain Lakes Wilderness
15. Crater Lake National Park
16. Kalmiopsis Wilderness

California

17. Redwood National Park
18. Marble Mountain Wilderness
19. Yolla-Bolly/Middle Eel Wilderness

▲ PM10* Nonattainment Areas

* PM10 = particulate matter 10 microns in diameter

Health and Welfare Effects of Prescribed Burning Pollutants

Criteria pollutants emitted from or formed as a result of prescribed fire include particulate matter (PM10), oxides of sulfur and nitrogen, carbon monoxide and ozone. Health effects associated with exposure to criteria pollutant levels greater than the NAAQS vary, and include lung damage, the reduction of the blood's ability to carry oxygen, eye irritation, chest pain, nausea, and an increased respiration rate. In terms of effects other than on human health (termed welfare effects), recent studies indicate that some aspects of forest health are adversely affected by several criteria pollutants produced by fire. Additional research is necessary to determine the human health and welfare effects specific to prescribed fire emissions.

Many other noncriteria, but potentially toxic, pollutants are emitted by prescribed fire, including polynuclear aromatic hydrocarbons (sometimes referred to as PAHs) and aldehydes. Effects vary from exposure to these pollutants emitted during combustion. Some polynuclear aromatic hydrocarbons are known or potential carcinogens; other components, such as aldehydes, are acute irritants. Many of these air toxics dissipate or bind with other chemicals soon after release, making it difficult to estimate human exposure and consequential health effects. Additionally, the health and welfare effects of air toxics released by prescribed burning or wildfires have not been directly studied.

Focus on PM10 (Particulate Matter Smaller Than 10 Micrometers)

PM10 is a term used to describe airborne solid and liquid particles 10 micrometers or smaller in size. Because of its small size, PM10 readily lodges in the lungs, thus increasing levels of respiratory infections, cardiac disease, bronchitis, asthma, pneumonia, and emphysema. The Environmental Protection Agency is considering a more stringent NAAQS for PM10 because recent studies indicate that the current NAAQS may not be adequate to protect individuals with a greater sensitivity to these particulates. Typical sources of PM10 include industrial processes, woodstoves, roads, agricultural practices, and prescribed fires and wildfires.

The air quality analysis in this SEIS focuses primarily on the impacts of particulate matter from prescribed burning. Particulate matter (PM10) is of the most interest because of the large quantities emitted from fires, the potential contribution of PM10 from prescribed and wildfires to pollutant concentrations above the PM10 standard, the major reduction of visibility caused by PM10, and the role PM10 plays as a carrier of other toxic pollutants.

Meteorological Factors

Weather patterns strongly influence air quality and smoke management by controlling the dispersion of emissions from fires. The primary weather conditions that affect dispersion are atmospheric stability, mixing height, and transport wind speed. Atmospheric stability refers to the tendency for air to mix vertically through the atmosphere. Mixing height is the vertical distance through which air is able to mix. Transport wind speed is a measure of the ability of air to carry emissions away from a source horizontally. These three factors determine the ability of the atmosphere to disperse and dilute emissions that are released from prescribed fires and wildfires.

The physiography, or physical shape, of landscapes interacts with and controls some weather patterns that influence emission dispersion. Many of the interior basins of the Pacific Northwest (e.g., the Puget/Willamette Trough and the Oregon and California Klamath Provinces) can trap emissions during periods when the atmosphere is relatively stable and winds are light. The mixing height is shallow, and pollutants may accumulate near the ground in these basins. This atmospheric condition is most likely to occur at times from November to March. However, little underburning or broadcast burning occurs at this time of year. In other physiographic provinces, and during the remainder of the year, prescribed burning is conducted when transport winds are not expected to carry emissions to smoke-sensitive areas in quantities that affect Prevention of Significant Deterioration increments and visibility. Furthermore, prescribed burning activities are coordinated with state and local air quality agencies to ensure that atmospheric stability and mixing heights are advantageous for dispersion.

Description of Natural Fire Regimes

Natural fire regimes vary widely between and within each province. However, some generalizations can be made to characterize the role of fire in natural ecosystem processes. These descriptions are based on knowledge of pre-European settlement fire regimes derived from historical accounts, early forest management inventories, and various imprints of fire on forest stands (e.g., stand ages and other tree ring data). Other discussions of the interactions between fire and ecosystem processes may be found in Appendix B2, Ecological Principles of Management of Late-Successional Forests, and in Description of Physiographic Provinces and Results of Assessing the Maintenance of a Functional and Interconnected, Late-Successional Ecosystem earlier in this chapter. Natural fires regimes are briefly summarized below. To facilitate this generalization, and to characterize the extent to which prescribed fire may be used in forest management under each alternative, the provinces are divided into three broad groups: moist, dry, and intermediate (see Figure 3&4-8). These are based primarily on climatic differences among the provinces, although forest types and fire regimes may also be inferred from the groupings.

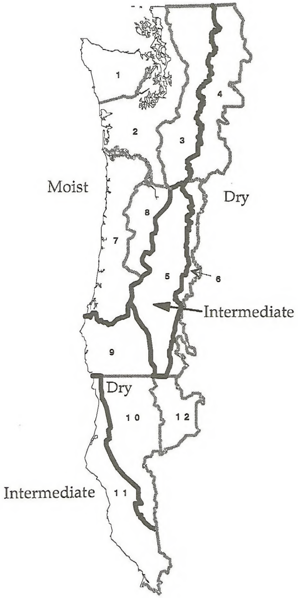
Moist Provinces

Historically, in the moist provinces within the range of the northern spotted owl, large expanses of relatively unbroken late-successional forest were common. Wildfires were generally large and infrequent. Though large, these fires were patchy, leaving behind many islands of unburned or lightly burned forest.

Intermediate Provinces

Fire has been the dominant forest disturbance factor in the intermediate provinces. Fire return intervals and fire severity were highly varied. In the warmer, drier areas, fire was more frequent and less intense. In these areas, wildfire played an important role in stand dynamics. For example, age-class distributions were altered with stand regeneration following wildfire. Wildfire did not always result in complete stand mortality. Recent studies of fires in the

Figure 3&4-8. Terrestrial physiographic provinces and climatic groups



Moist Provinces

1. WA Olympic Peninsula
2. WA Western Lowlands
3. WA Western Cascades
7. OR Coast Range
8. OR Willamette Valley

Intermediate Provinces

5. OR Western Cascades
11. CA Coast Range

Dry Provinces

4. WA Eastern Cascades
6. OR Eastern Cascades
9. OR Klamath
10. CA Klamath
12. CA Cascades

Oregon Western Cascade Province support this conclusion; fire killed 25 to 50 percent of trees within the areas burned, whereas 70 percent mortality (by basal area) is defined as a stand-replacement fire (see Appendix B2, Ecological Principles for Management of Late-Successional Forests). Surviving trees, snags, and coarse woody debris are important components of developing old-growth stands.

Dry Provinces

Fire has been the dominant natural disturbance factor within the dry provinces. The distribution, abundance, and dominance of the major plant groupings within the dry provinces reflect natural fire regimes to a greater extent than in the other provinces. In the dry provinces, fire suppression allowed fuel accumulations to become more continuous, both horizontally and vertically. This has led to larger, higher intensity fires than would have occurred under pre-European settlement conditions. The absence of fire has decreased the abundance of some old-growth forest types that are dependent on frequent, low intensity fires. Forest types that are less fire resistant have become more widely distributed. The stability of late-successional habitat is at risk without proactive fire management within the dry provinces (Agee 1993).

Recent Prescribed Fire Use and Emissions

Prescribed fire use during the recent past was analyzed to assess the effect on air quality of implementing the alternatives in this SEIS. The years 1985 through 1992 were analyzed because prescribed fire use trends for this period were representative of recent forest management practices, and because data quality was reasonably good. Detailed reporting of prescribed fire statistics is required in both Washington and Oregon in their State Smoke Management Plans. For California, prescribed burning statistics are not maintained at a single location, so data were obtained from each National Forest or Bureau of Land Management District. Information regarding fuel consumed (in tons) by burning in California was also more difficult to obtain, so estimates were made based on average fuel consumption data for areas with similar fuel types in Oregon.

Prescribed burning during the mid-to-late 1980's reflects a large amount of burning to dispose of harvest residues (usually called "slash burning") and to reduce moisture stress and growing-space competition from other onsite vegetation. Slash burning was used to reduce wildfire hazard and to prepare harvested sites for planting. Very little (less than 10 percent) of the burning that occurred from 1985 to 1992 was for ecosystem management purposes. From 1990 to 1992, PM10 emissions from prescribed burning declined rather sharply in each of the three climatic groups (Figure 3&4-9). During that period, the acreage requiring prescribed fire for slash burning and site preparation was reduced due to decreased timber harvesting. Emissions also decreased with the use of emission reduction techniques.

Prescribed Burning Air Quality Impacts

The air quality impact of prescribed burning during the 1985 to 1992 time period is difficult to quantify. While burning forest residues can create large quantities of particulate matter and other pollutants, this burning usually takes place in relatively remote areas with intensities that vent smoke high into the atmosphere where it is widely dispersed.

As one indicator of smoke impacts, Oregon Department of Forestry tracks smoke intrusions into designated areas (primarily population centers). An intrusion is defined as smoke from prescribed burning entering a designated area at ground level. Intrusions do not necessarily violate air quality standards, although they may cause public nuisances. The 1992 Oregon Smoke Management Annual Report displays the trend in intrusions over the 1985 to 1992 period. The area burned and the number of intrusions per year have both declined sharply in the early 1990's (Figure 3&4-10). However, because only smoke intrusions into designated areas are reported, potential impacts in very small towns or rural areas close to forest lands may be overlooked. Increased use of fire for ecosystem management may increase the number of intrusions per year. In particular, intrusions may increase because it is difficult to vent smoke from underburning into the upper atmosphere because of the low-intensity burning required to protect the residual stand.

The 1991 and 1992 Oregon Smoke Management Annual Reports also report PM10 violations. The Oregon Department of Forestry analyzed burning and weather conditions for the dates of violations and concluded that forestry-related burning did not contribute to any violation in either year.

Prescribed burning can adversely impact visibility in Class I areas where excellent air quality is an important value. Special remote-area monitoring in Oregon during 1982 to 1984 showed that prescribed burning contributed 48 percent of the particulate pollution at one Class I monitoring site and 41 percent at another, demonstrating that impacts can be significant. Prescribed fire use under any of the alternatives should follow state visibility requirements

Figure 3&4-9. Trends in PM10 emitted from prescribed fires (1985 to 1992) by climatic group

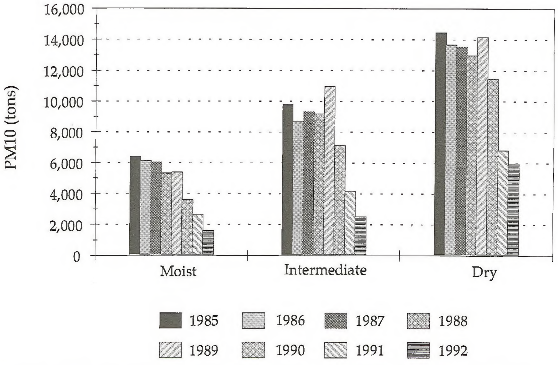
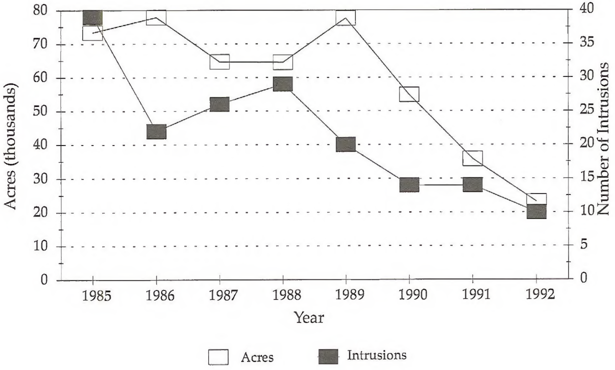


Figure 3&4-10. Trend in area burned and smoke intrusions per year in Oregon



to minimize impacts. Whether prescribed natural fire from unplanned ignitions should be restricted for visibility protection is still under discussion by air quality agencies.

Environmental Consequences

Estimation of Emissions by Alternative

Estimates of the expected annual acreage of prescribed fire use were calculated for all federally managed lands for each of the alternatives in this SEIS (see Table 3&4-16). Assumptions regarding the ecological need for prescribed burning, the hazard reduction that might be necessary for risk management, and the amount of prescribed burning necessary for site preparation were made at this programmatic level. These estimates are very generalized because many assumptions about the level of prescribed fire use for each land allocation within each province cannot be validated until watershed and landscape-level analysis or province-level planning are completed. Thus, air quality analyses at more site-specific planning levels are critical in determining the actual amount of prescribed fire that may be needed on the landscape.

The amount and type of prescribed burning projected under the alternatives represent a shift in emphasis compared to historical uses of prescribed fire. In the past decade, the majority of prescribed burning has consisted of broadcast burning of logging slash for site preparation and management of competing vegetation. Some of this burning simultaneously contributed to fuels hazard reduction. In the alternatives, prescribed burning emphasizes ecosystem processes restoration, habitat restoration and maintenance, and hazard reduction. Much of this burning would be underburning, in both natural and managed stands. Burning for hazard reduction and site preparation may frequently take place in stands with many more trees retained than previously left after harvest, necessitating changes in prescribed fire techniques. Burning piles of slash after harvest, or for hazard reduction, may be done during the most favorable emission dispersion conditions. This continues a recent trend in fuels management.

For emissions, the shift in emphasis from broadcast burning to underburning has some inherent risks along with its advantages. Large areas may burn in mosaics with varying fire intensity and severity. While this mimics natural underburning, there are risks associated with retaining coarse woody debris; the likelihood for reburning is increased, as is the possibility for a prescribed burn to escape the planned burn area. Consequently, the potential for additional, unanticipated emissions is also increased. Furthermore, costs associated with the need for rapid extinguishment of smoldering fuels may be high. Thus, fire management planning and risk assessment will need to become more fully integrated into land management planning decisions as part of ecosystems management.

Wildfire occurrence and risk are much greater in the dry and intermediate province groups. Table 3&4-17 shows information on wildfire occurrence, acres burned, and PM10 emissions from 1980 to 1989 in the Oregon and California Klamath Provinces. Where extensive fuel hazard reduction by prescribed burning is considered, a tradeoff analysis to compare emission levels from both

Table 3&4-16. Expected average annual acres of prescribed fire use by alternative and climatic group

Alternative	Moist	Intermediate	Dry	Total
1	6,232	7,087	32,502	45,821
2	7,367	7,706	38,584	53,657
3	7,019	7,270	67,546	81,835
4	6,525	7,680	38,352	52,557
5	7,217	8,399	42,219	57,835
6	7,467	8,203	40,857	56,527
7	10,508	9,327	47,131	66,966
8	8,146	8,542	42,252	58,940
9	7,406	14,656	66,871	88,933
10	7,467	8,153	40,857	56,477
Average (1985-92)	17,562	27,257	50,208	95,027
Average (1985-90)	20,673	31,928	56,669	109,270

Table 3&4-17. Recent fire history and PM10 emissions in the Oregon and California Klamath Provinces[1]: wildfire occurrence, acres burned and PM10 emissions (1980-1989)

Year	Wildfires (number)	Acres	PM10 Emissions (tons)
1980	1,289	11,376	1,229
1981	1,183	18,235	1,969
1982	955	6,515	704
1983	1,061	1,242	134
1984	1,439	4,276	462
1985	2,075	13,717	1,481
1986	1,443	4,010	433
1987	2,985	580,816	62,728
1988	1,594	38,429	4,150
1989	1,735	6,422	694
Klamath Provinces Total	**15,759**	**685,038**	**73,984**
10 Year Average[2]	1,576	68,504	7,398
5 Year Average[3]	1,966	128,679	13,897

[1] Includes all federally managed lands, as well as lands protected by the States of Oregon and California.
[2] 10 year average (1980-1989)
[3] 5 year average (1985-1989)

wildfire and prescribed fire is necessary. It is anticipated that by prescribed burning under advantageous weather conditions, subsequent wildfire emissions may be reduced due to a decreased amount of available fuel and a lowered risk of large-scale wildfire. A tradeoff analysis will document this reduction and the possible associated changes in air quality impacts.

Determination of Emission Factors

A description of the dominant vegetative cover-type was available for each of the physiographic provinces and land allocations. These descriptions were used to assign preburn fuel loadings based on standardized values available from the natural photo series. Fuel loadings were estimated for areas where natural fuels dominated and where activity-generated fuels dominated. Activity fuels may originate from timber harvest or thinning activities, and they may be left in place or concentrated into piles before burning. Fuel loading was estimated in two categories: woody fuels and litter/duff. Fuel consumption was estimated specific to cover type and whether fuels were natural or activity generated.

Emission factors were assigned by vegetative cover type and by fuel treatment activity (burning of activity fuels in place, burning fuels in piles, or ecosystem burning). An emission factor for each fuel type and treatment type was assigned based on current research and best professional judgement. Emission levels for both PM10 and total suspended particulates (TSP) were calculated for each alternative and the historical period of 1985 to 1992. Emission reduction goals in Oregon and Washington and Prevention of Significant Deterioration increments are described by TSP concentrations. PM10 is the unit of measure for NAAQS, and has more influence on visibility.

Emissions by Alternatives

Total particulate emissions and PM10 were calculated based on projections of acres to be burned by alternative, on estimates of preburn fuel loadings by cover type, on fuel consumption by fuel treatment alternative, and on emission factors assigned based on cover type and fuel treatment alternative. These estimates are displayed in Figures 3&4-11 and 3&4-12, and are compared to PM10 estimates from prescribed burning during 1985 to 1992. PM10 emissions are projected to decline for all alternatives.

Aggregated across the three climatic groups, Alternatives 3 and 9 have the greatest potential impact on air quality, with each proposing to emit roughly 35 to 40 percent of the historic PM10 levels from prescribed burning (1985 to 1992). Alternatives 1 and 4 have the least potential impact on air quality, with projected PM10 emissions from prescribed burning of approximately 15 to 20 percent of historic levels. The remainder of the alternatives are projected to emit roughly 25 to 30 percent of historic PM10 levels from prescribed fire use.

Within the moist provinces of western Washington and western Oregon, PM10 emissions from prescribed fire would decline from the historic level of 4,658 tons per year, down to 1,829 tons per year under Alternative 7, to a low of 908 tons per year under Alternative 1.

Within the intermediate climatic provinces covering the Oregon Western Cascades and California Coast Range Provinces, PM10 emissions from prescribed fire would decline from the historic level of 7,728 tons per year, down to 2,024 tons per year under Alternative 9, to a low of 702 tons per year under Alternative 1.

Within the dry provinces, PM10 emissions from prescribed burning are the greatest, although they are still projected to be roughly 40 to 80 percent lower than the historic level of 11,632 tons per year. Alternative 3 has the highest PM10 emissions at 6,685 tons per year; Alternative 1 has the lowest PM10 emissions at 2,069 tons per year.

State Emission Reduction Goals

Washington and Oregon have established emission reduction goals for Total Suspended Particulate (TSP) emissions from prescribed burning. Each goal calls for a 50 percent reduction in these emissions by the year 2000. To obtain some indication of how future burning may impact emission reduction goals, the emissions estimates for alternatives were converted to TSP and compared to an adjusted Oregon TSP baseline. The Oregon estimate was adjusted downward based on the portion of acres burned on federal lands between 1985

Figure 3&4-11. Historical and projected average annual PM10 emissions by alternative

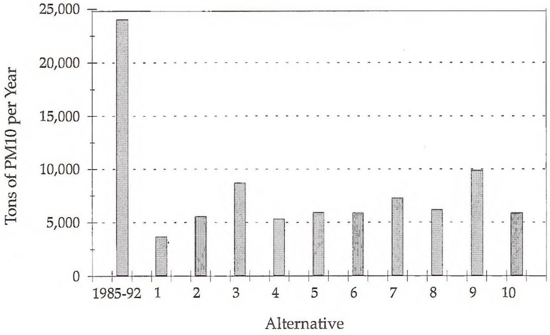
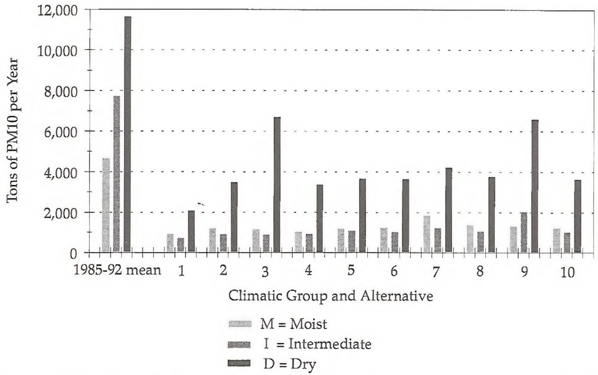


Figure 3&4-12. Historical (1985 to 1992) and projected average annual PM10 emissions by climatic group and alternative



and 1992. Comparison to the TSP baseline for the State of Washington was not presented because the baseline is being revised. However, emissions under the alternatives will be within the prorated federal proportion of the baseline. For each alternative, projected emissions for the entire planning area are well below the baseline value for historic burning. Therefore, it appears that fire use in the future will not compromise the ability of states to reach prescribed burning emission reduction goals. (California does not have an emission reduction goal for particulate emissions.)

Mitigation Measures to be Considered or Required

Several strategies can be used to manage smoke from prescribed fires. However, each prescribed burn within the planning area is different and requires individual analysis to select the best available control method.

Alternative fuel reduction treatments, described under Emission Reduction Techniques below, should be considered whenever they are compatible with the land allocations' resource management objectives. These fuel treatments are expected to be effective in the rural/urban interface, and generally in the matrix, Adaptive Management Areas, and Riparian Reserves.

Emission Reduction Techniques

Emission reduction techniques reduce the amount of smoke produced from a prescribed burn. The techniques used will depend on whether there is an overstory of trees, activity fuels, or natural fuels. Emission reduction techniques for prescribed burning can be can be categorized according to four basic factors that determine the amount of emissions generated: (1) reduce the number of acres burned, (2) reduce fuel loadings, (3) reduce fuel consumption, and (4) optimize the flaming emission factor when burning.

1. Reduce the Number of Acres Burned.

Perhaps the most obvious method to reduce emissions is to consider each area and determine if prescribed burning is the most effective option for treatment. In some cases, alternative silvicultural stand management methods, mechanical treatment methods, or utilization may be viable alternatives for meeting management objectives and eliminating the need to burn.

Density management through the use of thinning and understory removal will improve stand conditions in some cases and may alleviate the need for burning. Silvicultural activities may concentrate on the development of late-successional characteristics and the prevention of large-scale disturbances by fire, wind, insects and disease.

Manual treatment consists of hand piling, and may or may not include burning fuels. This method is generally used for specific silvicultural and hazard reduction objectives. Manual treatment is labor intensive, which results in increased costs. Usually it is not cost-effective in areas of heavy fuel loadings and/or large areas. Burning piles can be done during periods of weather that are more advantageous.

Mechanical treatments rearrange and change the size and shape of the slash (fuel) components. Mastication crushes and shreds small-diameter concentrations of slash into a scattered layer of residue on the ground. This level of treatment is generally sufficient for silvicultural objectives, but may not significantly reduce wildfire hazard. Equipment is limited to slopes less then 30 percent. Application in areas with heavy fuel loading may not be feasible, and mechanical treatments in natural stands may conflict with other resource management objectives.

Chipping onsite may be used to treat slash. Chipping can range from labor intensive to highly mechanized operations. Residue can be spread onsite or hauled away depending on local chip market conditions.

Piling residue can be accomplished by various types of machinery. Piling can be used for all levels of fuel concentrations depending on the type of equipment. Terrain and soil conditions are the limiting factors. While some grappler machines are made for slopes in excess of 30 percent, cost becomes a critical issue. Burning piles can be done during periods of weather that are more advantageous.

2. Reduce Preburn Fuel Loading.

If prescribed fire is determined to be the optimal treatment for an area, reducing the fuel loading before the burn will often reduce the fuel available for consumption, and consequently the emissions produced. Increased utilization, whole-tree yarding, firewood sales, and yarding unmerchantable material off the unit are several methods to reduce the fuel loading.

Because of new technology, there are more opportunities for increased utilization of residue. For example, some lumber mills are able to use bole wood down to a 4-inch diameter. However, this may conflict with guidelines for retention of coarse woody debris. Firewood is still a major use market.

3. Reduce Fuel Consumption.

Burning under conditions that reduce the proportion of biomass that is consumed will lower the emissions produced. The objective should be to burn only the biomass that needs to be burned. This can be accomplished by: burning when woody fuel and duff moisture contents are high, increasing the rate of mop-up, isolating large fuels and stumps from burning, burning only fuel concentrations, burning when fuel moisture is high in large fuels, and using high-intensity firing techniques.

4. Optimize Flaming Consumption Emission Factor.

There are ways to conduct a prescribed fire that will lower the applicable emission factor, thus lowering the total emissions produced. Three primary methods for lowering the emission factors are: (1) shifting from broadcast burning to pile burning, (2) employing high-intensity firing techniques, and (3) using back-firing techniques.

5. Favorable Weather Conditions.

Managing smoke emissions may include transporting smoke away from sensitive areas, and diluting emissions by projecting the smoke plume into transport winds. Burning during the spring has afforded the greatest opportunity to mitigate prescribed fire smoke impacts, because atmospheric instability and persistent transport winds are common. Most prescribed burning in the dry and intermediate provinces is accomplished from March through June. Fuel moisture is optimal for emission reduction during this period. Broadcast burning in the Oregon Coast Range Province extends into the summer and early fall months to take advantage of easterly winds that transport smoke away from smoke sensitive areas. Fall and winter temperature inversions often restrict pollutants to ground level when burning takes place under the inversion layer. Winter burning that follows the requirements of state smoke management plans normally does not impact smoke sensitive areas because burning is done above the inversion layer.

Emission Monitoring

An emissions information system is used by the States of Oregon and Washington to quantify prescribed fire emissions and to track emission reductions within their jurisdictions. Land managers have an obligation to complete smoke management reports and apply appropriate mitigation measures to reduce potential impacts on air quality. Managers can use available computer software such as CONSUME (Ottmar et al. 1993), SMSINFO (Ottmar et al., in press), and PUFF (Hardy et al. 1993) to estimate fuel consumption, emissions, and smoke dispersion from prescribed burns.

Additional Evaluation and Planning Needed

This SEIS is programmatic and covers a large geographic area (24.5 million acres of federal lands) encompassing hundreds of land management units. Information contained in this SEIS is, therefore, generalized. A number of important changes to forest management practices are also proposed. Because of the broad scope and suggested revisions to forest management, further evaluation and planning are necessary at subsequent planning levels.

Environmental analyses for the use of prescribed fire should address the following key points:

1. Assess the need for burning compared to alternate fuel reduction or site preparation methods such as scarification, and piling and yarding unmerchantable material;

2 Quantify the amount and types of material, and acreage to be burned;

3 Describe the type of burn proposed (e.g., broadcast, pile, understory);

4 Quantify emissions of air pollutants;

5. Describe mitigation measures to reduce emissions;

6. Describe applicable regulatory, permit and smoke management requirements;

7. Describe and quantify air quality impacts on downwind communities and discuss visibility impacts in Class I areas;

8. Model downwind concentrations of pollutants to document compliance with NAAQS, Prevention of Significant Deterioration increments (if applicable), and visibility impacts in Class I areas (if affected); and

9. Describe the existing monitoring network. If needed, develop a plan to revise or expand monitoring to ensure that the impacts of prescribed burning on air quality are measured.

All levels of planning should assess air quality impacts using these steps. In recognition of the limitations of current models for determining impacts from prescribed burning, other quantitative or qualitative means should be employed in the absence of an appropriate model. Modeling of downwind concentrations of pollutants (point number 8 above) was not possible for this SEIS with the available technology, but should be completed in future planning efforts using the best available models as they are developed. Also, at subsequent planning levels (province, watershed and landscape, and site and project), more site-specific detail should be incorporated.

Level of Analysis

Currently, review and planning efforts under the National Environmental Policy Act occur at the regional, District or National Forest, and unit-specific level. Changes in forest management proposed in this SEIS, such as the type of prescribed burning conducted, may dictate that future environmental analyses be based on physiographic provinces or watersheds. Watershed-level analysis procedures are under development, and responsible agencies should incorporate future air quality planning into these efforts.

To achieve the air quality goals set forth in this SEIS, local, state and federal agencies will need to coordinate and cooperate to a greater extent. The interagency efforts for developing this SEIS should be continued and expanded to subsequent planning levels.

Emissions Projections and Modeling

The characterization and quantification of emissions (e.g., plume direction and pollutant concentration) from prescribed fire are critical when evaluating impacts on human health and the environment. Estimates of the emissions from prescribed fire associated with the forest management described in this SEIS are limited. Emissions factors and consumption rates for underburning need to be developed. Also, new photo series to characterize the fuel loadings and conditions in stands proposed for burning under ecosystem management need to be developed. Further analyses of emissions on smaller, more specific geographic units are required by law and regulation.

Further analyses should also include the application of available air dispersion models in order to understand and estimate the downwind impacts on air quality from prescribed fire. Models currently available, such as PUFF and SASEM, vary in scope and function, and none have been extensively field tested to verify accuracy in predicting downwind pollutant concentrations. Also, current models cannot accurately predict the dispersion of smoke plumes in mountainous terrain. In order to refine smoke dispersion models, improvements in the emissions decay constant, plume rise modeling, and surface wind predictions must be completed. Future planning efforts should use the most appropriate air quality model.

Finally, differences in smoke production from prescribed fire versus wildfire need to be assessed through a tradeoff analysis which will enable managers to make informed decisions regarding managed fire, wildfire, and air quality. This analysis will demonstrate the amount of prescribed burning that will result in the lowest total level of emissions, when considering both prescribed fire and wildfire emissions.

Air Quality Monitoring

Several different monitoring networks currently measure air quality in the planning area. The most extensive of these is the State and Local Air Monitoring Stations/National Air Monitoring Stations. Operated by the states, this monitoring network is used to determine whether the National Ambient Air Quality Standards are met. Monitors in this network are concentrated in population centers. Federal agencies are also operating IMPROVE monitors at five sites within the planning area. IMPROVE monitors measure total PM10, changes in visibility, and have filters that can be analyzed to determine the relative contribution of different sources of PM10. Federal agencies are also monitoring pollutant concentrations during prescribed fire operations. In addition to monitoring pollutant concentrations, state and federal agencies collect information on acres burned, moisture content of fuels, and other measures.

Monitoring is essential to managing prescribed fire operations, verifying models, and assessing impacts. The responsible agency should review the monitoring plan and network for each planning area, and revise or expand monitoring, if necessary, to determine the adequacy of the monitoring system. The responsible agency should also identify sensitive receptors to include in their monitoring program for each Air Quality Related Value. Monitoring programs aimed at detecting or predicting air pollution impacts on these values must take into account the complexity of the interrelationships among ecosystem components.

Cumulative Impacts

To more accurately assess the local and subregional air quality effects of forest ecosystem management proposed in this SEIS, and to ensure that air quality impacts from prescribed burning for ecosystem management are quantified and minimized, a cumulative impacts analysis should be prepared at each planning level. The analysis should evaluate the cumulative impacts of individual burns on regional and subregional air quality. At a minimum, the analysis should include consideration of the direct, indirect, and cumulative impacts of emissions from fire on human health and the environment, including any potential effect on visibility and regional haze. A cumulative impacts analysis may also consider the impact of prescribed burning on wildfire emissions.

The value of a cumulative impacts analysis will depend largely on selecting the appropriate planning level and geographic boundaries for the analysis. The appropriate planning level to conduct a cumulative impacts analysis is not defined in this SEIS, nor are the parameters for establishing geographic boundaries for such an analysis. Both of these planning elements will vary depending on local, state, and federal (e.g., Environmental Protection Agency, Forest Service, and Bureau of Land Management) involvement, resources, and potential health impacts. Factors to consider when establishing the geographic boundaries for a cumulative impacts analysis include whether the action will result in impacts that cross political boundaries, and whether the action will affect sensitive air quality regions (i.e., Class I areas and nonattainment areas).

Conformity Determinations

Conformity determinations evaluate whether federal actions comply with State Implementation Plans. Some of the most stringent provisions in the applicable plans contain emission reduction goals to remedy visibility impairment and to reduce ambient levels of particulate matter; both Washington and Oregon have adopted 50 percent particulate matter emission reduction goals into their State Implementation Plans. Their goals are to achieve these reductions by the year 2000. In fact, these goals were achieved for both states by 1986. In addition, the projected particulate matter emissions for all of the SEIS alternatives are less than those emitted in Washington and Oregon for the years when they attained their goals. This supports the determination that all of the SEIS alternatives will be consistent with the Washington and Oregon state plans. Washington and Oregon also have Smoke Management Plans in their State Implementation Plans that regulate the conditions and procedures for prescribed burning. Federal actions must comply with the provisions in these Smoke Management Plans. Based on the broad level of analysis in this SEIS, it is unlikely that any of the proposed alternatives will violate the provisions in these Smoke Management Plans.

In California, no state wide particulate matter emissions reduction goal exists, and there are no PM10 nonattainment areas in the California portion of the SEIS planning area. Some of the local air pollution control districts within the planning area have adopted Smoke Management Plans, but these have not been adopted into the State Implementation Plan.

The projected reduction in estimated aggregated emissions compared to the 1985 to 1992 baseline makes it reasonable to conclude that, at this scale, the proposed alternatives will not degrade air quality, nor violate the applicable State Implementation Plans. However, due to the broad scale of these actions, projected emissions cannot be accurately quantified. Thus, an overall conformity determination for the alternatives in this SEIS cannot be made at this time. Aggregating emissions over the entire planning area masks subregional and subprovince level conditions and impacts. Therefore, the Forest Service and the Bureau of Land Management will conduct additional conformity determinations and cumulative impacts analyses at subsequent planning levels where emissions can be more accurately quantified and reasonably forecasted. In particular, future analyses will evaluate the effects of province-level and project-specific prescribed burning on nonattainment areas.

Water Quality

Affected Environment

Water quality and ecosystem health are closely linked. Changes in any of the chemical, physical, and biological properties of water can directly affect people, fish, wildlife, and overall ecosystem functions and values. Waters flowing from forested areas administered by the Forest Service and Bureau of Land Management have a number of beneficial uses, including providing domestic, industrial, and agricultural water, recreation opportunities, fish and wildlife habitat, and power production. However, most interest in water quality in the forested areas within the range of the northern spotted owl has centered on providing suitable conditions for aquatic species, particularly the salmonids. The section on Current Aquatic Conditions in this chapter discusses the affected environment for salmonids and other aquatic species, and provides water quality assessment information for the range of the northern spotted owl.

Water quality plays an important role in ecosystem function on federal lands. Primary factors affecting water quality are erosion and subsequent sedimentation resulting from natural and management-induced disturbances such as timber harvest, road construction, stream crossings, high intensity fires, and increased temperatures resulting from removal of riparian vegetation that shades streams. Other factors include nutrients, herbicides, pesticides, organic debris, and altered streamflow. The objectives of the Clean Water Act are "to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Biological and physical integrity includes aquatic dependent flora and fauna and the functions that sustain them. The objectives of the Aquatic Conservation Strategy are similar to those of the Clean Water Act, focusing on the maintenance of the physical and biological functions of aquatic systems.

The Clean Water Act directs federal agencies to comply with state water quality requirements to restore and maintain water quality necessary to protect beneficial uses such as public water supply, recreation in and on the water, and protection and propagation of fish, shellfish, and wildlife. The Forest Service and Bureau of Land Management are the designated management agencies within the range of the northern spotted owl, charged with implementing and enforcing natural resource management programs for the protection of water quality on lands they administer. Most of the water quality problems associated with activities on these lands fit into the category of nonpoint source pollution. Nonpoint sources of pollution may result from activities and events that alter vegetation or disturb the ground and are frequently hard to trace to a single point of origin. Management actions that cause nonpoint source pollution and point sources of pollution, such as mine adits and tailings impoundments, are subject to state water quality requirements under the Clean Water Act.

Under the Clean Water Act best management practices (BMPs) are water quality protection measures developed by the Forest Service and BLM to attain and maintain state water quality goals and objectives. These practices are certified by the state agency with water pollution control authority, approved by the Environmental Protection Agency, and included in current plans and draft plan preferred alternatives for lands administered by the Forest Service and BLM. All activities on these lands must adhere to the plans' best management practices. This SEIS identifies protective measures for water quality, such as Riparian Reserves and Key Watershed designations, that in many cases are more stringent than formally certified and approved best management practices and should help exceed water quality goals and objectives. The term best management practices, as used in this SEIS' water quality section, refers to both formally approved best management practices and the watershed protection measures proposed under the Aquatic Conservation Strategy.

The Coastal Zone Act Reauthorization Amendments require that states with federally approved coastal zone management programs to develop coastal nonpoint pollution control programs by 1996. The geographic area includes those watersheds affecting coastal zones and estuaries within the range of the northern spotted owl. The purpose of the program is to implement management measures for nonpoint source pollution by more fully integrating federal, state and local authorities. The programs are to contain enforceable policies and mechanisms to ensure the implementation of the management measures. Plans and activities undertaken by federal agencies are to be consistent with these programs.

A number of public water systems have their surface water sources originating on lands administered by the Forest Service and Bureau of Land Management. These systems must comply with various requirements of the Safe Drinking Water Act (40 CFR 141.70-.75) including the Surface Water Treatment Rule. Whether a system attempts to meet the Surface Water Treatment Rule criteria (which would allow it to remain unfiltered) or provides filtration, maintaining the highest water quality in its source water will enhance the water system's ability to meet the Safe Drinking Water Act's requirements, provide adequate public health protection, and reduce treatment costs.

Environmental Consequences

Methodology

Under the Clean Water Act, states adopt water quality standards. Water quality standards consist of designated beneficial uses for the waters of the state as delineated in the states' administrative rules, and criteria to protect the beneficial uses. Typical beneficial uses include primary and secondary contact recreation, water supply, and warm and cold water biota. Criteria may be constituent concentrations (e.g., turbidity, temperature), levels, or narrative statements (e.g., no discharge of materials in concentrations harmful to human health or aquatic life) representing water quality that supports a particular use. The water quality standards also include an antidegradation policy protecting existing uses and waters of high quality.

The success of site-specific projects in meeting water quality standards depends on the effectiveness of the best management practices applied for those projects. For example, the establishment of Riparian Reserves is a best management practice designed to help achieve water quality standards through shade-related maintenance of water temperatures and reductions in sediment delivery to the streams. Other practices, such as Late Successional Reserve allocations and road mileage restrictions in Key Watersheds, will also help maintain water quality and beneficial uses. Monitoring the effectiveness of best management practices will determine if those practices are resulting in water quality protection, that is, yielding water that meets water quality standards. If found ineffective, the best management practices will be revised or management activities will be altered. The application of best management practices alone cannot ensure that Clean Water Act requirements are being met. The adaptive management process, which consists of planning, monitoring, evaluation, adjustment, research, and implementation, is the iterative process that will be used for validating and, where appropriate, revising best management practices.

If the application of best management practices or technology-based controls (e.g., metal precipitators, secondary treatment of wastewater) cannot achieve designated water quality standards, a water body is classified as "water quality limited." Under Section 303(d) of the Clean Water Act, states must list those waters which are water quality limited and establish total maximum daily loads for these waters. To establish total maximum daily loads, the state must first determine the amount of pollutants a water body can safely assimilate, then allocate this amount to the various pollution sources. For example, a river in a watershed with an established total maximum daily load for sediment could have a portion of the total sediment load allocated to grazing, timber harvest, roads, background levels, and other sources of sediment within the watershed. If restoration projects resulted in a reduction of sediment from a source (i.e., road) within a watershed, then the amount of sediment allocated for other sources, including new projects, could be adjusted. Watershed and cumulative effects analysis for site-specific projects, together with the adaptive management process, will be implemented to closely parallel the approach for conducting total maximum daily loads.

Section 319 of the Clean Water Act requires each state to complete a water quality assessment and to develop a management program to control the addition of pollutants from nonpoint sources. These assessments identify water that cannot reasonably be expected to attain or maintain applicable water quality standards or goals without further control of nonpoint sources. The nonpoint source management program identifies best management practices and programs to reduce nonpoint source pollution. If a state determines that a federal project or program is not consistent with the provisions of its nonpoint source program, the federal agency must make efforts to accommodate the state's concerns.

Effects

The current plans and draft plan preferred alternatives for lands administered by the Forest Service and BLM address the potential effects of existing management activities on water quality. These plans generally correspond to Alternative 7 of the SEIS (see Chapter 2) and provide land allocations and standards and guidelines for controlling water quality impacts that are in most cases less stringent than the water quality protection measures proposed by the Aquatic Conservation Strategy in the SEIS. In those cases where current plans and draft plan preferred alternatives for lands administered by the Forest

Service and BLM provide greater water quality protection than the Aquatic Conservation Strategy, the current plans and draft plans' water quality protection measures will be applied.

The effects to water quality under the alternatives vary depending on the acreages and distribution of the various land allocations and the type and location of land-disturbing activities occurring under the alternative. The most significant factors related to potential water quality effects for each alternative are the Riparian Reserve scenarios, the level and location of road building, and the amount and method of timber harvest permitted. Alternatives 1, 4, and 9 would have the least adverse effects to water quality. Alternatives 2, 3, 5, 6 and 10 have the potential for comparatively greater effects to water quality than Alternatives 1, 4, and 9, primarily because they provide less protection for intermittent streams in Tier 2 Key Watersheds and non-Key Watersheds. Alternatives 7 and 8 have the greatest potential to impact water quality of the 10 alternatives analyzed in this SEIS. Based on the Riparian Reserve scenarios and other components of the Aquatic Conservation Strategy, all of the alternatives except 7 and 8 are expected to maintain or improve water quality, although watershed recovery rates would be quickest for Alternatives 1, 4, and 9. Subsequent analysis at the province, watershed, and site-specific levels will be needed to support development and implementation of water quality protection measures.

The level of water quality protection under Alternatives 1, 4, and 9 should also benefit water supply systems within and downstream from lands administered by the Forest Service and BLM. Although additional NEPA analysis will be needed to assess the effects of site-specific projects on water supply systems, the Riparian Reserve scenarios and other components of the Aquatic Conservation Strategy under these three alternatives should contribute to the ability of water systems to remain unfiltered and comply with Safe Drinking Water Act requirements.

Adverse cumulative effects to water quality and water supply systems would be the greatest under Alternatives 7 and 8 and the least under Alternatives 1, 4, and 9. The level of cumulative effects for Alternatives 2, 3, 5, 6 and 10 would fall somewhere between the prior two groups of alternatives. The difference in cumulative effects among alternatives is primarily a function of the alternatives' proposed level of land disturbance (e.g., roads, harvest levels) and the degree of Aquatic Conservation Strategy adoption. The broad scale application of the full Aquatic Conservation Strategy within the range of the northern spotted owl will significantly reduce the potential for adverse cumulative effects to water quality. Land disturbances will be more localized and related primarily to land allocations and the standards and guidelines that apply. Cumulative effects will be further addressed in subsequent analyses and for tiered plans and projects.

Nonfederal Lands

Many of the watersheds within the range of the northern spotted owl include a mixture of federal, state, private, and tribal and Indian owned lands. Federal lands are frequently located in the upper portions of watersheds and make a significant contribution to the maintenance of water quality and beneficial uses on downstream nonfederal lands. However, the role of nonfederal landowners is significant because water quality protection on federal lands alone may not ensure attainment of water quality standards downstream. Management practices and water quality protection measures for nonfederal lands are important because water withdrawals, discharges to streams, modifications of streamside habitat, and population densities are generally greater on nonfederal lands than on federal lands. A comprehensive approach to water quality protection for nonfederal and federal lands would help meet water quality goals and maximize the resource management opportunities within the planning area.

Riparian Reserves and the other components of the Aquatic Conservation Strategy would provide greater protection of water quality, fish habitat, and riparian areas than is currently required for nonfederal lands, particularly for Alternatives 1, 4, and 9. Significant timber harvest within the riparian management areas on nonfederal lands is allowed, and the width of the state required riparian zones is narrower, particularly for intermittent and smaller perennial streams. (See the FEMAT Report, Appendix V-K, for a detailed description of state forest practices.) State timber harvest practices do recognize the importance of water quality protection and have included more stringent water quality protection measures than in the past. Province and watershed analyses, site-specific cumulative effect analysis, total maximum daily loads, and the federal consistency provisions of Section 319 of the Clean Water Act represent opportunities for all landowners and agencies to more closely coordinate their activities and cooperate in achieving water quality goals.

Long-Term Soil Productivity

Affected Environment

Soil is a highly variable and complex layer of unconsolidated material. It consists of aggregates, airspace, water, chemicals, gases, organic material, living organisms, and rock fragments. The combined influences of time, parent material, climate, living organisms, and the topography of a site interact to form soils with unique sets of physical and chemical properties that determine the productivity of each soil. Natural soil productivity varies widely across the range of the northern spotted owl due to soil properties (e.g., nutrient status, depth, coarse fragment content, texture) and site characteristics (e.g., elevation, aspect, slope gradient). Soils located within the northern spotted owl's range that have relatively high annual precipitation and moderate mean annual temperature, are some of the most productive soils in the world; these soils typically occur at lower elevations west of the crest of the Cascade Range. Soils with lower productivity typically have colder mean annual temperatures (shorter growing seasons) and/or receive relatively low average annual precipitation. These soils are more prevalent at higher elevations and east of the crest of the Cascade Range. Generally, soils in the Oregon and California Klamath Provinces are intermediate in productivity, when compared to soils located in provinces to the north and west of the Cascades crest, and those provinces located at higher elevations and/or east of the Cascades crest. Within each physiographic province, the more productive soils are typically found on valley bottoms, lower ends of slopes, slope benches, and broad ridgetops.

Soils provide many functions such as storage and conveyance of water to streams and lakes, and providing a medium for plant growth and biological activity (e.g., arthropods, bacteria, mycorrhizal fungi). Soil productivity is a soil's ability to produce vegetation. Long-term forest soil productivity is the capacity or suitability of a soil to establish and grow a plant species and community over time, primarily through nutrient availability and available plant moisture. Ecosystem structures and functions ultimately depend on productive soils. A number of soil properties (organic matter content, nutrients, texture, structure, porosity and its influence on available moisture and oxygen; and depth) are recognized as important for vegetative growth. Forest dynamics such as fire, wind, and succession, affect soil organic matter accumulation and cycling, which in turn affects long-term soil productivity. Both amount and composition are important characteristics of the surface organic layer. Conservation of small materials (needles, leaves, twigs) is important for soil total nitrogen because these materials have the highest concentrations of nitrogen. Large materials (e.g., coarse woody debris, stems, large branches) are important for healthy soil biology because they influence soil nutrient availability and soil moisture.

Soil organisms interact with each other and their environment and play a fundamental role in many site processes. Soil organisms promote carbon cycling, nutrient transfer, water availability, vegetation vigor, and maintenance of soil structure. Most biological fixation of nitrogen in ecosystems occurs because of soil organism activity. Mycorrhizal fungi increase the absorbing surface area of roots, which directly increases the total soil volume that can be explored for nutrients and water. Mycorrhizal fungi and other microbes affect soil structure by helping bind soil particles into water-stable aggregates which, in turn, create soil volume with stable and adequate pore space. Soil pores are essential for adequate movement of water and air required by plants and soil organisms.

Soils within the range of the northern spotted owl vary considerably within and between watersheds, river basins and physiographic provinces. The following discussion gives a broad overview of the diversity of soil types within and between physiographic provinces.

Olympic Peninsula Province

Soils on the Olympic Peninsula span a wide temperature range due to the range in elevation and aspect. The orographic uplift effect, and a resultant rain shadow on the east side of the Olympic Range, create another range of soil moisture regimes. The highest elevations are composed mostly of rock outcroppings and young, shallow soils with low annual biological rates and nutrient capital. Mid-elevation soils have been influenced by glaciation and are developing from glacial deposits, as well as from local, residual materials. These mid-elevation soils vary in depth from shallow/rock outcrop complexes (steep slopes, drainage heads, and debris avalanches trails) to deep (gentle slopes, fans composed of debris flow deposits). Soils at low elevations are developing in alluvial deposits, glacial deposits, and/or residual materials. Typically, soils in the mid and low elevations are highly productive with high levels of organic material on the soil surface.

Washington Western Lowlands Province

This province contains two major areas with different geology, landscapes, and soils. One area is the Puget Trough and associated lowlands. Soils in this major area are relatively young because most are forming from glacial and alluvial materials. The glacial materials vary from outwash deposits, to moraines (residual deposits left by receding glaciers), to till. The glaciated materials extend south to the area between Olympia and Centralia. Soil moisture and temperature regimes are relatively constant while coarse fragment content, depth, and drainage are major variables that determine soil productivity in this area. The second major area in this province is the Southwest Washington Coast Range. Soils in this second area are developing predominantly from sedimentary bedrock parent material. This major area has highly productive soils due mainly to climate. Soil moisture and temperature regimes are very favorable for soil biological activity. Soil depth and coarse fragment content are dominant factors influencing productivity for this area.

Willamette Valley Province

Soils in this province developed predominantly from alluvial material. Soil temperature and moisture regimes do not vary much. Soil drainage is a major factor that determines soil productivity. Human induced actions have altered most of the valley's natural drainage, affecting the soil productivity.

Washington and Oregon Eastern Cascades Provinces

Soil moisture and temperature regimes are predominant factors that influence soil productivity in these provinces. The higher elevations have cold temperature regimes which inhibits soil biological activity. Soils are relatively young due to geologically recent glaciation and/or volcanic deposition. Glaciation is a predominant factor in soil formation for higher elevations in these provinces. Shallow soils and rock outcrops occur on the steep-sided valleys carved by glaciers. Glacial deposits compose the parent material for soil development in higher elevation valleys. Volcanic deposition (e.g., lava flows, ash/pumice deposits) also creates areas with shallow soils and rock outcrops on gentle to steep slopes. Plant available soil moisture becomes less in the eastern portion of these provinces. Soils in these provinces are intermediate in inherent productivity and resiliency when compared to soils of other provinces.

California Cascades Province

Soils in this province are drier, and therefore, are less resilient than soils in the Oregon and Washington Eastern Cascades Provinces. Otherwise, these soils are similar to the ones described above.

Washington and Oregon Western Cascades Provinces

Soils in this province are geologically older (better developed) and some of the most highly productive. Soil moisture varies; the southern portion is drier but still very productive. Soil temperature regimes vary; cold temperature regimes and lower soil biological activity occur at higher elevations.

Oregon Coast Range Province

This province has highly productive soils due mainly to climate. Soil moisture and temperature regimes are very favorable for soil biological activity. The less productive soils occur at high elevations. Soil depth and coarse fragment content are dominant factors that influence soil productivity in this province.

Oregon and California Klamath Provinces

Soil moisture regimes for these provinces are generally drier than the Oregon and California Coast Range Provinces to the west. Soil moisture tends to be even less in the eastern portion of these provinces. Inherent productivity tends to be intermediate when compared to other provinces. Soil parent material plays a major role in productivity for these provinces. Soils developing from some of the parent materials (e.g., serpentine) have low productivity due to chemical imbalances. Soils developing from other parent materials (e.g., granite) are droughty due to their coarse textures and low moisture-supplying capabilities (low water storage capability).

California Coast Range Province

This province has highly productive soils due mainly to favorable moisture and temperature conditions related to the climate. Soil biological activity and site organic material levels are high.

Environmental Consequences

Effects of Alternatives on Long-Term Soil Productivity

Long-term soil productivity is the capability of soil to sustain the inherent, natural growth potential of plants and plant communities over time. Ecosystem structures and functions ultimately depend on a productive soil resource. Maintenance of long-term soil productivity is widely recognized as a basic requirement of forest ecosystem management. The extent to which long-term soil productivity is affected by management activities is not precisely known because of the site variables involved, and the limited number of investigations that have occurred. However, it is known that forest management practices have the potential to reduce natural productivity if certain operating guidelines are not followed. Some researchers suggest that productivity may not be sustainable under management regimes with intense and frequent harvesting. Intense and frequent harvesting would also affect long-term productivity on high-productivity sites. Implementation of soil management prescriptions and best management practices should prevent unacceptable degradation of the soil resource and related productivity. Monitoring and incorporating the latest information will determine whether the prescriptions and best management practices are effective and being correctly applied.

Both soil and nonsoil factors influence soil productivity. Forest management activities do not influence nonsoil factors, such as geology. Soil factors that can be modified by management activities are soil moisture, soil aeration, organic matter content, nutrient availability, and soil biology.

Soils occurring within the range of the northern spotted owl differ in their resiliency and sensitivity to natural and management-induced disturbances. Generally, long-term productivity is more resilient for the higher productivity soils.

The potential effects of current plans and draft plan preferred alternatives on long-term soil productivity are addressed in the respective agency planning documents. The types of management activities, and conditions under which they occur, determine effects on soil productivity. Determining the suitability of specific soils for management practices is an important first step in preventing or minimizing soils-related adverse impacts. This determination will be accomplished during the review of specific projects.

Some management practices can enhance soil productivity on sites that have been disturbed in the past. Areas that have been compacted by previous activities could be tilled to improve soil aeration, infiltration, and percolation. Fertilization (typically nitrogen addition) could help restore the nutrient status for areas where excessive amounts of organic materials such as coarse woody debris have been removed or reduced by fire. Few management practices that increase natural, long-term soil productivity are practical. Fertilization could possibly increase natural amounts of site organic matter accumulation, but this effect may only be transient.

The most common types of management disturbances that affect soils and related long-term productivity include soil displacement and compaction, erosion (surface and mass wasting), and alteration of nutrient status and soil biology. Late-Successional Reserves, Riparian Reserves, and Administratively Withdrawn Areas have the highest probability of maintaining long-term soil productivity because they will have the least amount of management-induced disturbance. Most management, primarily timber harvest, will occur in the matrix. Thus, soils within the matrix will have the highest amount of management-induced disturbance, and, therefore, have the lowest probability of maintaining long-term soil productivity. However, implementation of appropriate soil management prescriptions and best management practices should prevent unacceptable degradation of the soils resource and related long-term productivity.

Alternatives 7 and 8 have the most acreage in the matrix and therefore, the highest potential to adversely affect long-term soil productivity. Ground-disturbing activities affect long-term soil productivity by influencing: (1) soil bulk density (untilled skid trails); (2) soil displacement through road building and skid trails; (3) erosion by exposure of mineral soil, road placement and drainage; (4) nutrient status (removal of organic material by prescribed burning, intense utilization); and (5) soil biology. Alternatives 1 and 4 would have the least amount of soil disturbance resulting from management actions because they contain the most Late-Successional Reserves and thus, would have the highest probability of maintaining long-term soil productivity.

Alternatives 2, 3, 5, 6, 9, and 10 would have intermediate levels of disturbance and probability relative to the previously described alternatives. These alternatives have less acreage within reserves but more acreage in the matrix than Alternatives 1 and 4.

Each alternative developed for managing federal lands within the range of the northern spotted owl would reduce the acreage of soil-disturbing management activities when compared to acreages of similar management activities under current plans and draft plan preferred alternatives. Fewer acres will be clearcut and broadcast burned, thus conserving more organic matter to maintain the nitrogen cycle. Management-related effects to soil bulk density would be less than under current plans and draft plan preferred alternatives due to less management activity on fewer acres. Less soil removal and displacement, primarily by road construction, would occur under all alternatives except Alternative 7.

Process for Assessing Effects of Alternatives on Species Habitat Sufficiency on Federal Lands Within the Range of the Northern Spotted Owl

Instructions to the Forest Ecosystem Management Assessment Team

The Forest Ecosystem Management Assessment Team was instructed by the Forest Conference Executive Committee "to identify management alternatives" that attain the greatest economic and social contributions from the forests and also "meet the requirements of the applicable laws and regulations, including the Endangered Species Act, the National Forest Management Act, the Federal Land Policy and Management Act, and the National Environmental Policy Act" (see Appendix C).

The Assessment Team was not asked to interpret the applicable laws and regulations or to indicate whether a particular alternative satisfied those requirements. The instructions included developing alternatives for long-term management that met the objective of maintaining and/or restoring late-successional and old-growth forest ecosystem conditions capable of supporting viable, well-distributed populations of associated species.

The Assessment Team was instructed to "include alternatives that range from a medium to a very high probability of ensuring the viability of species." Additionally, that the analysis "should include an assessment of current agency programs." The term "viability," in this context, refers to a Forest Service planning regulation issued under the National Forest Management Act stating that "fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired nonnative vertebrate species within the planning area" (36 CFR 219.19). The regulations also require provision "for diversity of plant and animal communities and tree species consistent with the overall multiple-use objectives of the planning area" (36 CFR 219.26-27).

Endangered Species Act considerations were not made explicitly in the viability assessments. The principal provisions of the Endangered Species Act extend to any species of plant or animal that is formally listed as endangered or threatened under the Act.

Identification of Species Closely Associated with Late-Successional Forests

To identify plant and animal species closely associated with late-successional forests and components, the Assessment Team relied on (1) existing assessments and publications and (2) the advice of experts who reviewed those lists for completeness for all federal lands within the range of the northern spotted owl.

Existing assessments and publications considered by the Assessment Team included the Scientific Analysis Team Report of Thomas et al. (1993), which identified late-successional and old-growth forest species and evaluated their likely future condition under alternatives presented in the Forest Service's Final Environmental Impact Statement on Management for the Northern Spotted Owl (USDA FS 1992). Thomas et al. (1993) identified species closely associated with old-growth forests and components of old-growth forests on National Forests within the range of the northern spotted owl. The Scientific Analysis Team's analysis found that 667 species were closely associated with these old-growth forests. This figure included many species whose ranges extends beyond the range of the northern spotted owl, and at-risk fish stocks.

The process used by Thomas et al. (1993) for identifying species of plants and animals that are closely associated with late-successional forests (including old-growth) within the range of the northern spotted owl on National Forests was adopted by the Assessment Team. Each species was listed along with ecological information used to determine (by applying specific criteria) the degree of association of the species with late-successional and old-growth forests (see Table 3&4-18). Species experts then expanded this list to account for new information and for additional plants and animals found on federal lands other than National Forests within the range of the northern spotted owl, particularly in National Parks and Bureau of Land Management Districts. For this process, the working definitions of late-successional and old-growth forests included all forests in which the dominant overstory trees were at least 80 years old. This definition encompasses old-growth forests as described by Spies and Franklin (1991) and Franklin and Spies (1991), as well as forests depicted by the Scientific Panel on Late-Successional Forest Ecosystems (Johnson et al. 1991).

Other Species Associated with Late-Successional and Old-Growth Forests

Literally thousands of species of all taxa are integral to the late-successional and old-growth forests in the planning area. Several previous efforts assessed the effects of various forest management plans on these species. The *Final Draft Recovery Plan for the Northern Spotted Owl* (USDI unpub.) discussed 640 terrestrial species that were old-growth forest associates or threatened, endangered, or candidate species. Thomas et al. (1993) assessed the effects of various forest management options on 667 species, including 555 terrestrial species and 112 fish stocks or species.

Table 3&4-18. Criteria for developing the list of species closely associated with late-successional and old-growth forests. A species was included if it met at least one of the following criteria. Adapted from Thomas et al. (1993).

Criterion 1:	The species is significantly more abundant (based on field study or collective professional judgment of the Forest Ecosystem Management Assessment Team) in late-successional and old-growth forest than in young forest, in any part of its range.
Criterion 2:	The species shows association with late-successional and old-growth forest (may reach highest abundance there, but not necessarily statistically so), and the species requires habitat components that are contributed by late-successional and old-growth forest (based on field study or collective professional judgment of the Forest Ecosystem Management Assessment Team).
Criterion 3:	The species is associated with late-successional and old-growth forest (based on field study) and is on a federal (Fish and Wildlife Service) or state threatened and endangered list, on the Fish and Wildlife Service candidate species list, Forest Service Regions 5 or 6[1] sensitive species list, or listed by the States of Washington, Oregon or California as a species of special concern or sensitive species.
Criterion 4:	Field data are inadequate to measure strength of association with late-successional and old-growth forest, and the species is listed as a federal (Fish and Wildlife Service) threatened and endangered species, and the Forest Ecosystem Management Assessment Team suspects that it is associated with late-successional and old-growth forest.

[1] Regions 5 or 6 = the Pacific Southwest Region or the Pacific Northwest Region of the Forest Service, respectively.

The Assessment Team reviewed and updated the various lists of species associated with late-successional and old-growth forests and included this information in the FEMAT Report. Criteria developed by Thomas et al. (1993) were used for this effort (see Table 3&4-18). The number of species identified in the FEMAT Report was greater than that identified by Thomas et al. (1993) because of new information and because the FEMAT Report focused on all federally administered lands within the range of the northern spotted owl. More than 1,000 species were identified as being closely associated with late-successional forests on federal lands. Table 3&4-19 shows the number of species in each species group.

Table 3&4-19. Species identified as being closely associated with late-successional forests on federal lands

Species Group	Number Identified
Bryophytes	106
Fungi	527
Lichens	157
Vascular plants	124
Mollusks	102
Amphibians	18
Fish (races/species/groups)	7
Birds	38
Mammals	26
Total species	1,105

In addition to this list of species, 15 functional groups of arthropods, representing more than 8,000 individual species, were reviewed. Information on these species and groups, and the effects of proposed management plans on them, is presented in this chapter.

Process for Assessing Effects of Alternatives on Species Habitat Sufficiency

Overview

For the 10 alternatives, the Assessment Team evaluated the relative likelihoods of four outcomes, representing the habitat conditions that would allow for various distributions of populations of northern spotted owls and marbled murrelets. For 7 of the 10 alternatives, similar assessments were performed for over 1,000 plant and animal species closely associated with late-successional and old-growth forests. The geographic boundaries consisted of the range of the northern spotted owl; the general timeframe was 100 years.

There were 14 separate panel assessments conducted during late April and again in June 1993, covering all major plant and animal taxa associated with federal late-successional and old-growth forest ecosystems within the range of the northern spotted owl. The second round of panel evaluations was conducted because new alternatives were developed, existing alternatives were refined, and some key issues needed to be addressed. The Assessment Team viewed the evaluations "not as precise analyses of likelihood of habitat and population conditions, but rather as judgements of knowledgeable experts" (FEMAT Report, p. II-29).

"The rating process was a subjective evaluation of the sufficiency of the amount and distribution of late-successional and old-growth habitat on federal lands under each option to support the species or group of species over the next 100 years. For most species, the information necessary to precisely quantify the response to changes in the quality and pattern of their environments simply does not exist. Our evaluations, therefore, should not be viewed as precise analyses of likelihoods of persistence or extinction; they represent the Forest Ecosystem Management Assessment Team's judgment as to the sufficiency of habitat on federal lands to support viable populations of the species examined. With additional data and studies, the ability to predict response of species to habitat change will improve" (FEMAT Report, p. II-29).

Panelist Selection

The Assessment Team convened assessment panels comprised of experts to elicit high quality judgments about expected effects of the alternatives on species. Panelists were selected using several criteria including technical expertise with the taxa, ecological understanding of habitat requirements, availability to attend panel sessions, and representation of a diversity of technical expertise. Nearly 70 panelists from the private sector, public sector, universities, and state and federal agency research branches participated in the assessments. The Assessment Team used advice from the panels, other information, and their own expertise to make its final assessments.

Description of Outcomes

The panelists' assessments displayed the likelihoods that each alternative would provide sufficient habitat on federal lands to provide for various distributions of species populations over the 100-year assessment period. These likelihoods were expressed as a scale of four possible outcomes, labeled A through D, and represented the range of possible trends and future conditions of habitat on federal lands. Each of the four "outcomes" describes a biological condition that is observable and mutually exclusive of the other three outcomes (see Table 3&4-20.

The panelists were instructed to consider the ability of the alternatives to buffer natural disturbances such as fire, insects, disease and windstorms, at their historical frequencies and severities. No data on these disturbances were provided, but discussion of these factors was encouraged during the sessions.

Description of Likelihood

Each panelist determined ratings of likelihoods. This was followed by group display and discussion. Verification was also handled in the discussion step as panelists explained the reasons for their ratings. Group interaction was used to clarify knowledge and exchange the basis for individual reasoning. Each panelist's final assessment was individual and there was no attempt to achieve consensus.

Panelists were asked to assign 100 "likelihood votes" over the four outcomes in the scale for each alternative and species. Each panelist could express complete

Table 3&4-20. Description of the outcomes used for rating the level of habitat support for populations

Outcome A:	Habitat is of sufficient quality, distribution, and abundance to allow the species population to stabilize, well distributed across federal lands.
Outcome B:	Habitat is of sufficient quality, distribution, and abundance to allow the species population to stabilize, but with significant gaps in the historic species distribution on federal land. These gaps cause some limitation in interactions among local populations.
Outcome C:	Habitat only allows continued species existence in refugia, with strong limitations on interactions among local populations.
Outcome D:	Habitat conditions result in species extirpation from federal land.

certainty in a single outcome by allocating 100 points to that outcome. The panelist could express complete uncertainty by spreading 25 votes across the four outcomes. Panelists, or the group, could refrain from assessing a species if there was simply too little understanding to express an informed opinion.

Panel Process

All panel assessments followed a similar process. Panels lasted, depending on the number of species being assessed, 1 to 2 days. To help standardize the process, all panels received an orientation that consisted of the following elements:

1. INTRODUCTORY STATEMENT. This included the purpose of the overall Forest Ecosystem Management Assessment Team assessment and the reasons for convening the panels.

2. ORIENTATION TO THE OUTCOME RATING SCALE. The Assessment Team presented and explained the rating scale. The Assessment Team defined terms and encouraged panelists to discuss their understanding of the scale. Some components received particular consideration. The first was the definition of "well distributed." The second was the separation of the condition of federal habitat from other influences on species viability.

The panelists discussed six factors that could influence species populations. These factors are habitat conditions on federal lands, life history characteristics of the species, "bottleneck" periods of low habitat and population, landownership patterns and habitat conditions on nonfederal lands, habitat conditions outside the range of the northern spotted owl, and other environmental conditions caused by activities off federal lands.

For the purposes of the rating, panelists were asked to focus their assessment on habitat conditions on federal lands; life history characteristics of the species; and any bottlenecks in habitat (and population) that would occur under the alternative. For this assessment, they were asked to assume that the other three factors would be adequate to support a stable, well-distributed population of the species if habitat on federal land was adequate to support such a population. These assumptions were relaxed later in the process when the likelihood rating had been completed. Panelists were then asked to describe the actual influence that these last three factors might have on overall population viability.

3. Orientation to the Likelihood Rating Scale.

The Assessment Team presented the likelihood scheme, its methodological rationale, and examples. The purpose of the group discussion was information exchange not consensus, and it was important to spend time calibrating judgments, customizing the outcome definitions, and discussing the concept of likelihood points.

4. Orientation to Process Flow.

The Assessment Team described the roles of the facilitator, panel leader, panelists, scribe and observers.

The facilitator's role was to clarify the task and use of materials, keep the process moving and the discussions relevant to the task; stimulate thinking and interchange about the assessments; probe for consistency, biases, and misunderstandings; and identify opportunities for improving the assessment process.

The scribe recorded discussion during the session and displayed the transcripts to the panel on an overhead projector. These transcripts were used to clarify and track points cited by panelists and support later interpretations.

Description of the Alternatives

In order to make the panel process manageable, the Assessment Team assessed 7 of the 10 alternatives (1, 3, 4, 5, 7, 8, and 9). The Assessment Team presented the seven alternatives in a 1-hour briefing with opportunities for panelists to ask questions. In an attempt to emphasize the biological nature of the task, only information relative to the biophysical aspects was presented; no economic, harvest level (probable sale quantity), or community assessment information was provided. The briefing was supplemented with visual materials provided to the panelists and displayed in the panel work area. In addition, an expert on the alternatives was available to answer questions at any time during the panel assessments. Materials provided for the seven alternatives included:

- Maps of alternatives, color-keyed to depict spatial allocations of reserves. These 1:500,000 maps, one for each state for each alternative, were displayed on walls in the panel work area.
- Graphic depictions of Riparian Reserve scenarios. Stream reserve widths were shown for an assortment of typical watersheds for each of the Riparian Reserve scenarios.

- Overlay maps of Key Watersheds.
- For vertebrates and vascular plants, overlay maps were available showing species ranges.
- Package of written descriptions of alternative components. Each alternative was described in a two-page summary that included details about Late-Successional Reserves, Managed Late-Successional Areas, Riparian Reserves, matrix management, and other standards and guidelines. For some alternatives this included supplementary guidelines for marbled murrelet management and, for Alternative 9, a two-page description of the Adaptive Management Areas. A pie chart of acreage allocations was also presented for each alternative except Alternatives 8 and 9.
- Summary table of alternatives, comparing them across the components. This table served as a bridge between the detailed descriptions and the maps, and was referred to repeatedly by the panelists.
- In addition to the materials provided to describe the alternatives, the Assessment Team provided overlay maps of the ranges of vertebrates and vascular plants. For many of the species groups, the panelists supplied maps of species locations or ranges.

The Assessment

The assessment for each species or group of species proceeded according to the following steps:

1. Present Species Profile. Panelists contributed to a set of facts and assumptions that could have been important in assessing the species or species group.

2. Individuals Assess Species for All Alternatives. Panelists were provided with rating forms to allocate 100 likelihood points to outcomes for each alternative for each species or group of species.

3. Display and Discuss Assessments. The facilitator recorded individual assessments on the overhead projector, and encouraged the panel to review patterns across alternatives and across panel members. Each panelist briefly explained the reasoning for the rating. The facilitator encouraged discussion among panel members.

4. Individuals Review Their Ratings and Modify as Appropriate. These final ratings were not displayed to the panel, but were turned in to the panel leader.

5. Record Judgment Factors. The facilitator led the group through a prepared list of alternative elements (Table IV-8 in the FEMAT Report, p. IV-48) ("factors influencing judgment"), and asked for a listing of factors that were most important in arriving at a final rating. In most cases these factors had already been introduced in the discussion.

6. Suggest Mitigation Measures.

The panels then suggested recommended mitigation measures for species and alternatives that did not provide an average of at least an 80 percent likelihood of achieving Outcome A (defined above). "Mitigation" was interpreted to mean relatively minor modifications that might enhance habitat conditions provided in the alternative. These measures did not include major changes that would have made one alternative similar to another. Mitigations were suggested that might increase likelihoods to achieve the 80 percent level, but no attempt was made to reevaluate the alternatives with the measures applied.

7. Record Other Influences on Population Viability.

The primary assessment was based on the adequacy of habitat provided on federal land. The final step was intended to look at the influence of population-level and nonfederal habitat factors on the overall success of the species. This assessment was not specific to any alternative. The panelists were asked to indicate which, if any, of the following factors were important: landownership patterns, species range outside the range of the spotted owl, and environmental conditions outside federal lands affecting the population. Panelists described how these factors might influence the overall species population. These discussions generally indicated that other factors would cause negative effects on populations.

Assumptions Used in Assessment

The assessments resulted in estimates of the likelihood, under each of the alternatives, that habitat conditions might result in each of four outcomes (see Table 3&4-20). The Assessment Team was charged with analyzing and displaying the consequences of a set of land management alternatives. The Assessment Team did not determine what percent likelihood of a specified outcome would satisfy applicable NFMA regulations.

The outcomes were meant to specifically address the distributional aspect of species viability. The concept of "well distributed" is difficult to assess and is not clearly specified. The Forest Service planning regulations state that ". . . habitat must be well distributed so that individuals can interact with others in the planning area." Well distributed is described in relation to the movement or interactive capabilities of particular species. Some species, especially those associated with specialized habitats or which are sedentary, occur naturally in small, relatively isolated patches. For such species, well distributed means something entirely different from what it might for habitat generalists with far-reaching ranges.

The evaluation of a species' distribution also depends on defining a suitable benchmark. Past land management activities and other factors have caused changes in species distributions. Overall, the Forest Service planning regulations do not indicate whether the species' distribution should be evaluated relative to its current or its historical distribution, or simply to its ability to continue to interact with other organisms of the same species.

The alternatives were designed as broad, programmatic, regional strategies, focused primarily on the habitat requirements of wide-ranging, threatened species such as the northern spotted owl and marbled murrelet, and at-risk fish stocks such as anadromous fish. The majority of the species assessed, such as fungi, lichens, mosses, arthropods, and mollusks, respond to site-specific conditions at the microsite scale. For some species, their entire distributional range might cover an area of a few acres. As a result, the kinds of attributes assessed, such as total amount and distribution of designated areas, were not site-specific enough or not described at a spatial resolution detailed enough to fully address the microhabitat requirements of these smaller organisms. These plants and animals respond to local conditions, but the alternatives were designed around regional objectives.

Broadly-distributed species will be affected, to varying degrees, by any land management activity. The falling of one tree will remove a finite portion of the existing habitat for, perhaps, a canopy-dwelling lichen. The species may well survive, but in reduced numbers. The assessment was meant to help determine when the cumulative effects of such incremental losses of habitat might result in risk to the species' survival. As discussed above, this determination is problematic. Background information about the exact habitat requirements of many organisms does not exist, nor is it possible to accurately predict the exact consequences of each potential land management activity for all species. General assessments of the likely consequences of large-scale patterns (e.g., distributions of seral stages or major habitat components such as snags and logs) across the landscape are provided. The site-specific needs for many species must be addressed at different planning levels in light of the potential influence of an array of actions, many of which may occur off-site on a significantly different scale.

Change is an inevitable and necessary attribute of biological systems. Species have evolved in an environment characterized by change, sometimes gradual as in succession, and sometimes sudden as in catastrophic storms or fires or as caused by human activities. Current species assessments cannot fully account for the level of change that can be tolerated by species. The Assessment Team attempted to account for change in its assessment by considering the capacity of species to sustain or recover from catastrophic events, but the ability to fully evaluate such responses is limited by lack of knowledge and uncertainty in predicting the scale and frequency of such events. The forest ecosystem is not static. Also, it is not clear what would constitute an acceptable level of variability in species populations over time, given the range of variability these species have experienced in their evolutionary history.

"Viability" Difficulties Raised in Assessment Panels

The following areas were subject to different interpretations by different panels:

1. Treatment for rare and locally endemic species. Many species have small and restricted ranges or exist in refugia even before habitat alteration. Some panelists tended to rate these species in Outcome B or C (see Table 3&4-20), under even the most protective alternatives, primarily as a reflection of their natural condition.

2. Habitat versus population outcomes. The Assessment Team defined the outcomes in terms of habitat "quality, distribution, and abundance," but some panelists found it difficult to separate the habitat and population elements.

3. Definition of "well distributed." Panelists were not uniformly clear about what well distributed meant for each taxon, although they concentrated on biological functions, particularly interaction. This issue was especially confusing between Outcomes A (well distributed) and B (distributed with gaps). Distinctions between B and C (occurrence in refugia) and between C and D (risk of extirpation) were more explicit.

4. Historic versus current species distribution. Reference in the scale to "historic species distribution" in Outcome A was difficult for species groups for which information is limited to the current distribution. Taken literally, the reference to historic distribution held the ratings to a high standard of requiring habitat reestablishment throughout the historic range.

5. It was difficult for panelists to project changes in biophysical conditions over the 100-year timeframe specified.

6. Some panelists said that the 100-year period was not long enough for the alternatives to express "equilibrium" conditions. These panelists considered 100 years to be an interim checkpoint and preferred 200 years or longer as an assessment timeframe.

Summary and Evaluation of Results

Ratings were averaged across panelists for each outcome under each alternative for each species. The panel leader, in conjunction with other Assessment Team members, evaluated the results to correct any obvious errors or apparent misunderstandings that might have led to illogical results.

The Assessment Team compared options by assessing whether a species (or group) attained an 80 percent or greater likelihood of achieving Outcome A (defined above). This basis for comparison "represents a relatively secure level of habitat and thus provides a stringent criterion for comparison. However, there is no single such level that represents a viable population for all species and circumstances. The 80 percent level was chosen here as a point of comparison only; other levels could also be chosen for comparing options" (FEMAT Report, p. IV-48).

"In focusing on the attainment of 80 percent likelihood of achieving Outcome A, we [the Assessment Team] are not suggesting that only options attaining that likelihood satisfy the viability regulation. We think it likely that options attaining such a percentage would be viewed as meeting the requirement, but a score of less than 80 should not automatically be regarded as a failing grade. Similarly, in some instances it may be appropriate to look at categories A and B (that is, A plus B) as the benchmark. Indeed, in situations where a species is already restricted to refugia, it may be appropriate to look at A plus B plus C" (FEMAT Report, Chapter II, Overview and Summary).

Methods For Additional Species Analysis

Additional analysis was conducted, between the Draft and Final SEIS, on many of the late-successional and old-growth related species within the range of the northern spotted owl. While the analysis was focused on responding to public comments on the preferred alternative (Alternative 9), much of it is also pertinent to the other nine alternatives. The complete analytical process and results are contained in Appendix J.

The additional analysis had the following objectives:

- Identify species for which additional consideration and analysis is appropriate under several criteria;
- Generate additional information on the impact of activities on nonfederal lands and cumulative effects;
- Explain, in more detail, the basis for the ratings provided in the Forest Ecosystem Management Assessment Team (FEMAT) Report and Draft SEIS for selected species; and
- Provide detailed specifications of mitigation measures that could be employed, and the relative benefits and costs of implementing those measures.

Because the original species assessments were done by the Assessment Team, original members were asked to provide additional analysis. Wherever possible, the Assessment Team member who originally dealt with a specific taxon was asked to provide the additional input for that taxon. In a few instances, assignments had to either be shifted, or new species experts recruited, to deal with a specific taxon. The list of individuals who contributed to this analysis is contained in the List of Preparers.

Wherever possible, information was sought from individuals who had participated in the original assessment panels. The assessment panels themselves, however, were not reconvened. The judgements and recommendations that resulted from this analysis are not the result of the formal expert opinion process used during the Assessment Team's efforts. Instead, they comprise a qualitative discussion that described the factors contributing to the outcome ratings in the FEMAT Report, the appropriateness of mitigation measures on federal lands, and any change in the effect of Alternative 9 on the species or species group under the mitigation measures described.

Description of the Process

The process had four main steps:

Step 1. Screen Species for Further Analysis

To identify species for further analysis, four separate screens were used. Although applicable laws were considered in the development of these screens, it is important to note that the screening levels do not represent a judgement about what is required by either NFMA or ESA. Use of the screens was intended to produce a list of species for which further investigation might prove useful or necessary.

Screen #1 - species screened based on original rating in the FEMAT Report The first step was to identify those species for which a specific concern had been expressed during the comment period, or for which additional analysis might be useful in light of the original assessment they received, or other factors described below. The following screening levels were adopted to assure a rigorous reexamination of any species for which the original ratings in the FEMAT Report might indicate additional analysis would prove useful:

- For vertebrates, reexamine all species with a likelihood of Outcome A of less than 80 percent, or any percent likelihood of Outcome D.

- For all other taxa, reexamine all species with a combined likelihood of Outcomes C and D of 20 percent or more, or any percent likelihood of Outcome D.

Outcomes A, B, C, and D refer to the system that was used for the original species ratings (see previous section Process for Assessing Effects on Species Habitat Sufficiency on Federal Lands). These outcomes were intended to describe how species would react to the amount, quality, and distribution of habitat that was provided for them. The outcomes are:

A — Habitat is of sufficient quality, distribution, and abundance to allow the species population to stabilize, well distributed across federal lands. (Note that the concept of well distributed must be based on knowledge of the species distribution, range, and life history).

B — Habitat is of sufficient quality, distribution, and abundance to allow the species population to stabilize, but with significant gaps in the historic species distribution on federal land. These gaps cause some limitation in interactions among local populations. (Note that the significance of the gaps must be judged relative to the species distribution, range, and life history, and the concept of metapopulations).

C — Habitat only allows continued species existence in refugia, with strong limitations on interactions among local populations.

D — Habitat conditions result in species extirpation from federal land within the range of the northern spotted owl.

Screen #2 - species screened considering post-Draft SEIS changes to Alternative 9 - Any species that was potentially adversely affected by the changes made between the Draft and Final SEIS was identified for further analysis.

Screen #3 - species screened based on cumulative effects - The Assessment Team evaluated the management of habitat on federal lands under the different options and displayed this in terms of ratings for species outcomes. The Assessment Team and panelists did not explicitly evaluate habitat conditions on nonfederal lands, threats to the species population on nonfederal lands, or other influences such as hunting, trapping, or water quality. Species were identified, after the Draft SEIS, for further analysis if they were potentially adversely affected by cumulative effects not considered by the Assessment Team and panels.

Screen #4 - species screened based on additional species-specific criteria - Some species that did not meet the above guidelines were selected for further consideration. For example, a species on a Regional Forester's sensitive list could be subject to additional analysis even though the species did not specifically meet the above criteria.

Results of Screens

Based on the screens described in Step 1, 468 species and 4 groups of insects were analyzed. Additional analyses were conducted for northern spotted owls and marbled murrelets based on issues raised in the Draft Biological Opinion.

Table 3&4-21. Comparison between species/ranges/groups assessed in the FEMAT Report and those subject to additional analysis

Species group	Species/ranges/groups assessed in the FEMAT Report	Species/ranges/groups subject to additional analysis
Bryophytes	106	9
Fungi	527	255
Lichens	157	75
Vascular plants	124	17
Arthropods (groups or ranges)	15	4
Mollusks	102	97
Amphibians	18	12
Fish (races/species/groups)	7	7
Birds	36	2
Bats	11	7
Other mammals	15	3
Spotted owls	1	1
Marbled murrelets	1	1
Totals	1,120	490

Step 2. Describe in Detail the Basis for the Original Species Rating, and/or The Basis for Concern About Cumulative Effects

For each of the species selected in the above screens, a detailed description and interpretation was provided of the basis for the species' original rating in the FEMAT Report under Option 9. In the process of completing these descriptions, original assessment panel notes were consulted, as well as detailed maps of Alternative 9 and of species' ranges and locations; original literature sources for the species; and information on the portion of the species' range and/or locations included within reserves. Updated information was sought from State Natural Heritage Program data bases, and new herbarium searches were conducted for lichens.

The additional analysis for some species was more detailed than the original assessment, and/or included new information that was not reasonably available at the time of the original assessment. In some cases, this additional information provided the basis for reinterpreting the assessments in the FEMAT Report. Where this occurred, it is noted in the species discussions later in this chapter.

In developing the detailed species descriptions in this analysis, the SEIS Team considered the contribution that each of the following factors may have made to the original rating.

- **Natural history** - In some cases, the species may be known from only a few sites or from within a very limited distribution. In other cases, the species habitat, and thus its distribution, may be naturally fragmented.

- **Past actions** - In some cases, the species' habitat has been severely impacted/ fragmented by previous actions, and can only recover slowly. In other cases, the species has already been extirpated from significant parts of its range, and recolonization is problematic.

- **Species' range** - A large portion of a species' range may lie outside the range of the northern spotted owl. In other cases, a large portion of a species' range may occur on nonfederal land.

- **Nonhabitat factors** - Factors such as hunting, fishing, air and water quality, and climate can influence the likely future for some species.

- **Inadequate information** - In some cases, the species' rating may be largely a reflection of scientific uncertainty due to the lack of available information about a species.

- **Features of the alternative** - The specific features of the alternatives were intended to play a primary role in determining the species' rating. For this analysis, the SEIS Team attempted to detail the specific features of the alternative that most influenced the original rating. This information is a critical building block for designing mitigation measures.

In addition to the above factors, the possible role of cumulative effects was examined for each species. This included species that were analyzed for a specific cumulative effect, as well as species that were analyzed based on other screens. Even though the original Assessment Team ratings of habitat outcomes for federal land were assigned largely independent of consideration of effects form management of nonfederal lands, the assessment panelists almost invariably also discussed other influences on some species in their panel workshops. In this most recent analysis, many of the discussions about cumulative effects and effects from nonfederal factors drew on the analysis of species' range and nonhabitat factors noted above.

Based on the above discussions, a summary statement was provided for each individual species report (Appendix J) that clarified the reasoning behind the species rating in the FEMAT Report. The summaries enabled the SEIS Team to distinguish between situations, for example, where a species received a particular rating because of naturally fragmented habitat, and situations where a species received a particular rating because the proposed action in the alternative was likely to further fragment its habitat.

Step 3. Describe Possible Mitigation Measures

Mitigation as defined by the CEQ Regulations at 40 CFR 1508.20 includes a wide variety of measures taken to improve conditions for a potentially impacted landscape, species, community, or other part of the environment. Mitigation measures include: avoiding the impact altogether, minimizing the impact by limits on implementation, rectifying the impact by restoration or repair, reducing or eliminating the impact by preservation or maintenance, and finally, compensating for the impact by providing substitutes.

In a very real sense, all the alternatives in this SEIS are, among other things, compilations and combinations of mitigation measures; all the allocations and standards and guidelines are designed to manage federal lands at different levels of risk or impact to forest ecosystems and human communities. Some of the allocations and standards and guidelines are common to more than one alternative; some could be added to existing alternatives to create yet another alternative which would mitigate one type of impact (but with a possible adverse effect on another part of the environment).

The additional species analysis that was conducted between the Draft and Final SEIS considered the incorporation of the additional standards and guidelines added to Alternative 9. These (and other) standards and guidelines could be added to any of the alternatives and result in additional beneficial impacts on species or forest ecosystems for them as well. However, if all standards and guidelines were added to all alternatives, they would be very similar, and not represent a range of alternatives.

In addition to these standards and guidelines that appear in at least one other alternative, there were measures considered that do not appear in any alternative. They could be included, if practicable, in any alternative. They are identified later in the chapter as possible mitigation measures for the species that they would most clearly benefit.

Possible mitigation measures were developed in conjunction with advice from species experts. The mitigation measures were designed primarily to modify features of Alternative 9. In many cases, the possible measures would adopt some component of another alternative in which the species outcome rated higher. In other cases, the mitigation measure would prescribe actions to be taken when very localized actions are planned. These mitigation measures were intended to address the rare and narrowly-distributed species. Finally, some mitigation measures were intended to offset the possible negative consequences of cumulative effects.

In all cases, evaluation of mitigation measures was done to determine if they would bring the species to a point where it would pass through all the screens described in Step 1, above. While the species analyzed were not rated again, the mitigation measures were designed to address aspects of the alternative that were adverse to the species and which were reflected in the FEMAT Report ratings. Where species outcomes did not respond sufficiently to pass through all the screens, it is stated (see the individual species discussions later in this chapter and Appendix J). In these cases, possible mitigation measures have been presented that would provide some benefit to the species. Mitigation measures have been described as specifically as possible to help display the benefits of the mitigation.

Mitigation Measures Considered

The following possible mitigation measures were developed during the species analysis process (described above) and benefits to species were considered. These possible mitigation measures may provide additional benefits to species under all alternatives. Those mitigation measures incorporated into Alternative 9 as standards and guidelines are in bold typeface (see Appendix B11 for full description). The effects on species are described in the individual species discussions later in this chapter.

Survey and Manage Measures

- **Protect known locations**
- **Survey and manage**

Riparian Reserves

- **Apply Riparian Reserve Scenario I**
  - In small wetlands
  - In the range of amphibians
  - In the range of coho salmon
  - **Throughout the range of the northern spotted owl**
- **Ensure riparian protection in Adaptive Management Areas**

Watershed Protections

- Remove Tier 1 Key Watersheds from programmed harvest
- Build no new roads in Tier 1 Key Watersheds
- Remove inventoried roadless areas (RARE II) from programmed harvest

Matrix Management Provisions

- **Provide coarse woody debris**
- **Emphasize clumped green tree/snag retention**
- **Provide buffers around caves**

- Modify site treatments
- Protect old-growth fragments where scarce

Northern Spotted Owl Measures
- Retain nest sites
- Manage the landscape for dispersal habitat

Marbled Murrelet Measures
- Retain old-growth forest in Marbled Murrelet Zone 1

Other measures
- Protect sites from grazing
- Manage impacts in recreation areas
- Identify species-specific measures

Step 4. Describe the Benefits of the Mitigation Measures

Qualitative statements about the efficacy of mitigation are provided in the individual species analyses in Appendix J. Wherever possible, information on the effectiveness of individual mitigation actions is provided, and is displayed in the individual species discussions later in this chapter.

Species not Threatened or Endangered

Nonvascular Plants and Allies

Bryophytes

Affected Environment

Hornworts, liverworts, and mosses (collectively known as bryophytes) are small, green, nonvascular, spore-bearing plants that include a wide array of species well adapted to nearly every habitat on earth. About 170 species of liverworts and 450 species of mosses occur within the range of the northern spotted owl. About 20 percent of these species are endemic to western North America or the Pacific Northwest (Lawton 1971).

See the FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment, for a more in-depth discussion of the affected environment.

Environmental Consequences

Methods Specific to Bryophytes

An assessment panel evaluated 106 species that were considered to be closely associated with late-successional and old-growth forests, including 32 species endemic to western North America or the Pacific Northwest (FEMAT Report, Table IV-A-3, p. IV-223). Bryophytes were divided into 13 habitat groups to facilitate discussion (Table 3&4-22). Groups were based on ecological relationships or habitat associations, and some of the groups were further subdivided by their degree of rarity. Ratings were based on the likelihood of an alternative providing habitat conditions to support various population distributions on federal lands for the bryophyte species.

Three species were rated individually because they did not readily fit into species groups or were too poorly known, and eight were rated individually because they are rare species. See the FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment for a more detailed description of methods. There were 16 species not rated because of insufficient information. Because little is known about the distribution and habitat requirements of these species, there is uncertainty of the effects of forest management activities to habitats supporting these species. Generally the alternatives that manage for more extensive and interconnected late-successional and old-growth forested conditions will minimize the risks to these species. While there is a risk that these species could be harmed by a variety of factors, including federal forest management activities, the relative lack of information concerning these species serves as an impetus to the monitoring and research and adaptive management plans that are part of these alternatives. Should habitat conditions decline significantly from projections, or should additional scientific information regarding the serious decline of these species become available, management of the relevant area would be considered for change under the adaptive management process described in Chapter 2.

There were 13 species groups and 12 species assessed in the FEMAT Report. Of these, nine bryophytes (three mosses and six liverworts) were subject to additional analysis as described earlier in Chapter 3&4, Methods for Additional Species Analysis. Two species from the Canopy-Branch, Interior species group (*Antitrichia curtipendula, Douinia ovata*) were individually analyzed because of concerns about possible effects from management of nonfederal lands, and *Scouleria marginata* was also analyzed because of concerns about cumulative effects. One species (*Ptilidium californicum*) was analyzed due to the adjustment of the harvest rotation length in California under Alternative 9 between the Draft and Final SEIS. Four species (*Kurzia makinoana, Tritomaria exsectiformis, Marsupella emarginata* var. *aquatica*, and *Diplophyllum plicatum*) were analyzed because of their ratings in the FEMAT Report. Although *Thamnobryum neckeroides* met the criterion for additional analysis described in the section Methods for Additional Species Analysis, it was dropped from further analysis because it was found not to be closely associated with late-successional and old-growth forests.

Effects of Alternatives

Results for the bryophytes for all alternatives are shown in Table 3&4-22. The species shown in the shaded portion of the table are those that were specifically considered when additional standards and guidelines were added to Alternative 9. The additional standards and guidelines incorporated into Alternative 9 (see Appendix B11) would increase habitat protection for several of these species. However, ratings for all species under Alternative 9 might be increased by the added standards and guidelines. The ratings shown in Table 3&4-22 have not been changed to reflect these and other additions to the alternative.

Table 3&4-22 Projected future likelihood for bryophytes habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Bryophytes	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Individual Species;																												
Blindia flexipoda	80	20	0	0	70	30	0	0	80	20	0	0	70	30	0	0	70	30	0	0	60	40	0	0	80	20	0	0
Diplophyllum plicatum	10	30	30	30	10	30	30	30	10	30	30	30	10	30	30	30	10	30	30	30	10	30	30	30	10	30	30	30
Fontinalis howellii	97	3	0	0	93	7	0	0	93	7	0	0	83	17	0	0	77	23	0	0	73	27	0	0	90	10	0	0
Kurzia makinoana	100	0	0	0	91	3	3	3	91	3	3	3	91	3	3	3	82	6	6	6	82	6	6	6	91	3	3	3
Marsupella emarginata var. aquatica	0	30	60	10	0	30	60	10	0	30	60	10	0	30	60	10	0	30	60	10	0	30	60	10	0	30	60	10
Pseudoleskeella serpentinense (CA)	100	0	0	0	90	10	0	0	90	10	0	0	90	10	0	0	90	10	0	0	80	20	0	0	90	10	0	0
Ptilidium californicum (CA only)	100	0	0	0	90	10	0	0	80	20	0	0	80	20	0	0	70	30	0	0	70	30	0	0	100	0	0	0
Racomitrium pacificum	70	30	0	0	70	30	0	0	60	40	0	0	60	40	0	0	50	50	0	0	50	50	0	0	70	30	0	0
Schistostega pennata (WA only)	100	0	0	0	100	0	0	0	100	0	0	0	80	20	0	0	80	20	0	0	80	20	0	0	100	0	0	0
Scouleria marginata	100	0	0	0	100	0	0	0	100	0	0	0	80	20	0	0	80	20	0	0	80	20	0	0	100	0	0	0
Thamnobryum neckeroides[1]	70	13	17	0	67	13	20	0	67	13	20	0	60	20	20	0	53	23	20	3	53	17	20	10	*60*	*20*	*20*	*0*
Tritomaria exsectiformis	0	30	40	30	0	30	40	30	0	30	40	30	0	30	40	30	0	30	40	30	0	30	40	30	0	30	40	30
Bryophyte Groups																												
Abundant Decaying Wood	100	0	0	0	97	3	0	0	97	3	0	0	93	7	0	0	83	17	0	0	73	27	0	0	97	3	0	0
Aquatic	100	0	0	0	97	3	0	0	100	0	0	0	87	13	0	0	80	20	0	0	77	23	0	0	97	3	0	0
Canopy-Branch, Interior	77	23	0	0	73	27	0	0	70	30	0	0	70	30	0	0	70	30	0	0	63	37	0	0	73	27	0	0
Canopy-Twigs, Exterior	95	5	0	0	95	5	0	0	95	5	0	0	95	5	0	0	95	5	0	0	65	35	0	0	95	5	0	0
Decaying Wood	93	7	0	0	87	13	0	0	87	13	0	0	83	17	0	0	77	23	0	0	73	27	0	0	90	10	0	0
Flood Plain	100	0	0	0	97	3	0	0	97	3	0	0	90	10	0	0	77	23	0	0	77	23	0	0	97	3	0	0
Shaded Duff/Humic Soil	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	97	3	0	0	93	7	0	0	100	0	0	0
Shaded Mineral Soil	87	13	0	0	83	17	0	0	83	17	0	0	83	17	0	0	80	20	0	0	77	23	0	0	87	13	0	0
Shaded Rock Outcrops	93	7	0	0	80	20	0	0	77	23	0	0	73	27	0	0	67	30	3	0	60	37	3	0	83	17	0	0
Splash Zone	100	0	0	0	100	0	0	0	100	0	0	0	97	3	0	0	83	17	0	0	83	17	0	0	100	0	0	0
Tree Boles/Decaying Wood	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Tree Boles/Understory	90	10	0	0	90	10	0	0	90	10	0	0	90	10	0	0	83	17	0	0	80	17	3	0	90	10	0	0
Wet Shaded Humic Soil	100	0	0	0	97	3	0	0	97	3	0	0	93	7	0	0	83	17	0	0	80	20	0	0	93	7	0	0

A-Well Distributed B-Locally Restricted C-Restricted to Refugia D-Risk of Extirpation

[1]Species dropped from original assessment.

Likelihood values are expressed as percentages that total to 100 for a given species within an Alternative. Number displayed may vary due to rounding errors. The Species shown in the shaded portion of the table are those that were specifically considered when additional standards are guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the standards and guidelines. The ratings shown in the table have not been changed to reflect these additions to Alternative 9. See text for fuller explanation and discussion of the rating scale and for discussion of the additional species analysis under Alternative 9.

The habitat components important to bryophytes include live, old-growth trees, decaying wood, riparian zones and generally the habitat characteristics achieved by more extensive and interconnected late-successional and old-growth forested conditions. Alternatives 1, 3, and 9, are generally the most favorable to bryophytes because they provide the set of allocations and management practices that best produce the habitat components for bryophytes. Alternatives 4, 5, 7 and 8, respectively, provide less of these habitat conditions. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Ratings were the same under all alternatives for three species (*Tritomaria exsectiformis, Marsupella emarginata* var. *aquatica,* and *Diplophyllum plicatum*) due to the rarity of these species. No standards and guidelines could be described that would avoid all risk of extirpation to these species on federal lands.

For the remaining 21 species or groups, all rated alternatives would provide 88 percent or greater likelihood of providing habitat of sufficient quality, distribution, and abundance to support stable populations either well distributed when measured against their historic range or distributed with gaps in their historic distribution on federal land.

For those 21 species, Alternatives 1, 3, and 9 consistently rated higher than others. Alternative 1 would provide 90 percent or greater likelihood of providing sufficient habitat to support stable populations, well distributed when measured against their historic range across federal lands for 17 bryophyte species or species groups, 80 to 89 percent likelihood for two bryophyte species or species groups, and 70 to 79 percent likelihood for two bryophyte species or species groups. With the additional standards and guidelines incorporated between Draft and Final SEIS, Alternative 9 would provide 90 percent or greater likelihood of providing sufficient habitat to support stable populations, well distributed when measured against their historic range across federal lands for 16 bryophyte species or species groups, 80 to 89 percent likelihood for 3 bryophyte species or species groups, and 70 to 79 percent likelihood for 2 species or species groups. Alternative 3 would provide 90 percent or greater likelihood of providing sufficient habitat to support stable populations, well distributed when measured against their historic range across federal lands for 15 bryophyte species or species groups, 80 to 89 percent likelihood for three bryophyte species or species groups, and 70 to 79 percent likelihood for three bryophyte species or species groups. Alternatives 4, 5, 7, and 8, respectively, have decreasing likelihoods of providing this habitat condition, as displayed in Table 3&4-22.

A number of species would benefit from the addition of standards and guidelines to Alternative 9. *Antitrichia curtipendula* and *Douinia ovata* would be benefited by the addition of Riparian Reserve Scenario 1. *Kurzia makinoana* would benefit from a combination of Riparian Reserve Scenario 1, provisions for coarse woody debris and green-tree retention, and provisions to retain old-growth fragments in watersheds where less than 15 percent late-successional forest remains. *Ptilidium californicum* would benefit from a combination of protection of known sites, provisions for coarse woody debris and green-tree retention, provisions to retain old-growth fragments, and provisions to provide 100-acre habitat areas around spotted owl activity centers. *Scouleria marginata* would receive additional habitat protection from Riparian Reserve Scenario 1, and further provisions for riparian management in Adaptive Management Areas.

Standards and guidelines were added to Alternative 9 for the three species described above (*Tritomaria exsectiformis*, *Marsupella emarginata* var. *aquatica*, and *Diplophyllum plicatum*). While these standards and guidelines would not avoid all risk of extirpation from federal lands, they would benefit these species. *Tritomaria exsectiformis* would benefit from Riparian Reserve Scenario 1 and also from protection of known locations from grazing. *Marsupella emarginata* var. *aquatica* would benefit from protection of the single site from which it is known, and which receives heavy recreational use. *Diplophyllum plicatum* would benefit from measures that provide for coarse woody debris in the matrix.

Possible Mitigation Measures

All of the alternatives contain standards and guidelines that are expected to benefit bryophytes. As noted previously in this chapter, to avoid or reduce impacts, a standard or guideline in one alternative could be added to another that currently does not include the measure. Those standards and guidelines which would retain live, old-growth trees, decaying wood, and riparian zones would be of greatest benefit to the bryophytes.

The following possible mitigation measures are not represented in the alternatives, but could benefit bryophytes:

Commercial moss collecting could be regulated in any of the alternatives to prevent overharvest.

Additional forest land along the coast could be managed for old-growth Sitka spruce.

Cold springs could be recognized as important resources for biological diversity.

Ensure that water pollution from sewage and motorboats at Waldo Lake does not negatively impact the population of *Marsupella emarginata* var. *aquatica.*

For *Schistostega pennate,* windfalls could be left in place to provide structurally diversehabitat.

Green trees should be retained along fog-drenched ridges (in stand sizes sufficient to withstand windthrow) for maintenance of biological diversity.

Cumulative Effects Including the Role of Nonfederal Lands

There is little habitat for late-successional and old-growth bryophyte species on private lands in the region. Most of the old-growth coniferous forest on private lands within the range of the northern spotted owl has been logged, and the landscape currently is being managed on relatively short (30 to 70-year) rotations. Cumulative effects due to conditions on nonfederal lands were judged to be especially important for three species (*Diplophyllum plicatum, Ptilidium californicum* and *Scouleria marginata*).

Bryophytes are sensitive to air quality, especially acid deposition and particulate matter; potential declines in air quality may cause significant population losses to these species. The bryophytes of the aquatic habitat group are affected by sedimentation, temperature change, hydroelectric projects, mining, recreational development, and nonpoint source pollution that can occur on state and private lands. Two species, *Antitrichia curtipendula* and *Diplophyllum plicatum*, are especially sensitive to air quality effects.

State lands, especially state parks , provide habitat for some bryophytes, particularly in the coastal Sitka spruce region. Many of these parks contain the last remnants of old-growth coastal Sitka spruce forests within the range of the northern spotted owl. Saddle Mountain State Park in Oregon, which is characterized by a high peak with a fog-drenched summit, hosts some of the rarest bryophytes in the Pacific Northwest. Unfortunately, these sites also may be impacted by declining air quality, although not so severely as parks in the interior valleys or foothills of the Cascade Range.

Fungi

Affected Environment

Fungi are neither plants nor animals but are recognized as a separate kingdom of organisms, both in structure and function. The large number of macrofungi in late-successional and old-growth forests, especially those of uneven-age structure, reflects the complexity of the late-successional and old-growth ecosystems as well as, or better than, many other groups of organisms. Estimates indicate there are at least six species of fungi for every vascular plant species in a given temperate ecosystem (Hawksworth 1991).

The fungal flora of the Pacific Northwest is extremely diverse. Of the 527 species of fungi that were evaluated as closely associated with late-successional and old-growth forests, 109 (21 percent) are known to be endemic to the Pacific Northwest (Ammirati, J. pers. comm.). This list of species represents only a small percentage of the macrofungi that occur in late-successional forests. If microfungi were included, the list would be greatly expanded. For every group of fungi, there are many species, perhaps hundreds, in addition to those on the original list (see FEMAT Report, Table IV-A-1, p. IV-213).

Fungi are essential to the functioning of forest ecosystems. Many of the forest fungi that produce large fruiting bodies (e.g., mushrooms, boletes, corals) have symbiotic relationships with vascular plants. The survival of most conifers and many flowering plants depends on associations with these mycorrhizal fungi for the uptake of nutrients and water (Trappe and Luoma 1992). Hypogeous fungi (fungi that fruit below ground) and certain mushrooms are important food for small mammals that, in turn, aid in spore dispersal. These small mammals are also the major prey of northern spotted owls over much of their range (Maser et al. 1978, Ure and Maser 1982). Saprobic fungi (fungi that live on dead or decaying organic matter) are a major component of all forest ecosystems, growing on recently fallen trees, well-decayed logs, litter, dung, etc. They play an important role in decomposition and nutrient recycling. For a fuller discussion see the FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment.

Environmental Consequences

Methods Specific to Fungi

A list of 527 fungi species closely associated with late-successional and old-growth forests on federal lands within the geographic range of the northern spotted owl was developed following the criteria used for the Scientific Analysis Team Report (Thomas et al. 1993). While not complete, the list suggests the high biological diversity of fungi that exists in late-successional and old-growth forests of the Pacific Northwest. Because there is little published information on the diversity of fungi for the old-growth forests of the Pacific Northwest, mycologists contributed to the development of this list based on their research and field experience throughout the region (FEMAT Report).

The assessment panel evaluated all 527 taxa of fungi (FEMAT Report, Table IV-A-1, p. IV-213). Two major functional divisions of fungi were identified: the ecto-mycorrhizal fungi, and the decomposers or saprobes. Several parasitic species were also included. Overall, the species were divided into 36 groups, based on taxonomic and ecological relationships, as well as their degree of rarity. The species of greatest concern for risk of extirpation were the rare or locally-distributed fungi that comprised 28 percent of the species evaluated.

Each species group was discussed by the assessment panel, and fungi species were added or deleted. Groups of species were finalized based on similarity in response to habitat provided on federal lands by the various management alternatives. The ratings for each group were based on the likelihood of an alternative providing habitat conditions to support various population distributions on federal lands for the fungi (Outcomes A-D, see discussion of assessment panels earlier in this chapter). Twelve species were treated individually because of differences in their biological or ecological attributes. Four species were not evaluated by the assessment panel because of insufficient information and uncertainty about their biology and ecology. In addition, three orders of microfungi representing hundreds of species were discussed by the assessment panel but not evaluated because of lack of information (FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment). Since little is known about the distribution and habitat requirements of these species, there is uncertainty surrounding the effects of forest management activities to habitats supporting these species. Generally, the alternatives that provide for more extensive and interconnected late-successional and old-growth forested conditions would minimize the risks to these species. The relative lack of information concerning these species serves as an impetus to the monitoring and research and adaptive management plans that are part of these alternatives. If habitat conditions decline significantly from projections, or if additional scientific information indicates a serious decline of these species' populations, a change of management of the relevant area would be considered under the adaptive management process described in the implementation section of this Final SEIS.

A summary of outcome scores for each group or species of fungi was based on the average scores of the three panelists (Table 3&4-23). See also the general discussion of viability analysis assumptions and the process for evaluating and describing the results earlier in this chapter.

There were 255 species of fungi subject to additional analysis between the Draft and Final SEIS (see Methods for Additional Species Analysis in this Chapter). The additional analysis considered each species separately rather than in the groups that were used for the initial rating. Of the total analyzed, 210 species were analyzed because of their initial rating in the FEMAT Report. Sixteen species were given additional review based on cumulative effects. One species was included in the additional analysis because of changes in Alternative 9. Five species (including two species of *Gastroboletus* examined separately out of the boletes group) received additional review both because of the change in the 180-year harvest rotation in California, and either their initial rating in the FEMAT Report or cumulative effects. An additional eight species were analyzed based on additional information not available at the time of the original rating. Fifteen species from the original Assessment Team list were dropped from the original assessment based on additional information which indicated those species did not meet the criterion of being closely associated with old-growth. The species that were analyzed represent the broad spectrum of fungi that occur in late-successional forest ecosystems, including mycorrhizal, saprobic and parasitic species. A full list of the species analyzed and discussion of the analysis is enclosed in Appendix J.

Additional analysis for the Final SEIS resulted in a number of corrections or changes from the FEMAT Report and Draft SEIS. These changes primarily involved moving species from one of the groups displayed in the original FEMAT Report to another group. When species were moved, they generally assumed the rating of the new group. These changes are discussed in detail in Appendix J.

Effects of Alternatives

Results for the fungi across all alternatives are shown in Table 3&4-23. The species or species' ranges shown in the shaded portion of Table 3&4-23 are those that were specifically considered when additional standards and guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the added standards and guidelines. The ratings shown in Table 3&4-23 have not been changed to reflect these additions to the alternative.

Species diversity of fungi appears highest in late-successional forests because of the diversity of habitat structures and host species, and the abundance of coarse woody debris and standing dead trees. Habitat components important to the fungi include dead, down wood; standing dead trees; and live, old-growth trees; as well as a diversity of host species and microhabitats. Also important for fungi is a well-distributed network of late-successional forest. Small forest fragments can function as refugia where fungi may persist until

Table 3&4-23. Projected future likelihood for fungi habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Fungi	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Mycorrhizal																												
Bolete-GARU, Rare	83	10	7	0	77	15	8	0	73	17	10	0	67	22	8	3	67	22	8	3	63	22	12	3	67	22	8	3
Bolete/False Truffles, Rare (3 species)	0	3	91	5	0	2	92	7	0	2	88	10	0	2	83	15	0	2	82	17	0	2	82	17	0	2	83	15
Boletes (13 species)	93	7	0	0	83	17	0	0	77	23	0	0	67	33	0	0	67	33	0	0	67	33	0	0	70	30	0	0
Boletes, Low Elevation (2 species)	20	53	27	0	20	43	37	0	20	43	37	0	17	47	37	0	17	47	37	0	17	43	40	0	17	43	40	0
Boletes, Rare (2 species)	13	67	17	3	8	65	22	5	8	57	30	5	3	52	33	12	2	52	28	18	3	48	28	20	2	52	28	18
Chanterelle-CAFO, Rare	33	33	28	5	27	35	33	5	22	37	35	7	13	37	32	18	10	30	38	22	0	30	38	22	10	33	38	18
Chanterelle-POMU, Rare	40	47	10	3	33	52	12	3	35	45	17	3	27	45	20	8	17	50	25	8	20	43	27	10	22	43	27	8
Chanterelles (3 species)	73	27	0	0	73	27	0	0	63	37	0	0	57	43	0	0	60	40	0	0	57	43	0	0	60	40	0	0
Chanterelles-Gomphus (4 species)	83	13	3	0	77	15	8	0	68	20	10	2	62	23	12	3	53	25	18	3	53	23	20	3	57	22	18	3
Coral Fungi (50+ species)	85	10	5	0	80	10	10	0	70	18	10	3	60	18	15	8	55	20	18	8	50	23	20	8	55	20	18	8
Ecto-Puffballs (2 species)	93	7	0	0	90	10	0	0	87	13	0	0	80	20	0	0	73	23	3	0	77	23	0	0	80	20	0	0
Ecto-Polypores, Rare (3 species)	10	50	37	3	7	52	35	7	8	43	38	10	3	42	37	18	2	42	35	22	3	38	38	20	2	42	38	18
Ecto-Polypores, Uncommon (2 species)	70	20	10	0	60	25	15	0	53	27	20	0	42	32	20	7	40	30	23	7	38	32	23	7	42	32	20	7
Ecto-Polypore-COPE	93	7	0	0	93	7	0	0	87	13	0	0	83	17	0	0	80	20	0	0	80	20	0	0	83	17	0	0
Ecto-Resupinate Fungi (3 species)	97	3	0	0	97	3	0	0	93	7	0	0	87	13	0	0	83	17	0	0	83	17	0	0	87	13	0	0
False Truffle-MALY, Rare	8	10	75	7	7	10	75	8	5	12	72	12	2	12	72	15	0	10	72	18	0	12	70	18	0	12	72	17
False Truffles (10 species)	95	5	0	0	85	15	0	0	80	15	5	0	70	20	10	0	50	30	20	0	55	25	20	0	55	25	20	0
False Truffles, Rare (22 species)	20	30	40	10	15	35	40	10	15	35	40	10	5	35	50	10	0	35	50	15	0	35	50	15	0	35	50	15
False Truffles, Uncommon (4 species)	30	40	30	0	25	40	35	0	25	35	35	5	25	30	40	5	15	25	40	20	20	30	40	10	20	30	40	10
Gilled Mushroom-CHLO, Rare	0	3	91	5	0	2	92	7	0	2	88	10	0	2	83	15	0	2	82	17	0	2	82	17	0	2	83	15
Gilled Mushrooms (125 species)	93	7	0	0	83	17	0	0	73	23	3	0	63	33	3	0	60	33	7	0	63	30	7	0	67	27	7	0
Gilled Mushrooms, Rare (6 species)	20	60	15	5	15	65	15	5	10	58	25	8	5	50	28	18	5	45	28	23	5	45	30	20	5	50	28	18
Gilled Mushrooms, Uncommon (15 species)	65	25	10	0	60	30	10	0	50	33	18	0	40	35	15	10	40	30	15	15	35	30	20	15	40	30	15	15
Phaeocollybia (13 species)	70	23	7	0	63	30	7	0	53	37	10	0	47	38	10	5	40	35	15	10	42	38	15	5	45	38	12	5
Tooth Fungi (5 species)	93	7	0	0	83	17	0	0	73	23	3	0	73	33	3	0	60	33	7	0	63	30	7	0	67	27	7	0
Truffles (5 species)	90	10	0	0	90	10	0	0	85	15	0	0	80	20	0	0	75	25	0	0	75	25	0	0	75	25	0	0
Truffles, Rare (5 species)	10	20	60	10	8	23	60	10	8	20	58	15	3	20	60	18	0	18	55	28	0	15	60	25	0	18	60	23
Truffles-TURU	10	30	40	20	5	28	40	28	0	33	40	28	0	33	40	28	0	30	40	30	0	30	40	30	0	30	40	30
Undescribed Taxa, Rare (29 species)	0	10	80	10	0	10	70	20	0	10	60	30	0	0	60	40	0	0	50	50	0	0	60	40	0	0	60	40
Zygomycetes, Rare (3 species)	10	20	60	10	8	23	60	10	8	20	58	15	3	20	60	18	0	18	55	28	0	15	60	25	0	18	60	23
Parasitic																												
Cauliflower Mushroom	83	13	3	0	80	15	5	0	73	20	7	0	67	25	5	3	60	25	12	3	63	25	8	3	67	25	5	3
Parasitic Fungi (7 species)	65	25	10	0	60	30	10	0	50	28	23	0	40	30	25	5	35	30	25	10	35	30	30	5	40	30	25	5
Parasitic Fungi, Common (2 species)	90	10	0	0	90	10	0	0	80	20	0	0	75	25	0	0	70	30	0	0	70	30	0	0	75	25	0	0

Table 3&3-23. Projected future likelihood for fungi habitat outcomes under land management alternatives in the Draft SEIS

Fungi (continued)	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Saprobic - (Decomposers)																												
Branched Coral Fungi (3 species)	90	10	0	0	85	15	0	0	75	25	0	0	65	35	0	0	60	40	0	0	60	40	0	0	65	35	0	0
Cup Fungi (15 species)	90	10	0	0	90	10	0	0	80	20	0	0	70	30	0	0	65	35	0	0	65	35	0	0	70	30	0	0
Cup Fungi, Rare (14 species)	15	40	28	18	10	40	33	18	0	45	35	20	0	35	38	28	0	35	38	28	0	30	38	33	0	35	38	28
Gilled Mushrooms (80 species)	90	10	0	0	85	15	0	0	75	25	0	0	65	35	0	0	60	40	0	0	60	40	0	0	65	35	0	0
Gilled Mushrooms, Rare (6 species)	10	55	25	10	10	50	25	15	3	50	30	18	0	40	38	23	0	35	43	23	0	35	40	25	0	40	38	23
Gilled Mushrooms, Uncommon (17 species)	65	30	5	0	60	30	10	0	50	33	18	0	40	35	15	10	35	35	15	15	35	35	20	10	40	35	15	10
Jelly Mushroom	60	35	5	0	55	35	10	0	55	33	13	0	35	30	25	10	35	25	25	15	30	30	30	10	35	30	25	10
Oxyporus nobilissimus	18	28	37	17	13	28	40	18	10	28	47	15	10	25	43	22	7	22	47	25	10	25	40	25	10	25	43	22
Polypores (10 species)	90	10	0	0	85	15	0	0	75	25	0	0	65	35	0	0	60	40	0	0	60	40	0	0	65	35	0	0
Resupinate Fungi (14 species)	90	10	0	0	85	15	0	0	75	25	0	0	65	35	0	0	60	40	0	0	60	40	0	0	65	35	0	0
Resupinates and Polypores, Rare (6 species)	10	70	10	10	10	70	10	10	5	60	20	15	0	50	25	25	0	50	25	25	0	40	30	30	0	50	25	25
Other																												
Bondarzewia mesenterica	40	30	30	0	40	30	30	0	35	28	33	5	30	25	30	15	30	20	30	20	25	25	35	15	30	25	30	15
Club Coral Fungi (unknown # of species)	85	10	5	0	80	15	5	0	65	23	13	0	55	30	10	5	50	30	15	5	50	25	20	5	55	25	15	5
Moss Dwelling Mushrooms (7 species)	55	35	10	0	50	35	15	0	45	35	20	0	40	35	25	0	35	40	25	0	35	40	25	0	40	35	25	0
Mushroom Lichen	95	5	0	0	95	5	0	0	90	10	0	0	80	20	0	0	75	25	0	0	75	25	0	0	80	20	0	0

A-Well Distributed B-Locally Restricted C-Restricted to Refugia D-Risk of Extirpation

Likelihood values are expressed as percentages that total to 100 for a given species within an Alternative. Number displayed may vary due to rounding errors. The Species shown in the shaded portion of the table are those that were specifically considered when additional standards are guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the standards and guidelines. The ratings shown in the table have not been changed to reflect these additions to Alternative 9. See text for fuller explanation and discussion of the rating scale and for discussion of the additional species analysis under Alternative 9.

suitable habitat conditions become available in adjacent stands. Alternatives that retain more of these habitat features generally had higher ratings for species. Alternatives 1, 3, 4, and 9, would be generally the most favorable to bryophytes, because they provide the set of allocations and management practices that best produces the habitat components for bryophytes. Alternative 5 would provide somewhat lesser levels of this habitat. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for bryophytes. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Effects Common to All Alternatives.

Of the species subject to additional analysis, 115 species did not display a substantially different rating among alternatives, and no additional mitigation was considered adequate to avoid all risk of extirpation from federal lands for these species. These species are restricted to refugia and are known from only one or a few locations. Protection of known populations and surveys for additional sites will decrease the risk of extirpation for these species. Their narrow distribution may be due to either inherent life history characteristics or specific habitat requirements that are sporadic or rare in the landscape. These include 15 species of rare coral fungi, 3 rare boletes, 1 uncommon false truffle, 19 rare false truffles, 25 undescribed rare and false truffles, 3 rare truffles, 14 Phaeocollybia, 7 rare gilled mushrooms, 2 rare ecto-polypores, 2 rare zygomycetes, 6 rare gilled mushrooms, *Oxyporous nobilissimus*, *Bondarzauria montana*, 7 rare resupinates and polypores, 1 uncommon cup fungus, and 8 rare cup fungi (see the Cumulative Effects Including the Role of Nonfederal Lands discussion below). The discussion and analysis for these species is in Appendix J.

Fourteen species would be of concern under all alternatives because of the large percentage of their ranges on nonfederal land. These include four species of rare false truffles, two undescribed rare and false truffles, two rare truffles, one rare zygomycetes, one parasitic fungus, and four rare cup fungi (see discussion of Cumulative Effects Including the Role of Nonfederal Land). These species do not display a substantially different rating among alternatives, and no additional mitigation was considered adequate to fully provide for these species.

Comparison of Alternatives.

Outcomes for the remaining 383 fungus species are displayed in Table 3&4-23. Alternative 9 would provide 74 percent or greater likelihood of providing habitat, for these species, of sufficient quality, distribution, and abundance to support stable populations either well distributed when measured against their historic range or distributed with gaps in their historical distribution on federal land. Alternatives 1, 3, and 4 would have 66, 62 and 62 percent or greater likelihoods, respectively, of achieving the same outcome(s). Alternative 5 would have a 50 percent or greater likelihood of providing habitat to allow these fungus species to achieve these outcome(s). Alternatives 7 and 8 would each have 40 percent or greater likelihood of providing habitat at that level. The projected future likelihoods of habitat for fungi corresponded with the acreage of Late-Successional Reserves and management in the matrix. Ratings for the groups of fungi were based on habitat conditions on federal lands and varied considerably across the alternatives. Fungi were rated lower for alternatives that had less acreage in Late-Successional Reserves, fewer old-growth patches, and less coarse woody debris and green-tree retention in the matrix. The majority of species evaluated occur on upland sites, so riparian protection may not be as important for many of these fungi as for other organisms. However, fungi associated with riparian areas are not well represented in this evaluation.

The results discussed above for Alternative 9 include consideration of the standards and guidelines added between the Draft and Final SEIS. The changes improved outcomes for 101 species that would have at least an 80 percent likelihood of providing stable populations, either well distributed when measured against their historic ranges or with significant gaps in the historic range (described in Chapter 2 and Appendix B11). The list of species includes 4 boletes, 5 false truffles, 9 chanterelles, 13 uncommon coral fungi, 31 uncommon gilled mushrooms, 5 tooth fungi, 14 uncommon cup fungi, 1 jelly mushroom, 3 branched coral fungi, 1 mushroom lichen, 6 parasitic fungi, 1 cauliflower mushroom, 7 moss-dwelling mushrooms, and 1 coral fungus.

An additional four species would be benefited by the standards and guidelines, but not to the level where they would achieve both 80 percent of Outcomes A and B and have no risk of extirpation. These four species are one bolete species, two uncommon ecto-polypores, and one uncommon gilled mushroom. An additional mitigation that would have benefited these species consists of designating all remaining old-growth forest in Marbled Murrelet Zone 1 as reserve. However, that mitigation would cover many areas that may not be occupied by these species. The survey and manage standards and guidelines are more site-specific measures that may provide the same or greater benefit to these species.

Seven of the species subject to additional analysis (all of the club coral fungi) are so poorly known that the level of benefit provided by the mitigation measures is difficult to determine. Surveys for these species should provide additional information that can be used in their conservation.

As noted previously, 15 of the species subject to additional analysis were removed from the list of species being rated, and 115 species remained with outcomes that were not different across alternatives.

Possible Mitigation Measures

All of the alternatives contain standards and guidelines that are expected to benefit fungi. As noted in the section earlier, to avoid or reduce impacts, a standard or guideline in one alternative could be added to another that currently does not include the measure. Those standards and guidelines which would retain dead, down wood; standing dead trees; stands of live, old-growth trees; and a well-distributed network of late-successional forests would be of greatest benefit to these species. The protection of known locations of the rare and locally endemic fungus species is also important.

The following possible mitigation measures are not represented in the alternatives, but could benefit fungi:

Designate Special Interest Areas or Areas of Critical Environmental Concern.

Identify additional stands for development into old-growth forest in areas where late-successional or old-growth stands are limited.

Within the matrix, maintain a mosaic of forest, age-class distributions, successional stages, habitat structures, habitat types, and topographic positions (i.e., riparian, midslope, and ridgetop). Patches should be large enough (5 to 10 acres at a minimum) to provide for habitat needs, lessen the risk of windthrow, and provide suitable microclimate conditions.

Determine appropriate levels of sustained harvest for commercial species of fungi by inventorying species, collecting baseline data, and monitoring the effects of harvest. Monitoring programs suggested by Molina et al. (1993) could form the basis for determining the effects of harvest, predicting yields, and developing management practices to maintain and enhance wild mushroom harvest.

Cumulative Effects Including the Role of Nonfederal Lands

Fourteen species of fungi representing six of the original groups assessed by the Assessment Team (rare false truffles, rare truffles, undescribed taxa of rare truffles and rare false truffles, rare zygomycetes, rare cup fungi, and parasitic fungi) were reassessed, in part, because they failed to pass the cumulative effects screen. Additional mitigations could not resolve these risks under any of the alternatives (see Appendix J for a complete list of species). Cumulative effects are a concern, although somewhat less critical, for many of the other species considered in this analysis. Important factors contributing to cumulative effects include land ownership patterns and management practices that result in loss of extensive areas of habitat for fungi associated with late-successional forest. For example, four species of rare cup fungi in the genus *Helvella* are known only to occur on nonfederal lands. For many of these species, particular areas of concern are the coastal and low-elevation forests where nonfederal lands play a key role in maintaining species connectivity, and where the amount of late-successional forest is limited due to past harvest. Frequency and intensity of land-disturbing activities on nonfederal lands, including recreation, is another important factor in cumulative effects analysis. Site treatments, which disrupt the soil and litter layer, will have a detrimental effect on populations of fungi, and may alter the role of decaying wood in the nutrient-cycling process. Trampling, compacting the soil and litter layer, removing woody debris for firewood or other reasons, or inadvertently introducing nonnative species could impact fungal populations, particularly the rare species. Forest management practices and site treatments in early-successional stands could also influence the occurrence and diversity of species in late-successional forests. Many species of fungi depend on a renewable supply of large down logs in a managed landscape, and the quality and quantity of this substrate may decline with short-rotation forestry. As an area progresses through several short-rotations, the input of large down logs ceases; trees do not have sufficient time to attain large diameters under the prescribed rotation lengths, except on highly productive sites. Coarse woody debris functions as a nutrient sink that contributes to long-term forest productivity and provides habitat for a wide range of organisms that require this substrate.

Commercial harvest of fungi has greatly increased in recent years, creating potential impacts on species populations and habitats. Harvest of fungi may affect species' viability under any of the alternatives by potentially decreasing distribution, frequency, reproduction, and productivity, as well as genetic variability of species. Currently, most of the species that are commercially harvested are not considered at risk, but future impacts may affect their viability.

Deteriorating air quality may result in a decrease in species' viability under any of the alternatives. Evidence from European forests shows a decline of both ecto-mycorrhizal fungal diversity and abundance due to air pollution. Although other causal factors in this decline are not well established, intensive forestry management practices and harvest of fungi are also implicated. In addition, fungi seem to be sensitive to subtle changes in temperature. This suggests that global climate warming could reduce distributions of species populations, but the likelihood and extent of such an effect cannot be estimated.

LICHENS

Affected Environment

The lichen flora in the Pacific Northwest is diverse and abundant. Lichens are a conspicuous component of old-growth forest ecosystems where they play an important ecological role. The lichen flora of the Pacific Northwest includes many endemic species; therefore, extirpation of these species in the region may for some species equate to the extinction of the species as a whole. Twenty-six species closely associated with old-growth forests are endemic to the Pacific Northwest (FEMAT Report, Table IV-A-2, p. IV-220).

Lichens are primary producers: they accumulate biomass and carbohydrates, and contribute to forest nutrient cycling. Arboreal lichens capture fog and retain moisture within the forest canopy. Many lichens fix atmospheric nitrogen (Denison 1973). Their litterfall provides organic material and increases the soil's moisture-holding capacity. The forage lichens are a major food source for animals such as flying squirrels, red-backed voles, and woodrats (Maser et al. 1985). They are also a food source for deer, elk and mountain goats during the winter (Fox and Smith 1988, Hodgman and Boyer 1985). American Indians used forage lichens for food (Turner 1990). Lichens provide habitat and food for canopy-dwelling invertebrates (Gersun and Seaward 1977), and are used by birds and small mammals for nest-building material and camouflage (Broad 1989). Air quality can be assessed by using lichens as biological indicators. Lichens are sensitive to sulfur dioxide and other gases and are efficient accumulators of heavy metals (McCune 1988). Some species of lichens show potential for antibiotic and medicinal qualities (Hawksworth and Hill 1984).

Many lichens have poor dispersal capability and are not able to move far from the parent plant. Small patches of old-growth forest fragments distributed across the landscape are important as refugia and centers of dispersal (Esseen et al. 1992). Some lichens, particularly the nitrogen-fixing species, do not become established until stands are several hundred years old (McCune, in press). Older stands that are well distributed geographically are believed to be important to the survival and persistence of these species in the ecosystem. Riparian protection on all orders of streams are important for the riparian and aquatic lichens.

Habitat components important to lichens primarily include the availability of live, old-growth trees, but decaying wood and riparian zones are also important to some species. Live trees provide substrates for most lichen species although others grow on decaying wood as well as on rocks, in soil, or in streams. Aquatic lichens are found on rocks in streams and create conditions that enhance aquatic invertebrate populations.

Environmental Consequences

Methods Specific to Lichens

The assessment panel evaluated the outcome of 157 species of lichens that are closely associated with late-successional and old-growth forests. This is a fairly comprehensive list of the macrolichens that occur in old-growth forests in the Pacific Northwest. Seven species were not assessed because of uncertainty about their biology or distribution (FEMAT Report, Table IV-A-2, p. 220). Since little is known about the distribution and habitat requirements of these species, there is uncertainty about the effects of forest management activities on habitats supporting these species. Generally the alternatives that manage for more extensive and interconnected late-successional and old-growth forest conditions will minimize the risks to these species. The relative lack of information concerning these species serves as an impetus to the monitoring and research and adaptive management plans that are part of these alternatives. Should habitat conditions decline significantly from projections, or should additional scientific information indicating a decline of these species become available, management of the relevant area would be considered for change under the adaptive management process described in this Final SEIS, Chapter 2, in the Implementation Section.

Lichen species were divided into 12 functional groups based on ecological relationships, and some of these were further subdivided by their degree of rarity. A discussion of the various groups is presented in the FEMAT Report. The Assessment Team concluded that rare species that exist in refugia historically or naturally could not rate higher than Outcome C because these species will always be distributed in isolated pockets or refugia regardless of the alternative.

All 16 groups of lichens, representing 136 species, were subject to additional analysis related to their ratings in the FEMAT Report. However, 5 groups representing 57 species had only a very low likelihood of risk of extirpation. Groups and species that were assessed as having less than 3 percent likelihood of risk of extirpation were not evaluated further if the total likelihood of Outcomes C and D was less than 20 percent.

To better reflect the specific information available, species were considered separately in the additional analysis (see Appendix J), rather than in the groups as in the FEMAT Report (See Table 3&4-24). Seventy-five species of lichens did not meet the above modified criterion and were subject to additional analysis. No additional species were analyzed solely on the basis of cumulative effects. However, cumulative effects in the form of air pollution or collection of lichens as special forest products will certainly influence many of the species that were analyzed (see discussion below on Cumulative Effects Including the Role of Nonfederal Land).

Effects of Alternatives

Results for lichen species, for all alternatives, are shown in Table 3&4-24. The species or species' ranges shown in the shaded portion of Table 3&4-24 are those that were specifically considered when additional standards and guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the added standards and guidelines. The ratings shown in Table 3&4-24 have not been changed to reflect these additions to the alternative. The additional standards and guidelines for lichens that have been incorporated in Alternative 9 are described in detail in Chapter 2 and Appendix B11 of this SEIS.

The habitat components important to lichens include live, old-growth trees, decaying wood, riparian zones, and extensive and interconnected late-successional and old-growth forest conditions. Alternatives 1, 4, and 9, would generally be the most favorable to lichens, because they provide the set of allocations and management practices that best produces the habitat components for lichens. Alternatives 3 and 5 would provide somewhat lower levels of this habitat. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for lichens. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

The analysis indicated significant likelihoods of restriction to refugia or some risk of extirpation under any of the alternatives considered in the SEIS for the oceanic-influenced lichens, rare oceanic-influenced lichens, rare rock lichens, the rare forage lichen, the two rare leafy arboreal lichens, and the six rare nitrogen-fixing lichens. No mitigations could be defined for these groups that would significantly improve the existing ratings. As mentioned above, the Assessment Team concluded that rare species that exist in refugia historically or naturally could not rate higher than Outcome C because these species will always be distributed in isolated pockets or refugia regardless of the alternative. See the discussion of these groups in the Cumulative Effects Including the Role of Nonfederal Lands section below.

For the remaining 10 common and rare lichen groups, Alternatives 1, 4, and 9 generally rated higher than other alternatives (Table 3&4-24). Alternatives 1, 4, and 9 (with additional standards and guidelines) would have 79, 78 and 73 percent or greater likelihoods, respectively, of providing habitat of sufficient quality, distribution, and abundance to allow the remaining 10 common and rare lichen group populations to stabilize either well distributed when measured against historic distribution or distributed with gaps in the historic

Table 3&4-24. Projected future likelihood for lichens habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Lichens	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Aquatic [3 species]	30	53	16	1	13	53	31	3	24	55	19	2	10	45	29	16	2	20	53	25	0	22	52	26	10	47	27	16
Decaying wood [8 species]	78	18	3	1	65	29	5	1	62	30	7	1	40	41	14	5	22	50	21	7	11	47	37	5	40	42	17	1
Forage Lichen (10 species)	80	18	1	1	70	27	2	1	58	39	2	1	47	41	9	3	28	49	19	4	34	47	17	2	61	32	5	2
Forage Lichen, Rare (1 species)	0	20	68	13	3	35	49	14	0	10	74	16	0	6	69	25	0	4	53	44	0	8	58	35	0	6	75	19
Leafy Arboreal (17 species)	89	9	1	1	81	17	1	1	76	19	4	1	59	33	7	1	37	45	17	1	36	45	18	1	52	40	7	1
Leafy Arboreal, Rare (2 species)	4	26	67	3	1	25	70	4	1	20	72	7	1	18	72	9	0	15	69	16	1	15	69	15	0	20	63	17
Nitrogen-fixing Lichens (20 species)	55	41	3	1	45	45	7	3	41	50	6	3	9	60	27	4	3	44	41	12	8	35	51	6	17	56	23	4
Nitrogen-fixing Lichens, Rare (6 species)	4	34	56	6	0	32	57	11	0	26	58	16	0	12	60	28	0	8	54	38	0	10	50	40	0	20	52	28
Oceanic Influence (4 species)	8	45	44	4	5	45	46	4	5	43	46	6	5	38	49	9	0	23	63	15	0	23	63	15	5	40	46	9
Oceanic Influence, Rare (12 species)	0	16	60	24	0	12	67	21	0	8	65	27	0	8	60	32	0	2	52	46	0	0	54	46	0	12	59	29
Pin Lichens (16 species)	37	47	15	1	30	48	21	1	30	48	21	1	23	47	27	3	11	38	42	9	10	30	51	9	22	46	29	3
Riparian (9 species)	18	61	18	3	11	53	33	3	16	62	19	3	6	52	36	6	2	36	48	14	4	26	50	20	9	54	32	5
Rock (4 species)	57	37	5	1	42	51	6	1	39	52	7	2	32	51	14	3	22	53	22	3	22	51	22	5	31	52	16	1
Rock, Rare (2 species)	3	15	65	18	0	15	60	25	0	13	64	24	0	13	59	29	0	10	45	45	0	8	49	44	3	13	56	29
Soil (8 species)	78	18	3	1	72	23	4	1	70	23	6	1	64	29	6	1	58	31	10	1	62	31	6	1	70	23	6	1
Tree boles (14 species)	76	21	2	1	69	26	4	1	60	33	4	3	55	36	6	3	26	57	13	4	26	60	11	3	46	44	7	3

A-Well Distributed B-Locally Restricted C-Restricted to Refugia D-Risk of Extirpation

Likelihood values are expressed as percentages that total to 100 for a given species within an Alternative. Number displayed may vary due to rounding errors. The Species shown in the shaded portion of the table are those that were specifically considered when additional standards are guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the standards and guidelines. The ratings shown in the table have not been changed to reflect these additions to Alternative 9. See text for fuller explanation and discussion of the rating scale and for discussion of the additional species analysis under Alternative 9.

species' distributions across federal lands. Alternatives 3 and 5 would have 64 and 55 percent or greater likelihoods, respectively, of providing habitat to allow the remaining 10 common and rare lichen group populations to achieve the same outcome(s). Alternatives 7 and 8 would each have 22 percent or greater likelihood of providing habitat at those levels for the remaining 10 common and rare lichen groups. Outcome ratings for lichens were generally correlated with the acreage of Late-Successional Reserves, stand treatments within the matrix, and protection for riparian corridors (aquatic and riparian lichens). Rare lichens rated much lower than common lichens because some of the rare lichen species have narrow geographic ranges and only occur in special habitats. Many of these special habitats occur as rare combinations of abiotic and biotic conditions such as a specific tree species in the fog zone of a waterfall at a low elevation.

Possible Mitigation Measures

All of the alternatives contain standards and guidelines that are expected to benefit lichens. As noted in the section earlier, to avoid or reduce impacts, a standard or guideline in one alternative could be added to another that currently does not include the measure . Those standards and guidelines which would increase the availability of live, old-growth trees and decaying wood, and riparian zones would be of greatest benefit to these species.

The following possible mitigation measures are not represented in the alternatives, but could benefit lichens:

> Designate Botanical Special Interest Areas (BSIA) or Areas of Critical Environmental Concern (ACEC).
>
> Management plans have been developed by federal agencies for many rare animals and vascular plants; similar plans could be developed to address rare lichen species. Such plans provide biological and habitat information, management direction, and recommendations for selecting and monitoring key populations.
>
> Retention of trees on ridgelines would benefit some lichen species because this location optimizes dispersal. This pattern of retaining trees mimics the retention patterns created by natural fire.

Cumulative Effects Including the Role of Nonfederal Lands

Nearly all of the species of lichens (with the possible exception of the pin lichens) are sensitive to air pollution. Increased levels of particulate matter and other pollutants may pose a risk to long-term survival of these species under any of the alternatives. The rare nitrogen-fixing lichens have a narrow ecological tolerance, generally inhabiting stands that are over 200 years old. Several of the species in this group are also most strongly associated with low elevation forests that are largely on nonfederal lands. These factors led to cumulative effects concerns under all of the alternatives. Nonfederal land management is important to the long-term viability of rare rock lichens because road building and rock quarry operations have reduced habitat for these species. The aquatic lichens are sensitive to acid precipitation, and are often taken incidentally by moss collectors in accessible areas of their range. In addition, recreational activity and destruction of habitat in populated coastal areas cause cumulative effects risks to viability of the rare oceanic-influenced lichens.

Much of the low elevation forest land in the Pacific Northwest is in nonfederal ownership (and administered by state and private timber managers). This land covers thousands of acres and is generally managed on short harvest rotations. Given that lichens are slow to establish in rapidly growing stands and that many species do not become abundant until later in the successional development, most of these stands are harvested before lichens have a chance to establish substantial populations. Lichens considered in this assessment have poor dispersal capability, and restoration of populations on managed nonfederal lands cannot be assured under any of the alternatives.

Vascular Plants

Affected Environment

The largest and most dominant organisms of the late-successional and old-growth forest ecosystem are the vascular plants, some of which may tower over 250 feet and have lifespans over 1,000 years. Vascular plants are defined as those that contain conducting or vascular tissue. They include seed-bearing plants (flowering plants and conifers) and spore-bearing forms, such as ferns. They create the structure of the forest and function as the primary producers, capturing sunlight through photosynthesis and converting it to food consumed by animals and fungi. Vascular plants provide substrate and habitat for other organisms, influence microclimate (e.g., sunlight, humidity, and temperature), and provide forage, hiding, and thermal cover for vertebrate and invertebrate species. They produce litterfall that contributes to organic matter and soil development. Some species are symbiotic with fungi and other vascular plants, while others fix nitrogen. Trees with dwarf mistletoe develop broom-like structures that function as nesting platforms for birds and small mammals. Many vascular plants have close relationships with specific animal pollinators and predators.

In addition to their vital role in maintaining a functioning ecosystem, vascular plants provide commercial resources, including timber, forage, and other forest products. Harvest of medicinal, horticultural, and edible plants from Pacific Northwest forests has increased dramatically in recent years. Commercially-collected vascular plant species include beargrass, salal, huckleberry, sword fern, cascara, and Pacific yew.

Within the range of the northern spotted owl, several important areas of high diversity are recognized that feature plants that are restricted to narrow geographical areas. The areas with the greatest number of endemic species include the Oregon and California Klamath Provinces, the Olympic Peninsula Province, the Columbia River Gorge, and the Wenatchee Mountains. Rare and local plants are often restricted to distinctive soils (e.g., serpentine or ultramafic) and to special habitats such as rock outcrops, bogs, and wetlands.

Nonphotosynthetic species, such as fringed pinesap and coralroot orchid, are characterized by complex, symbiotic relationships involving both fungi and photosynthetic vascular plants (Furman and Trappe 1971, Wells 1981).

While many vascular plants colonize quickly and have short reproductive cycles, most species closely associated with late-successional and old-growth forests are long-lived perennials. Many woody and herbaceous vascular plants are extremely long-lived, requiring decades to reach reproductive size (Hanzawa and Kalisz 1993). Reestablishment in disturbed sites may be slow, particularly for species with limited dispersal capabilities. Many rare plants are characterized by low seedling production (Crowder 1978, Fredricks 1992) and are further limited by seed predation and competition from other species.

Environmental Consequences

Methods Specific to Vascular Plants

Hundreds of vascular plant species occur in late-successional forests within the planning area, (Table 3&4-25) and 150 species are considered to be closely associated with these forests (FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment). The vascular plant species "short list" in the Scientific Analysis Team Report (Thomas et al. 1993: Appendix 5-D) formed the basis of the list developed for this analysis. Additional input was provided by botanists from land management and cooperating agencies, universities, and from both private and nonprofit organizations. Twenty-five species not evaluated in the Scientific Analysis Team Report (Thomas et al. 1993) were added. Nine species considered in the Scientific Analysis Team Report were found not to meet the criterion of close association with late-successional and old-growth forests and were deleted from this analysis.

The vascular plant panel performed an assessment of 124 vascular plant taxa for each of the alternatives, based on projected future habitat conditions on federal lands. Seven species that exhibit dissimilar ecological characteristics in different portions of their range were ranked separately based on geographical areas.

Maps illustrating the locations of populations of 19 threatened, endangered, and sensitive plants tracked by the State Natural Heritage Programs were overlaid on maps of the land allocations for the alternatives being considered in the analysis. The species maps included both historical and current distributions. The number and percentage of known populations that occur within the various land allocations set by the alternatives were calculated and used in the viability analysis. Rare and endemic species were identified and treated separately in some analyses.

A total of 131 species or species ranges were assessed in the FEMAT Report. Of these, 17 species or species ranges were subjected to additional analysis as described earlier in Chapter 3&4, Methods for Additional Species Analysis. All of the 17 species analyzed were either rare within the range considered, or locally endemic. Five species were narrowly endemic with known distributions spanning one to four National Forests (*Aster vialis, Clintonia andrewsiana, Corydalis aquae-gelidae, Pedicularis howellii,* and *Scoliopus bigelovii*); of these, two are federal candidate species (*Aster vialis* and *Corydalis aquae-gelidae*). All others are considered rare either throughout their entire range or within the planning area. Six species (*Arceuthobium tsugense, Botrychium minganense, Coptis trifolia, Cypripedium montanum, Galium kamtschaticum,* and *Habenaria orbiculata*) have ranges which extend beyond the planning area and may be more common in other portions of their range.

Table 3&4-25. Projected future likelihood for vascular plants habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Vascular Plants	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Abies lasiocarpa (California)	50	13	38	0	50	13	38	0	50	13	38	0	50	13	38	0	50	13	38	0	50	13	38	0	50	13	38	0
Achlys triphylla	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	85	15	0	0	82	19	0	0	97	4	0	0
Adenocaulon bicolor	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	95	5	0	0	95	5	0	0	100	0	0	0
Adiantum pedatum	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	92	8	0	0	92	8	0	0	98	2	0	0
Adiantum jordanii	100	0	0	0	78	23	0	0	78	23	0	0	75	25	0	0	68	33	0	0	68	33	0	0	78	23	0	0
Allotropa virgata	62	34	4	0	34	53	13	0	34	53	13	0	33	51	17	0	19	52	25	4	28	52	17	4	28	53	16	4
Anemone deltoidea	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	92	9	0	0	92	9	0	0	98	2	0	0
Apocynum pumilum	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	75	25	0	0	90	10	0	0	90	10	0	0
Aralia californica	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	87	13	0	0	87	13	0	0	94	6	0	0
Arceuthobium tsugense	0	80	20	0	0	80	20	0	0	80	20	0	0	60	40	0	0	50	50	0	0	50	50	0	0	50	50	0
Arnica latifolia	100	0	0	0	100	0	0	0	100	0	0	0	98	2	0	0	93	7	0	0	98	2	0	0	100	0	0	0
Asarum caudatum	97	4	0	0	87	14	0	0	88	12	0	0	87	14	0	0	81	19	0	0	82	18	0	0	87	14	0	0
Asarum hartwegii	100	0	0	0	93	7	0	0	87	13	0	0	83	17	0	0	72	28	0	0	75	25	0	0	83	17	0	0
Asarum marmoratum	80	20	0	0	60	40	0	0	60	40	0	0	60	40	0	0	60	40	0	0	60	40	0	0	60	40	0	0
Asarum wagneri	100	0	0	0	100	0	0	0	90	10	0	0	90	10	0	0	80	20	0	0	80	20	0	0	90	10	0	0
Aster vialis	0	61	39	0	0	61	39	0	0	59	41	0	0	56	44	0	0	26	74	0	0	26	74	0	0	48	53	0
Bensoniella oregana (California)	90	10	0	0	0	0	50	50	0	0	50	50	0	0	50	50	0	0	50	50	0	0	50	50	0	0	50	50
Bensoniella oregana (Oregon)	78	23	0	0	68	33	0	0	73	28	0	0	63	38	0	0	31	43	26	0	31	43	26	0	58	33	10	0
Berberis pumila	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	95	5	0	0	98	3	0	0	100	0	0	0
Boschniakia strobilacea	88	12	0	0	80	20	0	0	80	20	0	0	80	20	0	0	58	33	8	0	62	30	8	0	80	20	0	0
Botrychium minganense	30	58	12	0	30	50	20	0	30	50	20	0	30	50	20	0	30	43	27	0	30	43	27	0	30	50	20	0
Botrychium montanum	30	58	12	0	30	50	20	0	30	50	20	0	30	50	20	0	30	43	27	0	30	43	27	0	30	50	20	0
Botrychium virginianum	63	32	5	0	58	35	7	0	58	37	5	0	54	39	7	0	48	32	20	0	48	32	20	0	52	41	7	0
Calypso bulbosa	90	10	0	0	86	14	0	0	86	14	0	0	86	14	0	0	80	16	4	0	82	14	4	0	84	16	0	0
Chamaecyparis lawsoniana (north)	87	7	7	0	80	13	7	0	80	13	7	0	77	17	7	0	60	27	13	0	60	27	13	0	77	17	7	0
Chamaecyparis lawsoniana (south)	80	10	10	0	60	30	10	0	60	30	10	0	60	30	10	0	30	50	20	0	30	50	20	0	60	30	10	0
Chamaecyparis nootkatensis	100	0	0	0	98	2	0	0	98	2	0	0	98	2	0	0	93	7	0	0	93	7	0	0	98	2	0	0
Chimaphila menziesii	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	92	8	0	0	94	6	0	0	98	2	0	0
Chimaphila umbellata	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	92	8	0	0	94	6	0	0	98	2	0	0
Cimicifuga elata	69	21	10	0	53	36	11	0	50	39	11	0	48	41	11	0	29	40	31	0	34	38	29	0	48	40	13	0
Cimicifuga laciniata	100	0	0	0	90	10	0	0	90	10	0	0	90	10	0	0	80	20	0	0	80	20	0	0	90	10	0	0
Clintonia andrewsiana	80	20	0	0	70	27	3	0	70	27	3	0	70	27	3	0	57	33	10	0	60	30	10	0	70	27	3	0
Clintonia uniflora	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	93	8	0	0	93	8	0	0	98	2	0	0
Collomia mazama	100	0	0	0	85	15	0	0	85	15	0	0	85	15	0	0	70	30	0	0	70	30	0	0	85	15	0	0
Coptis asplenifolia	0	10	90	0	0	10	90	0	0	10	90	0	0	10	90	0	0	0	90	10	0	0	90	10	0	10	90	0

Table 3&4-25. Projected future likelihood for vascular plants habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Vascular Plants (continued)	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Coptis laciniata	98	3	0	0	93	8	0	0	93	8	0	0	90	10	0	0	71	29	0	0	71	29	0	0	83	18	0	0
Coptis trifolia	50	30	20	0	30	30	40	0	30	30	40	0	30	30	40	0	0	30	40	30	0	30	40	30	20	30	50	0
Corallorhiza maculata	98	2	0	0	97	3	0	0	97	3	0	0	97	3	0	0	86	14	0	0	88	13	0	0	95	5	0	0
Corallorhiza mertensiana	98	2	0	0	97	3	0	0	97	3	0	0	97	3	0	0	88	13	0	0	89	11	0	0	95	5	0	0
Corallorhiza striata	98	2	0	0	98	2	0	0	97	3	0	0	97	3	0	0	88	13	0	0	89	11	0	0	95	5	0	0
Corydalis aquae-gelidae	20	49	31	0	17	47	37	0	20	49	31	0	10	48	40	2	2	32	57	10	2	30	58	10	10	48	40	2
Cypripedium fasciculatum (Cascades)	0	28	38	33	0	17	43	40	0	17	43	40	0	17	40	43	0	8	40	52	0	8	37	55	0	8	37	55
Cypripedium fasciculatum (Klamath)	50	40	10	0	15	50	20	15	15	50	20	15	5	55	30	10	0	40	35	25	0	43	38	20	0	43	38	20
Cypripedium montanum (east Cascades)	0	75	25	0	0	50	50	0	0	50	50	0	0	50	50	0	0	25	50	25	0	25	50	25	0	25	75	0
Cypripedium montanum (west Cascades)	12	33	41	14	0	25	50	25	0	25	48	27	0	23	50	27	0	14	42	44	0	17	41	42	0	21	52	27
Dentaria californica	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	95	5	0	0	95	5	0	0	100	0	0	0
Disporum hookeri	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	92	8	0	0	92	8	0	0	98	2	0	0
Disporum smithii	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	91	9	0	0	91	9	0	0	98	2	0	0
Dryopteris austriaca	100	1	0	0	100	1	0	0	100	1	0	0	100	1	0	0	87	13	0	0	87	13	0	0	95	6	0	0
Eburophyton austiniae	83	8	8	0	83	8	8	0	83	8	8	0	83	8	8	0	76	11	13	0	78	9	13	0	82	5	13	0
Erythronium montanum	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	97	3	0	0	97	3	0	0	100	0	0	0
Frasera umpquaensis	78	20	3	0	65	33	3	0	65	33	3	0	63	35	3	0	33	51	16	0	33	51	16	0	60	35	5	0
Galium kamtschaticum	0	90	10	0	0	90	10	0	0	90	10	0	0	70	30	0	0	70	30	0	0	70	30	0	0	70	30	0
Galium oreganum (Klamath)	98	3	0	0	98	3	0	0	98	3	0	0	93	8	0	0	85	15	0	0	88	13	0	0	93	8	0	0
Gaultheria humifusa	95	5	0	0	95	5	0	0	95	5	0	0	90	10	0	0	85	15	0	0	85	15	0	0	85	15	0	0
Gaultheria ovatifolia	98	2	0	0	98	2	0	0	98	2	0	0	98	2	0	0	94	6	0	0	96	4	0	0	98	2	0	0
Goodyera oblongifolia	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	95	5	0	0	97	4	0	0	98	2	0	0
Gymnocarpium dryopteris	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	96	4	0	0	96	4	0	0	100	0	0	0
Habenaria orbiculata	0	100	0	0	0	80	20	0	0	80	20	0	0	80	20	0	0	50	50	0	0	50	50	0	0	50	50	0
Habenaria saccata	100	0	0	0	98	2	0	0	98	2	0	0	98	2	0	0	91	9	0	0	91	9	0	0	96	4	0	0
Habenaria unalascensis	100	0	0	0	98	3	0	0	98	3	0	0	98	3	0	0	94	6	0	0	94	6	0	0	98	3	0	0
Hemitomes congestum	82	18	0	0	69	23	8	0	69	23	8	0	63	29	8	0	52	29	19	0	57	24	19	0	58	26	16	0
Hierochloe occidentalis	100	0	0	0	92	8	0	0	92	8	0	0	88	12	0	0	72	28	0	0	72	28	0	0	87	13	0	0
Hypopitys monotropa	90	10	0	0	69	23	8	0	69	23	8	0	66	26	8	0	55	29	16	0	58	26	16	0	62	28	10	0
Isopyrum hallii	80	20	0	0	70	30	0	0	70	30	0	0	70	30	0	0	60	40	0	0	60	40	0	0	70	30	0	0
Lathyrus polyphyllus	100	0	0	0	95	5	0	0	95	5	0	0	95	5	0	0	89	11	0	0	91	9	0	0	95	5	0	0
Listera borealis	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	90	10	0	0	90	10	0	0	100	0	0	0
Listera caurina	98	3	0	0	96	4	0	0	96	4	0	0	91	9	0	0	84	16	0	0	89	11	0	0	88	13	0	0
Listera convallarioides	97	3	0	0	95	5	0	0	95	5	0	0	88	12	0	0	83	17	0	0	90	10	0	0	83	17	0	0
Listera cordata	100	0	0	0	99	1	0	0	99	1	0	0	96	4	0	0	87	13	0	0	91	9	0	0	92	9	0	0

Table 3&4-25. Projected future likelihood for vascular plants habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Vascular Plants (continued)	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Luzula hitchcockii	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	96	4	0	0	96	4	0	0	100	0	0	0
Lycopodium selago	93	7	0	0	83	17	0	0	83	17	0	0	80	20	0	0	73	27	0	0	73	27	0	0	83	17	0	0
Lysichiton americanum	100	0	0	0	98	2	0	0	98	2	0	0	97	4	0	0	93	7	0	0	93	7	0	0	96	4	0	0
Melica subulata	98	2	0	0	98	2	0	0	98	2	0	0	98	2	0	0	96	4	0	0	97	3	0	0	98	2	0	0
Menziesia ferruginea	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	91	9	0	0	91	9	0	0	100	0	0	0
Mitella breweri	97	3	0	0	97	3	0	0	97	3	0	0	97	3	0	0	90	10	0	0	90	10	0	0	97	3	0	0
Mitella caulescens	98	3	0	0	95	5	0	0	98	3	0	0	95	5	0	0	86	14	0	0	86	14	0	0	95	5	0	0
Mitella ovalis	98	2	0	0	97	3	0	0	98	2	0	0	97	3	0	0	89	11	0	0	89	11	0	0	95	5	0	0
Mitella pentandra	97	3	0	0	93	7	0	0	93	7	0	0	93	7	0	0	87	13	0	0	87	13	0	0	90	10	0	0
Mitella trifida	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	85	15	0	0	85	15	0	0	90	10	0	0
Monotropa uniflora	89	11	0	0	70	25	5	0	70	25	5	0	62	28	10	0	58	30	12	0	60	28	12	0	63	27	10	0
Oxalis oregana	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	98	2	0	0	98	2	0	0	100	0	0	0
Oxalis trilliifolia	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	88	13	0	0	88	13	0	0	100	0	0	0
Pedicularis howellii	85	15	0	0	40	45	15	0	40	45	15	0	40	45	15	0	20	30	40	10	25	25	35	15	30	40	25	5
Phlox adsurgens	100	0	0	0	96	4	0	0	96	4	0	0	96	4	0	0	88	13	0	0	88	13	0	0	95	5	0	0
Picea breweriana	83	17	0	0	82	18	0	0	82	18	0	0	82	18	0	0	67	23	10	0	68	22	10	0	82	18	0	0
Pityopis californica	92	8	0	0	78	22	0	0	78	22	0	0	78	22	0	0	60	33	7	0	70	23	7	0	73	23	3	0
Pleuricospora fimbriolata	88	12	0	0	78	22	0	0	78	22	0	0	76	24	0	0	60	33	7	0	63	30	7	0	72	27	2	0
Poa laxiflora (Cascade)	85	15	0	0	70	30	0	0	80	20	0	0	70	30	0	0	55	35	10	0	55	35	10	0	70	30	0	0
Poa laxiflora (Coast)	90	10	0	0	83	17	0	0	83	17	0	0	83	17	0	0	60	40	0	0	60	40	0	0	83	17	0	0
Polystichum californicum (Cascades)	100	0	0	0	78	23	0	0	73	28	0	0	73	28	0	0	50	50	0	0	63	38	0	0	73	28	0	0
Pterospora andromedea	82	18	0	0	78	23	0	0	78	23	0	0	73	28	0	0	62	33	6	0	64	30	6	0	73	28	0	0
Pyrola asarifolia	100	0	0	0	99	1	0	0	99	1	0	0	97	3	0	0	89	11	0	0	91	9	0	0	95	5	0	0
Pyrola chlorantha	97	3	0	0	97	3	0	0	97	3	0	0	93	7	0	0	90	10	0	0	93	7	0	0	93	7	0	0
Pyrola dentata	100	0	0	0	95	5	0	0	95	5	0	0	93	8	0	0	81	19	0	0	84	16	0	0	93	8	0	0
Pyrola picta	98	2	0	0	98	2	0	0	98	2	0	0	97	3	0	0	90	10	0	0	92	8	0	0	95	5	0	0
Pyrola secunda	100	0	0	0	99	1	0	0	99	1	0	0	97	3	0	0	91	9	0	0	92	8	0	0	95	5	0	0
Pyrola uniflora	93	7	0	0	87	13	0	0	87	13	0	0	83	17	0	0	75	25	0	0	78	22	0	0	87	13	0	0
Rubus lasiococcus	100	0	0	0	99	2	0	0	99	2	0	0	99	2	0	0	95	5	0	0	95	5	0	0	97	3	0	0
Rubus nivalis	98	2	0	0	94	6	0	0	94	6	0	0	92	8	0	0	86	14	0	0	89	11	0	0	90	10	0	0
Rubus pedatus	100	1	0	0	100	1	0	0	100	1	0	0	95	6	0	0	95	6	0	0	95	6	0	0	100	1	0	0
Sarcodes sanguinea	73	21	6	0	64	24	13	0	64	24	13	0	61	26	13	0	53	33	15	0	58	28	15	0	60	28	13	0
Satureja douglasii	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	93	8	0	0	93	8	0	0	100	0	0	0
Scoliopus biglovei	100	0	0	0	73	28	0	0	73	28	0	0	73	28	0	0	55	45	0	0	55	45	0	0	65	35	0	0
Scoliopus hallii	100	0	0	0	90	10	0	0	98	3	0	0	90	10	0	0	78	23	0	0	78	23	0	0	90	10	0	0

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	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Vascular Plants (continued)	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Selaginella oregana	60	33	7	0	53	40	7	0	53	40	7	0	53	40	7	0	47	47	7	0	47	47	7	0	53	40	7	0
Smilacina racemosa	100	0	0	0	99	1	0	0	99	1	0	0	99	1	0	0	95	5	0	0	95	5	0	0	97	4	0	0
Smilacina stellata	100	0	0	0	99	1	0	0	99	1	0	0	99	1	0	0	95	5	0	0	95	5	0	0	97	4	0	0
Streptopus amplexifolius	100	0	0	0	99	1	0	0	99	1	0	0	99	1	0	0	93	7	0	0	93	7	0	0	97	4	0	0
Streptopus roseus	100	0	0	0	97	3	0	0	97	3	0	0	97	3	0	0	86	14	0	0	86	14	0	0	95	5	0	0
Streptopus streptopoides (Oregon)	95	5	0	0	80	20	0	0	80	20	0	0	80	20	0	0	60	40	0	0	60	40	0	0	80	20	0	0
Streptopus streptopoides (Washington)	90	10	0	0	90	10	0	0	90	10	0	0	90	10	0	0	90	10	0	0	90	10	0	0	90	10	0	0
Synthyris schizantha	97	3	0	0	97	3	0	0	97	3	0	0	97	3	0	0	93	7	0	0	93	7	0	0	97	3	0	0
Taxus brevifolia (entire range)	97	4	0	0	93	7	0	0	93	7	0	0	92	9	0	0	78	22	0	0	80	20	0	0	87	14	0	0
Taxus brevifolia (nw CA)	80	20	0	0	60	40	0	0	60	40	0	0	60	40	0	0	40	60	0	0	40	60	0	0	40	60	0	0
Thuja plicata	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	98	2	0	0	98	2	0	0	98	2	0	0
Tiarella trifoliata	100	0	0	0	97	3	0	0	99	1	0	0	97	3	0	0	95	5	0	0	95	5	0	0	97	3	0	0
Tiarella unifoliata	100	0	0	0	97	3	0	0	99	1	0	0	97	3	0	0	95	5	0	0	95	5	0	0	97	3	0	0
Trillium ovatum	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	98	2	0	0	98	2	0	0	100	0	0	0
Vaccinium alaskaense	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	98	3	0	0	98	3	0	0	100	0	0	0
Vaccinium membranaceum	100	0	0	0	99	1	0	0	99	1	0	0	99	1	0	0	98	2	0	0	99	1	0	0	99	1	0	0
Vaccinium ovalifolium	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Vaccinium parvifolium	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Vancouveria hexandra	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	97	4	0	0	97	4	0	0	100	0	0	0
Vancouveria planipetala	97	3	0	0	88	12	0	0	87	13	0	0	85	15	0	0	75	25	0	0	75	25	0	0	88	12	0	0
Vicia americana var. villosa	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	98	2	0	0	98	2	0	0	100	0	0	0
Viola glabella	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	96	4	0	0	96	4	0	0	97	3	0	0
Viola orbiculata	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	97	3	0	0	97	3	0	0	100	0	0	0
Viola renifolia	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	95	5	0	0	95	5	0	0	100	0	0	0
Whipplea modesta	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	98	2	0	0	98	2	0	0	100	0	0	0

Table 3&4-25 Projected future likelihood for vascular plants habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Vascular Plants (continued)	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Xerophyllum tenax (Olympic Penisula)	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0

A-Well Distributed B-Locally Restricted C-Restricted to Refugia D-Risk of Extirpation

Likelihood values are expressed as percentages that total to 100 for a given species within an Alternative. Number displayed may vary due to rounding errors. The Species shown in the shaded portion of the table are those that were specifically considered when additional standards are guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the standards and guidelines. The ratings shown in the table have not been changed to reflect these additions to Alternative 9. See text for fuller explanation and discussion of the rating scale and for discussion of the additional species analysis under Alternative 9.

Effects of Alternatives

Results for all species under all alternatives are shown in Table 3&4-25. The species or species' ranges shown in the shaded portion of the table are those that were specifically considered when additional standards and guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the added standards and guidelines. The ratings shown in Table 3&4-25 have not been changed to reflect these additions to the alternative.

The habitat components important to vascular plants are those that generally increase amounts of late-successional, riparian, and old-growth habitat. Alternative 1 is generally the most favorable to vascular plants because it provides the set of allocations and management practices that best produce the habitat components for vascular plants. Alternatives 3, 4, 5, and 9 are similar in providing somewhat lower levels of these habitat conditions. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for vascular plants. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Alternative 1 would provide a 90 percent or greater likelihood of achieving habitat of sufficient abundance and quality to support stable populations well distributed when measured against their historic range across federal lands for 95 species or species ranges, and an 80 percent or greater likelihood for 110 species or species groups. The overall ratings of Alternatives 3, 4, 5, and 9 (with adjustments in standards and guidelines) are similar to each other: from 74 to 81 species or species' ranges rated as having a 90 percent or greater likelihood of achieving sufficient habitat well distributed across federal lands within their natural geographic range, and 92 to 94 species or species' ranges rated as having an 80 percent likelihood. Alternatives 7 and 8 rated lowest, with likelihoods of achieving Outcome A of 50 percent or less for 25 species or species' ranges under Alternative 7, and for 19 species or species' ranges under Alternative 8.

Ratings tended to be lowest for rare species that were geographically restricted (e.g., *Aster vialis*) or sparsely distributed throughout a larger range (e.g., *Allotropa virgata, Cypripedium fasciculatum*). Because rare species are often restricted to localized areas, the reserve areas in this analysis afforded different degrees of protection to individual species.

Examining the original Assessment Team ratings, there were 21 species or species' ranges, under all alternatives, that had less than an 80 percent likelihood of achieving habitat of sufficient quality, abundance and distribution to allow for stable, well-distributed species populations when measured against their historic range. Of these species, 5 are local endemics, 3 are on the periphery of their range, and 13 are rare or uncommon. One species, *Arceuthobium tsugense*, is a parasitic epiphyte found most commonly on older western hemlocks (*Tsuga heterophylla*) in wetter climatic areas, such as along the western Olympic Peninsula. Substantial gaps in its historical range currently exist, and panelists predicted that the gaps would persist even under Alternative 1. Seven species were considered to have no likelihood of achieving well-distributed habitat of sufficient quality, distribution, and abundance to allow populations to stabilize across federal lands within their natural geographic range. One species (*Coptis asplenifolia*) was expected to be restricted to refugia under all alternatives.

The nonphotosynthetic, mycotrophic species received lower ratings, on average, under all alternatives (except Alternative 1) compared to other species. This perhaps reflects their complex life histories involving fungal symbionts, other vascular plants, and in some cases, unidentified seed disseminators.

For all species that were subject to additional analysis, the standards and guidelines for surveys and subsequent management of known sites to maintain populations have significant benefits. For some of these species, simple protection of known sites may not be sufficient. In these cases, the recommended site-specific management may include the reintroduction of fire within the proposed fire management standards and guidelines (Appendix B8). It will be important to conduct experimental studies to develop effective prescriptions which minimize risk and maximize benefit on a site-specific basis. Other survey and manage provisions for these species are more fully described in Appendix B11.

The standards and guidelines for vascular plants incorporated into Alternative 9 are described in Chapter 2 and Appendix B11. Of the 17 plants subject to additional analysis, ratings for 5 species were not significantly improved through additional standards and guidelines. These species include *Abies lasiocarpa* [in California], *Bensoniella oregona, Coptis asplenifolia, Cypripedium fasciculatum*, and *C. montanum*. No additional standards and guidelines could be devised to significantly increase the likelihoods of persistence of these species on federal lands (see Cumulative Effects Including the Role of Nonfederal Lands discussion below). For the other 12 species, Alternative 9 would provide a likelihood of at least 80 percent that the species would stabilize well distributed when measured against their historic ranges, or distributed with gaps, on federal lands.

Possible Mitigation Measures

All of the alternatives contain standards and guidelines that are expected to benefit vascular plants. As noted previously in the chapter, to avoid or reduce impacts, a standard or guideline in one alternative could be added to another that currently does not include the measure. Those standards and guidelines that would retain additional low elevation late-successional forest, or would retain additional old-growth fragments in the matrix, would be of greatest benefit to the vascular plants.

The following possible mitigation measures are not represented in the alternatives, but could benefit vascular plants:

> Botanical Special Interest Areas and Areas of Critical Environmental Concern could reduce risk to rare and local species by protecting habitat

and key populations (e.g., *Aster vialis, Bensoniella oregana, Cimicifuga elata, Corydalis aquae-gelidae, Frasera umpquaensis, Poa laxiflora* and *Streptopus streptopoides*). Key habitat and populations of many of the species at risk have already been identified in conservation strategies (Cripps 1993, Gamon 1991, Goldenberg 1990, Grenier 1992, Kagan and Vrilakas 1993, Kaye and Kirkland 1993, Lang 1988).

Developing, updating, and implementing conservation strategies for species, species groups, and habitats can reduce risk for many sensitive species. Information is needed on the distribution and life histories of many vascular plant species. Few studies have attempted to track population trends of species with limited distributions and occurrences. Implementation of well-designed monitoring studies are priorities for these species. Basic inventories and studies to determine sustainable yields of special forest products should be conducted to avoid overharvest of these resources. Riparian areas have not been as well studied as uplands, and development of consistent inventory and classification of riparian plant associations on an interagency basis could be initiated.

A pathogenic root disease (*Phytophthora lateralis*) has spread through much of the range of *Chamaecyparis lawsoniana*, resulting in the elimination of stands from some habitats and threatening the commercial status of the species throughout its range (Zobel et al. 1985). The root disease has spread from the northern portion of the species range into remote areas, killing Port-Orford-cedars of all ages. No known genetic resistance or chemical control has been identified. The spores are spread via water and are transported primarily by movement of people, machinery, and animals; and through root grafts (Zobel et al. 1985) (for further information see the Final Northern Spotted Owl EIS (USDA FS 1992) which is supplemented by this SEIS and Forest Service Port-Orford-Cedar Action Plans (USDA FS unpub.)). Closing roads and restricting road construction in watersheds that contain uninfected stands would benefit this species.

Cumulative Effects Including the Role of Nonfederal Lands

Cumulative effects were a significant concern for *Bensoniella oregona*. This species occurs in the Coast Range of Oregon and California. Only one population in California is known to occur on federal land; all other sites are on privately-owned lands. *Bensoniella* is at risk under all alternatives because it has rarely been found on federal lands, it has narrow ecological requirements, a restricted range, and small populations sizes.

Cumulative effects were also a concern for *Coptis asplenifolia*, which is reported from two disjunct populations in the north Coast Range of Oregon on nonfederal land and six sites in Washington State in the Olympic Peninsula and western Washington Cascades. Due to the small, scattered populations of this species, there is still risk to the species under any of the alternatives due to extremely limited opportunity for gene exchange, risk of large-scale disturbance, and likely sensitivity to global climate warming.

Coptis trifolia occurs on state, private, and tribal and Indian owned lands of Oregon. This species has medicinal properties for which it is collected and marketed, and which could threaten local populations. This species should receive significant benefit from inventories and management of sites, although additional standards and guidelines may be unsuccessful in maintaining populations in Oregon because of the uncertain future of disjunct populations. Although widely distributed, *Allotropa virgata* has limited dispersal capabilities and is associated with low elevation forest primarily on nonfederal lands. For these reasons, population connectivity may not be maintained, but the species' distribution is not well known and the extent of this risk is difficult to judge. Similar concerns exist for *Aster vialis*, a federal Candidate 2 species. Fragmentation of habitat on nonfederal lands may result in population reduction and risk of extirpation from federal lands under any of the alternatives.

Scoliopus bigelovii is endemic to California, primarily within coastal redwood forests. Most of its range is on private land, where harvest of redwood may pose a risk of extirpation from federal lands.

Abies lasiocarpa is extremely rare in California, known from only two sites, both within Congressionally Reserved Areas. Because of demographic uncertainty and risk of large-scale disturbance, no additional standards and guidelines could raise the ratings for the California portion of the species' range. However, *Abies lasiocarpa* is widespread and common elsewhere; its range extends throughout much of the Rocky Mountain Range and into southeastern Alaska and the central Yukon Territory.

Two species with risk of extirpation from federal lands under all alternatives include *Cypripedium fasciculatum* and *C. montanum*. These species are thought to have been strongly affected by fire suppression. Perhaps due to higher fire frequency east of the Cascade Range, *Cypripedium montanum* is more abundant east of the Cascades than west of the Cascades. Additional standards and guidelines under Alternative 9, including protection and management of known sites, should benefit these species. However, even with these standards and guidelines in place, there will still be some risk of extirpation.

Invertebrates

ARTHROPODS AND THEIR ALLIES

Affected Environment

Arthropods are invertebrates with jointed legs, a segmented body, and an exoskeleton (an external supporting covering). They include insects, crustaceans, arachnids, and myriapods and collectively constitute over 85 percent of the biological diversity in late-successional and old-growth forests in the Pacific Northwest (Asquith et al. 1990). Arthropods assume numerous ecological roles that are important to ecosystem function (Olson 1992). Lattin (pers. comm.) estimates there are between 20,000 and 25,000 species of arthropods within the range of the northern spotted owl.

Arthropods inhabit virtually every part of the coniferous forest ecosystem including coarse woody debris, litter and soil layer, understory vegetation, canopy foliage, tree trunks, snags, and the aquatic system. The litter and soil of the forest floor are the site of some of the greatest biological diversity found anywhere. The soil under a square yard of forest may hold as many as 250 species and 200,000 mites from a single taxonomic group, plus tens of thousands of other mites, beetles, centipedes, pseudoscorpions, springtails, and spiders. Many of these species are not described and most are poorly understood. The structure and function of temperate forest soils may be determined by the dietary habits of the soil arthropods (Lattin and Moldenke 1992). They are the basic consumers of the forest floor where they ingest and process massive quantities of organic litter and debris, from large logs to bits of moss (Lattin and Moldenke 1992). While the richness of arthropod species in late-successional and old-growth forests suggests a great number of different processes and functions, relatively little is known about how arthropods interact, survive, and contribute to ecosystem function.

Arthropods in late-successional and old-growth forests are of concern for several reasons. First, many of the species are flightless, which means their dispersal capabilities are limited. In fact, little is known about the dispersal capabilities of these invertebrates. Second, their flightless condition is believed to reflect habitat stability and permanence over a long period. Third, many of the old-growth forest associates have disjunct distributions and are found only in undisturbed forests. They are often found only within the range of coniferous forests within the Pacific Northwest and are therefore endemic to this area. Fourth, arthropods are key to ecosystem function and may serve as indicators of ecosystem function. They are a key element in the nutrient cycling of down logs, major components in the litter and soil, herbivores of the forest canopy, pollinators of flowering plants, and play important roles in aquatic systems. Lastly, many of the species native to this region have not been named, and the number of known species probably represents less than half of the number of species estimated to exist (Lattin and Moldenke 1992).

Environmental Consequences

Methods Specific to Arthropods

The Assessment Team reviewed lists of arthropods that are associated with or indicative of late-successional forests in the Pacific Northwest. These lists were contained in the Final Draft Spotted Owl Recovery Plan (USDI unpub.) and the Scientific Analysis Team Report (Thomas et al. 1993). A revised list of species was assembled which includes approximately 155 insects, 25 spiders, 25 millipedes, and 1 crustacean (see Appendix J).

Assessment of the capability of habitat to support arthropod populations is complex for several reasons. First, many species have not been described, resulting in a lack of information on specific habitat associations. Second, there have not been adequate surveys of arthropods in the Pacific Northwest. Third, the diversity of arthropods is greater than any other group of organisms (Asquith et al. 1990, Lattin and Moldenke 1992).

Given this complexity, the Assessment Team grouped the arthropods into 11 functional groups based on the ecological roles they occupy in the ecosystem: (1) coarse wood chewers, (2) litter and soil dwellers, (3) understory and forest gap herbivores, (4) canopy herbivores, (5) epizootic forest species, (6) aquatic herbivores, (7) aquatic detritivores, (8) aquatic predators, (9) pollinators, (10) riparian herbivores, and (11) riparian predators.

Because there is a gradient of increasing species richness and endemicity of arthropods with decreasing latitude, groups 1 through 4 were rated separately in the southern and northern portions of the range of the northern spotted owl. Thus, a total of 15 arthropod groups or ranges were assessed (11 functional groups, 4 of which received separate ratings for both north and south portions of their range). The southern portion consisted of the Oregon and California Klamath Provinces, the California Cascades Province, and the California Coast Range Province. The northern portion consisted of the Oregon and Washington Eastern and Western Cascades Provinces, the Oregon Coast Range Province, and the Olympic Peninsula Province.

Ratings expressed the likelihood that habitat to support functional groups would be maintained, rather than expressing the likelihood of viability of individual species. This approach emphasizes ecosystem function rather than a species-by-species analysis and was necessary because many of the species have not yet been identified and described. The Assessment Team expressed caution about habitat and population assessments for arthropods because of the general paucity of information on this group. Therefore, the Assessment Team considered the ratings to be preliminary and subject to modification as new scientific information becomes available.

A total of 15 functional groups or ranges of arthropods and their allies were assessed in the FEMAT Report (Table 3&4-26). Of these, four functional groups were subject to additional analysis because of their original ratings in the FEMAT Report (described in Methods for Additional Species Analysis earlier in this chapter). The four functional groups analyzed included the canopy herbivores, coarse woody debris chewers, litter and soil-dwelling species, and understory and forest gap herbivores. In the original assessments, these groups were divided into northern and southern ranges. Only the southern ranges of the groups were subject to additional analysis. The southern portions of the range had some likelihoods of extirpation from federal lands in the original assessment because of the large number of endemic species with very limited ranges, potential for drought, significant risk of fire, patchy distribution of suitable habitats, and past actions.

Additional standards and guidelines were incorporated into Alternative 9 and are described in Chapter 2 and Appendix B11. Three standards and guidelines were important additions for the four groups analyzed. These included: survey to acquire additional information and determine appropriate levels of protection or management, emphasize clumped green tree and snag retention in matrix management, and provide for retention of old-growth fragments in watersheds where little remain.

Effects of Alternatives

The functional groups shown in the shaded portion of Table 3&4-26 are those that were specifically considered when additional standards and guidelines were added to Alternative 9. However, ratings for all functional groups under Alternative 9 might be increased by the added standards and guidelines. The ratings shown in Table 3&4-26 have not been changed to reflect these additions to the alternative.

Table 3&4-26. Projected future likelihood for arthropods habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Arthropods	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Aquatic detritivores	88	11	1	0	86	14	0	0	81	19	0	0	80	20	0	0	74	26	0	0	70	29	1	0	75	25	0	0
Aquatic herbivores	76	21	3	0	84	14	3	0	81	18	1	0	80	19	1	0	81	18	1	0	81	18	1	0	84	16	0	0
Aquatic predators	81	16	3	0	85	15	0	0	81	19	0	0	80	20	0	0	79	21	0	0	78	21	1	0	83	18	0	0
Canopy herbivores (North range)	83	18	0	0	79	21	0	0	79	21	0	0	79	21	0	0	64	34	3	0	68	32	0	0	69	29	3	0
Canopy herbivores (South range)	84	16	1	0	74	26	1	0	76	21	2	1	74	24	2	1	71	24	5	1	58	28	11	4	66	29	4	2
Coarse wood chewers (North range)	90	10	0	0	86	13	1	0	76	21	1	1	76	21	1	1	75	21	3	1	65	23	9	4	76	20	3	1
Coarse wood chewers (South range)	80	16	4	0	80	16	4	0	70	20	8	3	70	20	8	3	68	19	10	4	54	23	15	9	65	21	10	4
Epizootic forest species	94	6	0	0	86	14	0	0	80	20	0	0	80	20	0	0	80	20	0	0	70	28	3	0	69	31	0	0
Litter & soil dwelling species (North range)	94	6	0	0	86	13	1	0	80	18	1	1	76	20	3	1	71	20	8	1	65	24	9	3	71	19	9	1
Litter & soil dwelling species (South range)	83	14	4	0	78	18	5	0	76	15	6	3	74	16	6	4	65	20	9	6	50	23	19	9	60	20	15	6
Pollinators	84	15	1	0	85	15	0	0	80	20	0	0	80	20	0	0	83	18	0	0	83	17	0	0	85	14	1	0
Riparian herbivores	81	19	0	0	80	20	0	0	78	23	0	0	76	24	0	0	70	28	1	0	71	21	6	1	85	15	0	0
Riparian predators	81	19	0	0	79	21	0	0	79	21	0	0	78	23	0	0	68	28	5	0	71	19	8	3	86	14	0	0
Understory & forest gap herbivores (North range)	75	25	0	0	74	26	0	0	69	31	0	0	69	31	0	0	70	29	1	0	58	38	5	0	63	36	1	0
Understory & forest gap herbivores (South range)	71	23	6	0	66	29	6	0	58	32	7	4	56	33	8	4	54	34	9	4	35	42	17	6	47	45	5	4

A-Well Distributed B-Locally Restricted C-Restricted to Refugia D-Risk of Extirpation

Likelihood values are expressed as percentages that total to 100 for a given species within an Alternative. Number displayed may vary due to rounding errors. The Species shown in the shaded portion of the table are those that were specifically considered when additional standards are guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the standards and guidelines. The ratings shown in the table have not been changed to reflect these additions to Alternative 9. See text for fuller explanation and discussion of the rating scale and for discussion of the additional species analysis under Alternative 9.

The habitat components important to arthropods include all the features that comprise an extensive and interconnected late-successional and old-growth forested condition, including a diversity of live, old-growth trees; standing dead trees; dead and down wood; canopy structure; and riparian habitats. Alternatives 1, 3, and 4 are generally the most favorable to arthropods because they provide the set of allocations and management practices that best produce the habitat components for arthropods. Alternatives 5, 7, and 9 would provide somewhat lower levels of habitat protection. Alternative 8 would provide less favorable habitat conditions for arthropods. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Alternative 1 was assessed as providing the best habitat conditions for arthropods. For Alternative 1, the likelihood of providing habitat for stable, well-distributed populations when measured against their historic ranges on federal lands, across arthropod functional groups would range from 94 to 71 percent. Alternative 3 would have an 86 to 66 percent likelihood of providing this habitat. Alternative 4 would have an 81 to 58 percent likelihood of providing well-distributed habitat when measured against their historic ranges on federal lands. Alternatives 1, 3 and 4 would also have at least a 90 percent likelihood of providing habitat for stable populations either well distributed when measured against their historic distributions on federal lands or distributed with significant gaps in the historic range. Alternative 5 would have a likelihood ranging from 80 to 56 percent of providing stable populations with well-distributed habitat when measured against their historic distribution on federal lands. Alternative 7 would have an 83 to 54 percent likelihood of achieving this outcome. Alternative 9 would have an 86 to 47 percent likelihood of providing well-distributed habitat. Alternatives 5, 7, and 9 would also have at least an 80 percent likelihood of providing stable populations either well distributed when measured against their historic distributions or distributed with gaps in the historic range. This includes the four groups for which additional analysis was done under Alternative 9. Alternative 8 would have likelihoods of providing this habitat across arthropod functional groups ranging from 83 to 35 percent, with at least a 70 percent likelihood of providing stable populations either well distributed when measured against their historic distributions or distributed with significant gaps in the historic range.

The three standards and guidelines added to Alternative 9 (see Methods, above), would benefit the canopy herbivores. Additional habitat protection for the coarse woody chewers and understory and forest gap herbivores was provided by two additional standards and guidelines: provisions for coarse woody debris in matrix management and modification of site treatment practices to minimize disturbance. The above standards and guidelines would benefit the litter and soil-dwelling species, which would additionally benefit from protection of some sites from grazing.

For all functional groups subject to additional analysis, the standard and guideline for survey and management is not intended to be site specific. Rather, it is meant to be a general survey across the range that would provide improved information on species' distributions and habitat associations. These surveys would be conducted in a sample of watersheds. They would not necessarily precede ground-disturbing activities, but would provide information that could be used to refine management guidelines over time.

Possible Mitigation Measures

All of the alternatives contain standards and guidelines that are expected to benefit arthropods. As noted earlier, to avoid or reduce impacts, a standard or guideline in one alternative could be added to another that currently does not include the measure. Those standards and guidelines that would provide the greatest diversity of live, old-growth trees; standing dead trees; dead and down wood; canopy structure; riparian habitats; and others are important to the arthropods.

The following possible mitigation measure is not represented in the alternatives, but could benefit arthropods:

> Eliminate burning as a means of site preparation after timber harvest. Burning often negatively impacts the arthropods that are associated with coarse woody debris and the litter and soil layers.

Cumulative Effects Including the Role of Nonfederal Lands

As noted above, in the southern portions of their ranges four of the functional groups of arthropods had higher likelihoods of extirpation in the original assessment of Alternative 9 because of the large number of endemic species with very limited ranges, potential for drought, significant risk of fire, patchy distribution of suitable habitats, and past actions. It is likely that the ranges of particular species within these functional groups may fall mostly within nonfederal lands. For such species, management practices may lead to considerable risk of population decline to the extent that these practices influence soil moisture, fire frequency and intensity, or loss of patches of habitat. Reduction of coarse woody debris and application of insecticides on nonfederal lands may be especially detrimental to these functional groups under all of the alternatives. Although late-successional arthropod groups are likely to be maintained on federal lands without contributions from nonfederal lands, the potential exists for movement of epizootic species between federal and nonfederal ownerships. This is most likely to occur in the eastern and southern portions of the range of the northern spotted owl.

Because many of the species of arthropods are sensitive to microclimatic conditions, long-term global climate change poses a potential risk to species persistence under all of the alternatives. Similarly, large-scale disturbances will also pose an unknown risk to locally endemic species whose habitat may be lost over their entire range.

Mollusks

Affected Environment

Mollusks represent a major source of biological diversity in late-successional forests of the Pacific Northwest. Mollusk species of northwest coniferous forests are comprised of land snails, slugs, aquatic snails and clams. As a group, they are diverse in number and function and many have restricted geographic ranges and narrow ecological requirements. Scientists are still discovering new species in coniferous forests of the Pacific Northwest and estimate that the known fauna may eventually double (Frest and Johannes

1993, Roth 1993). Currently, approximately 350 species of mollusks are known to occur in forests within the range of the northern spotted owl.

Land snails and slugs account for over 150 of the 350 species of mollusks. Most are found in moist forest environments and in areas around springs, bogs, and marshes. Basalt and limestone talus slopes are also important habitats for many species. Areas within the range of the northern spotted owl support large groups of snails that are endemic. Their distribution is influenced by geologic history, soil types, moisture requirements, and vegetative cover. Over 100 species have been identified as being associated with late-successional forests.

Land snails and slugs are mostly herbivores. A few consume animal matter, and several (*Ancotrema*) feed on other snail species. Primary food items for the herbivorous species include deciduous tree leaves (both green and fallen), understory vegetation, large fungi species, and inner bark layers. Many small mammals and some birds consume land snails and slugs. Local populations of slugs or snails are often termed colonies. Colony density varies from species to species, and potentially stable colonies can range in size from tens to hundreds of square feet. There are sizeable groups of endemic species in the land snail genera *Monadenia, Trilobopsis, Megomphix,* and *Vespericola*, and the slug genus *Hemphilli*. Geologic history, substrate, moisture requirements, and vegetative cover are the physical factors that limit their distribution. Because most land snails do not disperse far from their natal sites, areas are rarely repopulated following extirpation.

Freshwater mollusks are found in permanent water bodies of all sizes. In the Pacific Northwest, spring-fed streams and pools often support the greatest abundance and diversity of both clams and snails. There are many endemic species within the group of freshwater snails. The highest concentration of endemism occurs in northern California and southern Oregon. In this area, some species inhabit only a few seeps or springs, possibly resulting in a species' entire range being smaller than the size of a township. Endemic species are most common in the genera *Juga, Lanx,* and *Fluminicola*. Species are often confined to single streams, particularly intermittent streams, springs, and seeps. For the species that have localized geographic ranges, potential exists for serious impacts from even small scale ground-disturbing activities or changes in stream conditions. Freshwater mollusks are primary herbivores in aquatic ecosystems, and serve as food for a variety of other species including fish, aquatic insects, and birds. Some clams and snails are also eaten by raccoons, otters, and beavers.

Environmental Consequences

Methods Specific to Mollusks

The list of species considered by the Assessment Team was developed by mollusk experts and was partially based on lists in the Final Draft Spotted Owl Recovery Plan (USDI unpub.) and Thomas et al. (1993) which included 58 species. The Assessment Team's list included 108 species and reflects updated information that was not available for the previous efforts. However, six of those species were not assessed because they are not known to occur on public land or are likely extinct. The final list of 102 species that were assessed included 38 land snails, 7 slugs, 54 freshwater snails, and 3 freshwater clams.

Most of these species are associated with both late-successional forests and riparian areas. However, the strength of these associations is not well understood in many cases, and some of the species are probably more closely associated with riparian vegetation than with late-successional forests. The 102 species that were assessed include 8 that have been identified as candidates for federal listing. There are seven Category 2 species (*Anodonta californiensis, Monadenia fidelis minor, Monadenia setosa, Monadenia troglodytes troglodytes, Vespericola karokorum, Fluminicola columbiana*, and *Pisidium (C.) ultramontanum*) and one Category 3 species (*Fisherola nuttalli nuttalli*).

Differences among the alternatives were based primarily on the total acres proposed for reserves, the locations of specific reserves, the management proposed within reserves, and the proposed forms of watershed protection.

Effects of Alternatives

A total of 102 mollusk species was assessed in the FEMAT Report (Table 3&4-27). The species shown in the shaded portion of Table 3&4-27 are those that were specifically considered when additional standards and guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the added standards and guidelines. The ratings shown in Table 3&4-27 have not been changed to reflect these additions to the alternative. Each of the mollusk groups is discussed below. Standards and guidelines for mollusks have been incorporated into Alternative 9 and are described in Chapter 2 and Appendix B11.

The habitat components important to mollusks include moist forest environments; areas around springs, bogs, and marshes; basalt and limestone talus slopes; diverse vegetative cover; and Riparian Reserve and Late-Successional Reserve sizes. Alternatives 1, 3, and 9 are generally the most favorable to land snails because they provide the set of allocations and management practices that best produce the habitat components for land snails. Alternatives 4, 5, 7, and 8 would provide less favorable habitat conditions for land snails. Alternatives 1, 4, and 9 are generally the most favorable to slugs, freshwater snails, and clams because they provide the set of allocations and management practices that best produce the habitat components for these species. Alternatives 3, 5, 7, and 8 would provide less favorable habitat conditions for slugs, freshwater snails, and clams. Based on their overall features, Alternatives 2, 6, and 10, which were not rated by the Assessment Team, would likely have effects on mollusk habitat similar to Alternative 5.

Land Snails.

The rarity and localized distribution of the 38 land snail species played an important role in the rating of virtually all these species. Past actions, both on federal and nonfederal lands, also contributed to the ratings for virtually all the land snails. Lack of information about species, their locations, and their habitat associations contributed to many of the ratings. Ratings for the mollusks also reflected their vulnerability to relatively minor disturbances. Even in Late-Successional Reserves, species could suffer impacts from activities such as thinning and burning.

As a consequence, overall ratings for the land snails are relatively low. They primarily reflect total acres included in Late-Successional Reserves, and

Table 3&4-27. Projected future likelihood for mollusk habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Mollusks	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Land Snails																												
Ancotrema voyanum	57	33	7	3	3	20	50	27	0	27	47	27	0	17	47	37	3	13	27	57	0	13	33	53	7	13	30	50
Cryptomastix devia	33	33	20	13	17	30	33	20	10	25	48	17	13	20	50	17	0	10	47	43	0	10	47	43	0	7	50	43
Cryptomastix hendersoni	53	30	10	7	47	28	18	7	32	23	30	15	32	23	30	15	13	20	33	33	27	22	25	27	27	22	25	27
Helminthoglypta arrosa monticola	70	23	7	0	63	28	8	0	57	33	7	3	57	33	7	3	53	33	3	10	60	27	13	0	53	30	17	0
Helminthoglypta hertleini	50	33	10	7	40	28	25	7	40	28	25	7	40	28	25	7	23	35	30	12	33	23	32	12	32	27	30	12
Helminthoglypta talmadgei	57	33	10	0	40	38	22	0	33	40	20	7	33	40	23	3	22	37	32	10	27	37	30	7	27	40	27	7
Megomphix californicus	57	25	18	0	47	32	20	2	33	30	27	10	27	33	27	13	13	23	37	27	17	27	30	27	17	30	30	23
Megomphix hemphilli	43	40	17	0	30	37	27	7	23	37	30	10	17	37	33	13	7	23	47	23	10	30	43	17	13	33	37	17
Monadenia callipeplus	60	27	10	3	20	28	22	30	20	28	25	27	20	28	22	30	7	23	27	43	17	22	28	33	20	22	25	33
Monadenia chaceana	53	33	10	3	35	35	25	5	35	35	25	5	30	25	30	15	25	30	30	15	25	25	20	30	23	37	27	13
Monadenia churchi	70	23	7	0	53	33	10	3	47	30	13	10	43	33	13	10	33	33	17	17	33	33	17	17	40	33	13	13
Monadenia fidelis celeuthia	60	30	10	0	40	30	27	3	33	27	30	10	33	27	30	10	12	30	45	13	33	37	23	7	33	33	23	10
Monadenia fidelis flava	70	20	10	0	50	30	20	0	47	33	20	0	40	37	23	0	17	37	30	17	23	37	37	3	27	37	30	7
Monadenia fidelis klamathica	67	23	10	0	43	33	20	3	37	30	27	7	33	37	23	7	17	25	25	33	27	30	23	20	23	27	33	17
Monadenia fidelis leonina	43	33	17	7	40	30	20	10	33	30	27	10	30	30	30	10	17	22	28	33	23	30	30	17	27	33	30	10
Monadenia fidelis minor	70	20	10	0	50	32	18	0	47	32	22	0	43	35	22	0	28	32	22	18	43	32	15	10	43	35	22	0
Monadenia fidelis ochromphalus	60	33	7	0	47	33	13	7	43	37	17	3	40	33	20	7	23	37	27	13	33	33	20	13	40	30	20	10
Monadenia fidelis salmonensis	70	20	10	0	50	28	22	0	50	33	17	0	50	30	20	0	37	30	30	3	43	30	27	0	47	30	23	0
Monadenia rotifer	80	20	0	0	50	50	0	0	50	50	0	0	50	50	0	0	50	25	25	0	50	50	0	0	50	50	0	0
Monadenia scottiana	57	27	10	7	43	3	23	10	42	23	25	10	42	23	25	10	23	23	23	30	30	25	32	13	42	23	25	10
Monadenia setosa	63	23	10	3	33	30	30	7	33	30	33	3	37	28	28	7	23	23	30	23	27	27	30	17	30	28	28	13
Monadenia troglodytes troglodytes	67	27	7	0	60	30	10	0	33	37	17	13	33	37	17	13	27	33	23	17	30	30	27	13	33	37	17	13
Monadenia troglodytes wintu	67	27	7	0	60	30	10	0	33	37	17	13	33	37	17	13	27	33	23	17	30	30	27	13	33	37	17	13
Oreohelix n. sp.	55	30	15	0	50	30	15	5	40	35	15	10	40	35	15	10	35	35	20	10	40	35	15	10	40	35	15	10
Pristiloma articum crateris	63	30	7	0	47	37	13	3	47	33	17	3	40	37	17	7	40	37	17	7	40	37	17	7	40	37	17	7
Punctum (Toltecia) hannai	80	20	0	0	60	40	0	0	60	40	0	0	60	40	0	0	50	25	25	0	60	40	0	0	60	40	0	0
Trilobopsis roperi	63	27	7	3	47	23	20	10	40	30	23	7	37	30	27	7	27	27	30	17	37	27	23	13	37	30	23	10
Trilobopsis tehamana	67	23	7	3	50	27	17	7	43	33	20	3	40	33	23	3	30	30	27	13	40	30	20	10	40	33	20	7
Vertigo n. sp.	60	20	15	5	35	25	25	15	40	35	20	5	35	30	25	10	30	25	35	10	35	25	30	10	35	25	25	15
Vespericola depressa	63	30	7	0	50	32	18	0	47	32	22	0	43	35	22	0	25	28	25	22	43	35	22	0	43	35	22	0
Vespericola euthales	50	50	0	0	40	50	10	0	40	40	20	0	40	40	20	0	25	25	40	10	30	40	30	0	40	40	20	0
Vespericola karokorum	80	20	0	0	70	30	0	0	70	30	0	0	70	30	0	0	50	40	10	0	60	40	0	0	70	30	0	0
Vespericola pressleyi	50	50	0	0	20	40	30	10	20	40	30	10	20	40	30	10	0	20	50	30	10	20	50	20	20	40	30	10
Vespericola shasta	50	30	20	0	33	30	27	10	37	33	27	3	30	33	27	10	23	28	33	15	27	33	30	10	30	33	27	10
Vespericola sierranus	53	30	17	0	47	30	17	7	53	30	17	0	43	33	17	7	37	33	20	10	37	37	20	7	43	33	17	7

Table 3&4-27. Projected future likelihood for mollusk habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Mollusks (continued)	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Land Snails (continued)																												
Vespericola undescribed # 1	70	20	10	0	50	30	10	10	40	30	20	10	40	30	20	10	0	20	50	30	30	30	30	10	40	30	20	10
Vespericola undescribed # 2	50	40	10	0	30	30	30	10	30	30	30	10	30	30	30	10	20	30	25	25	30	30	30	10	30	30	30	10
Vespericola undescribed # 3	80	20	0	0	70	30	0	0	70	30	0	0	70	30	0	0	50	40	10	0	60	40	0	0	70	30	0	0
Slugs																												
Deroceras hesperium	70	15	10	5	30	40	15	15	40	25	25	10	30	35	20	15	30	25	25	20	30	25	25	20	30	30	20	20
Hemphillia barringtoni	63	23	10	3	33	40	17	10	40	30	23	7	33	37	20	10	33	23	23	20	33	27	23	17	33	27	20	20
Hemphillia glandulosa	50	23	20	7	20	40	27	13	27	30	33	10	20	37	30	13	20	27	33	20	20	30	33	17	20	33	30	17
Hemphillia malonei	70	20	10	0	37	35	22	7	40	28	25	7	37	25	25	13	28	25	25	22	28	32	22	18	28	28	25	18
Hemphillia pantherina	70	20	7	3	50	28	18	3	47	28	18	7	40	25	22	13	32	25	22	22	43	28	18	10	32	25	22	22
Prophysaon coeruleum	65	30	5	0	50	25	15	10	50	30	15	5	50	25	15	10	50	25	15	10	50	25	15	10	50	25	15	10
Prophysaon dubium	63	23	3	0	57	23	17	3	57	27	13	3	57	23	17	3	53	25	18	3	57	23	17	3	57	23	17	3
Riparian																												
Anodonta californiensis	45	25	15	15	30	30	20	20	30	30	20	20	30	30	20	20	10	25	35	30	25	30	25	20	30	25	25	20
Anodonta wahlametensis	40	25	20	15	30	30	20	20	30	30	20	20	30	30	20	20	20	30	25	25	25	30	25	20	30	25	25	20
Fisherola nuttalli nuttalli	60	20	15	5	45	25	25	5	40	30	25	5	35	30	25	10	25	30	25	20	30	30	25	15	35	30	25	10
Fluminicola columbiana	60	20	15	5	45	25	25	5	40	30	25	5	35	30	25	10	25	30	25	20	30	30	25	15	35	30	25	10
Fluminicola n. sp. 1	60	20	15	5	50	20	20	10	50	25	25	0	40	20	30	10	30	20	30	20	30	20	30	20	40	20	30	10
Fluminicola n. sp. 2	40	25	20	15	30	15	30	25	40	20	20	20	40	20	20	20	20	25	25	30	30	20	30	20	30	20	25	25
Fluminicola n. sp. 3	50	15	20	15	40	20	25	15	50	15	20	15	35	30	15	20	25	30	20	25	25	35	20	20	35	30	15	20
Fluminicola n. sp. 4	70	20	10	0	50	25	20	5	70	15	15	0	40	25	15	20	25	30	20	25	25	35	25	15	40	25	15	20
Fluminicola n. sp. 5	70	20	10	0	50	25	20	5	70	15	15	0	40	25	15	20	25	30	20	25	25	35	25	15	40	25	15	20
Fluminicola n. sp. 6	70	20	10	0	50	25	20	5	70	15	15	0	40	25	15	20	25	30	20	25	25	35	25	15	40	25	15	20
Fluminicola n. sp. 7	70	20	10	0	50	25	20	5	70	15	15	0	40	25	15	20	25	30	20	25	25	35	25	15	40	25	15	20
Fluminicola n. sp. 8	70	20	10	0	50	25	20	5	70	15	15	0	40	25	20	15	25	30	20	25	25	35	25	15	40	25	15	20
Fluminicola n. sp. 9	70	20	10	0	50	25	20	5	70	15	15	0	40	25	20	15	25	30	20	25	25	35	25	15	40	25	15	20
Fluminicola n. sp. 10	70	20	10	0	50	25	20	5	70	15	15	0	40	25	20	15	25	30	20	25	25	35	25	15	40	25	20	15
Fluminicola n. sp. 11	50	15	20	15	40	20	25	15	50	15	20	15	35	30	15	20	25	30	20	25	25	35	20	20	35	30	15	20
Fluminicola n. sp. 12	40	30	25	5	25	30	30	15	35	30	25	10	25	33	33	10	20	20	30	30	25	30	25	20	25	30	30	15
Fluminicola n. sp. 13	60	15	20	5	40	20	20	20	35	25	30	10	35	25	20	20	35	20	20	25	35	25	20	20	35	30	20	15
Fluminicola n. sp. 14	70	20	10	0	40	15	25	20	50	15	20	15	40	20	20	20	25	20	30	25	25	25	30	20	40	20	20	20
Fluminicola n. sp. 15	70	20	10	0	40	15	25	20	50	15	20	15	40	20	20	20	25	20	30	25	25	25	30	20	40	20	20	20
Fluminicola n. sp. 16	60	20	20	0	40	30	20	10	40	30	30	0	40	30	20	10	30	30	20	20	30	30	20	20	25	30	25	20

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	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Mollusks (continued)	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Riparian (continued)																												
Fluminicola n. sp. 17	60	20	20	0	40	30	20	10	40	30	30	0	40	30	20	10	30	25	25	20	30	30	20	20	25	30	25	20
Fluminicola n. sp. 18	70	20	10	0	40	15	25	20	50	15	25	10	40	20	20	20	25	20	30	25	25	25	30	20	40	20	20	20
Fluminicola n. sp. 19	55	20	15	10	30	25	25	20	50	15	20	15	30	20	30	20	30	20	25	25	30	20	30	20	30	20	30	20
Fluminicola n. sp. 20	55	20	15	10	30	25	25	20	50	15	20	15	30	20	30	20	30	20	25	25	30	20	30	20	30	20	30	20
Fluminicola seminalis	70	20	10	0	35	30	20	15	50	20	25	5	35	25	25	15	25	25	30	20	30	25	25	20	30	25	25	20
Helisoma newberryi newberryi	70	20	10	0	45	25	25	5	60	30	10	0	50	25	20	5	35	20	10	35	40	15	20	25	40	20	20	20
Juga (C.) acutifilosa	70	20	10	0	45	20	15	20	70	20	10	0	50	20	15	15	35	20	10	35	40	15	20	25	40	15	15	30
Juga (C.) occata	70	20	10	0	45	20	15	20	70	20	10	0	40	25	15	20	35	15	15	35	40	20	15	25	40	20	15	25
Juga (J.) n. sp. 1	70	10	10	10	50	30	20	0	70	10	10	10	40	10	30	20	30	20	30	20	30	20	30	20	40	10	30	20
Juga (J.) n. sp. 3	70	10	10	10	50	30	20	0	70	15	10	5	45	10	25	20	30	20	25	25	30	20	30	20	40	10	30	20
Juga (O.) n. sp. 1	70	10	10	10	50	20	20	10	40	20	30	10	30	20	30	20	20	20	20	40	40	20	10	30	40	20	20	20
Juga (O.) n. sp. 2	70	15	10	5	50	20	20	10	40	20	30	10	30	20	30	20	25	20	20	35	40	20	15	25	40	20	20	20
Juga (O.) n. sp. 3	60	20	20	0	40	30	20	10	40	30	30	0	40	30	20	10	30	30	20	20	30	30	20	20	25	30	25	20
Juga (Oreobasis) chacei	70	20	10	0	50	20	20	10	60	20	20	0	40	30	20	10	30	25	25	20	40	25	25	10	40	25	25	10
Juga (Oreobasis) orickensis	70	20	10	0	50	30	10	10	60	30	10	0	40	40	10	10	30	20	30	20	40	20	20	20	40	40	10	10
Juga hemphilli dallesensis	50	20	10	20	50	30	20	0	50	20	10	20	40	10	30	20	30	20	20	30	30	20	30	20	40	10	30	20
Juga hemphilli hemphilli	70	10	10	10	50	30	20	0	70	10	10	10	40	10	30	20	30	20	20	30	30	20	30	20	40	10	30	20
Juga hemphilli n. subsp. 1	70	10	10	10	50	30	20	0	70	10	10	10	40	10	30	20	30	20	20	30	30	20	30	20	40	10	30	20
Lanx alta	70	20	10	0	50	30	20	0	70	20	10	0	40	15	30	15	30	20	20	30	35	20	30	15	40	15	30	15
Lanx klamathensis	50	20	20	10	40	20	20	20	50	20	20	10	40	20	20	20	30	20	20	30	30	20	30	20	40	20	20	20
Lanx patelloides	70	20	10	0	50	20	20	10	60	20	20	0	50	20	20	10	40	20	20	20	50	20	20	10	50	20	20	10
Lanx subrotundata	70	20	10	0	50	20	20	10	60	20	20	0	50	20	20	10	40	20	20	20	50	20	20	10	50	20	20	10
Lyogyrus n. sp. 1	70	10	10	10	50	30	20	0	70	10	10	10	40	10	30	20	30	20	20	30	30	20	30	20	40	10	30	20
Lyogyrus n. sp. 2	60	20	0	20	50	20	10	20	60	20	0	20	50	10	20	20	30	20	20	30	30	20	30	20	50	10	20	20
Lyogyrus n. sp. 3	40	30	20	10	30	20	20	30	30	25	20	25	35	20	20	25	25	20	25	30	30	20	20	30	30	20	20	30
Lyogyrus n. sp. 4	50	20	15	15	30	15	30	25	50	20	15	15	40	20	20	20	30	15	25	30	30	15	25	30	30	15	25	30
Lyogyrus n. sp. 5	50	20	15	15	30	15	30	25	50	20	15	15	40	20	20	20	30	15	25	30	30	15	25	30	30	15	25	30
Lyogyrus n. sp. 6	40	25	20	15	30	15	30	25	40	20	20	20	40	20	20	20	20	25	25	30	30	20	30	20	30	20	25	25
Physella columbiana	30	25	30	15	20	25	25	30	30	25	25	20	20	20	30	30	15	15	30	40	20	20	30	30	20	20	30	30
Pisidium (C.) ultramontanum	70	20	10	0	40	20	30	10	60	20	20	0	40	20	30	10	30	20	10	40	40	10	30	20	40	20	30	10
Pyrgulopsis archimedis	40	25	20	15	30	15	30	25	40	20	20	20	40	20	20	20	20	25	25	30	30	20	30	20	30	20	25	25
Pyrgulopsis intermedia	70	20	10	0	40	20	30	10	70	20	10	0	40	20	30	10	30	20	30	20	40	25	25	10	40	20	30	10
Pyrgulopsis n. sp. 1	40	25	20	15	30	15	30	25	40	20	20	20	40	20	20	20	20	25	25	30	30	20	30	20	30	20	25	25
Vorticifex klamathensis klamathensis	50	20	15	15	30	15	30	25	50	20	15	15	40	20	20	20	30	15	25	30	30	15	25	30	30	15	25	30
Vorticifex klamathensis sinitsini	40	25	20	15	30	15	30	25	40	20	20	20	40	20	20	20	20	25	25	30	30	20	30	20	30	20	25	25

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	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Mollusks (continued)	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Riparian (continued)																												
Vorticifex n. sp. 1	40	30	20	10	30	20	20	30	30	25	20	25	35	20	20	25	25	20	25	30	30	20	20	30	30	20	20	30
Vorticifex neritoides	30	25	30	15	20	25	30	25	30	25	25	20	20	20	30	30	15	15	30	40	20	20	30	30	20	20	30	30

A-Well Distributed B-Locally Restricted C-Restricted to Refugia D-Risk of Extirpation

Likelihood values are expressed as percentages that total to 100 for a given species within an Alternative. Number displayed may vary due to rounding errors. The Species shown in the shaded portion of the table are those that were specifically considered when additional standards are guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the standards and guidelines. The ratings shown in the table have not been changed to reflect these additions to Alternative 9. See text for fuller explanation and discussion of the rating scale and for discussion of the additional species analysis under Alternative 9.

locations of some specific reserves. Alternative 1 was judged most favorable for the land snails. It would provide sufficient habitat to maintain 35 of the 38 species well distributed across federal lands within their historic range with 50 percent or greater likelihood. Under Alternative 3, habitat would be sufficient to provide a 50 percent or greater likelihood of maintaining 15 species well distributed across their historic range on federal lands. The number of species judged to be at this level was lower under other alternatives, with Alternative 7 rating lowest. Viewed from the standpoint of risk of extirpation, Alternative 1 would provide habitat at a level where only 2 species would have 20 percent or greater likelihood of being restricted to refugia or of extirpation. This number rises to 24 species under Alternative 3, and 30 or more species under Alternatives 4, 5, 7, and 8. Under Alternative 9, only 7 species would have a 20 percent or greater risk of extirpation or restriction to refugia, and these are all primarily due to effects of the nonfederal portions of their habitat.

Based on their overall features, Alternatives 2, 6, and 10, which were not rated by the Assessment Team, would likely have effects on land snails similar to Alternative 5.

Slugs.

Patterns of effects on slugs are similar to those for land snails. Habitat provided by Alternative 1 would be at a level where only 1 of 7 species would have 20 percent or greater risk of extirpation or restriction to refugia. Two species would fall in this category in Alternative 9, 6 in Alternative 4, and 7 in Alternatives 3, 5, 7, and 8.

Based on their overall features, Alternatives 2, 6, and 10 would likely have effects on slugs similar to Alternative 5.

Freshwater Snails and Clams.

Habitat assessments for the freshwater snails and clams were influenced primarily by the Riparian Reserve strategies proposed for the alternatives. Thus, Alternatives 1, 4, and 9 rated better for these species than did other alternatives. All 54 freshwater snails and 3 freshwater clams are judged to have 20 percent or greater likelihood of being restricted to refugia or being extirpated under Alternatives 3, 5, 7, and 8. The combination of Riparian Reserves and Late-Successional Reserves in Alternatives 1, 4, and 9 would provide habitat that would reduce the likelihood of these outcomes. Under Alternative 1, there is less than a 20 percent likelihood of restriction to refugia or extirpation for 22 species; under Alternative 4, 14 species are judged to be in that category; and the additional standards and guidelines applied to Alternative 9 provide a similar level of protection to 51 species. Based on their overall features, Alternatives 2, 6, and 10 would likely have effects on freshwater snails and clams similar to Alternative 5.

Possible Mitigation Measures

Each of the alternatives contains standards and guidelines that are expected to benefit mollusks. As noted previously in Chapter 3&4, to avoid or reduce impacts, a standard or guideline in one alternative could be added to another that currently does not include the measure. Of those standards and guidelines, those that would increase Riparian Reserve or Late-Successional Reserve sizes, or provide for site-specific mitigations for mollusks, would be most beneficial.

Cumulative Effects Including the Role of Nonfederal Lands

Nonfederal lands are an important consideration for the persistence of some mollusks, particularly in southwestern Washington and northern California. Management for slug species on nonfederal lands in southwestern Washington would have important benefits. Many endemic freshwater mollusks are also associated with a mixture of federal and nonfederal lands in northern California in the headwaters of the Shasta, Pit, and Sacramento Rivers. As more areas are surveyed for mollusks, conservation needs on federal and nonfederal lands will become more evident.

Virtually all of the species of land snails are distributed on a mixture of federal and nonfederal lands. For seven species of land snails, the influence of management on nonfederal lands is thought to be so significant that substantial risks of extirpation will remain even with significant conservation measures in place on federal lands. These species are *Helminthoglypta hertleini*, *Monadenia chaceana*, *Monadenia fidelis flava*, *Trilobopsis roperi*, *Vertigo n.* sp., *Vespericola sierranus*, and *Vespericola* undescribed #2. No additional standards and guidelines could be identified for these species to compensate for possible effects on the nonfederal portion of their ranges.

Nonfederal lands play a somewhat less significant role for the slug species. The slug species were likely previously distributed more broadly across nonfederal lands, but past habitat modification has severely restricted their distribution. Nonfederal lands might still play some role in the maintenance of these species, but their future is clearly most strongly dependent on federal lands.

Nonfederal lands and other environmental factors play a major role for the freshwater snails and clams. Virtually all species that were assessed are known to occur on a mixture of federal and nonfederal land, and could be negatively affected by management of nonfederal portions of their range. A variety of activities have previously affected many species and could affect them in the future. These include hydropower development, grazing, water pollution from a variety of sources, water diversions, highway construction, and chemical spills. For two of the freshwater clams and four of the freshwater snails, the influence of cumulative effects is thought to be so significant that substantial risks of extirpation will remain even with significant conservation measures in place on federal lands. The two freshwater clams are *Anodonta californiensis* and *Anodonta wahlametesis*, which occur in large rivers and lakes. These two species retain some risk of extirpation under all alternatives. The four freshwater clams are *Fisherola nuttalli nuttalli*, *Fluminicola columbiana*, *Physella columbiana*, and *Vorticifex neritoides*. These species are all associated with large rivers, and are thought to be at some risk of extirpation from federal lands under any alternative.

Vertebrates

Amphibians and Reptiles

Affected Environment

The number of species of amphibians and reptiles in coniferous forests of the Pacific Northwest is not large compared to the number of birds and mammals; however, amphibians and reptiles comprise a distinct and important component of the vertebrate fauna (Bury 1988). The amphibian fauna of the Pacific Northwest includes 13 species that are endemic to the range of the northern spotted owl. The Pacific Northwest supports the second highest number of amphibian species in the United States, second only to the Southeast (Nussbaum et al. 1983). Approximately 62 species of amphibians are found in the Pacific Northwest, but fewer are found in coniferous forests. Most forested areas support as many as 19 to 23 species of amphibians and reptiles (Nussbaum et al. 1983, Stebbins 1985), and these vertebrate communities are ecologically important because of the high population numbers and biomass they attain (Bury 1988). A total of 10 species of reptiles were evaluated by Thomas et al. (1993) for their association with late-successional forests, and none were found to be closely associated with this forest type. However, some reptiles, such as the sharp-tailed snake and northern alligator lizard, are associated with components of late-successional forests, including down logs and forest litter cover.

Amphibians are functionally important components of coniferous forests in the Pacific Northwest. Amphibians, particularly salamanders, can reach high densities in forest ecosystems. Aquatic larvae, terrestrial juveniles, and adults may function as predators or as the major food source for other vertebrate species and aquatic invertebrates (Walls et al. 1992).

Amphibians are particularly sensitive to environmental change because their complex life cycle exposes them to hazards in both the aquatic and terrestrial environments. Most of the species require cool, moist conditions to maintain respiratory function. Stream-dwelling species generally require cool water, and are sensitive to sedimentation that can inhibit reproduction and foraging. Within locales in the Pacific Northwest, populations of several species of amphibians have been extirpated, and the ranges of numerous species have been drastically reduced (Blaustein and Wake 1990). Most declines have occurred in forest-dwelling species. Several species including Del Norte, Larch Mountain, Siskiyou Mountains, and Shasta salamanders and western spotted, red-legged, and Cascades frogs, are federal candidates for listing under the Endangered Species Act.

Many amphibians are highly specialized; these include the predatory giant salamanders and the very primitive tailed frog. Most amphibians have specific habitat requirements such as association with headwater streams or coarse woody debris. The clouded salamander, for example, occurs most frequently in the space between the bark and sapwood of large diameter down logs. Twelve species of salamanders are associated with riparian areas, particularly headwater streams, springs, and seeps. Two species (Oregon slender and clouded salamanders) are closely associated with coarse woody debris. Some of the species have very restricted geographic ranges, particularly the Larch Mountain, Siskiyou Mountains, and Shasta salamanders.

The special natural history traits of salamanders include low mobility and dependence on moist environments for at least part of their life cycle. The loss of moist environments following timber harvest undoubtedly influences both their local abundance and distribution. There is considerable genetic variability among and within species of amphibians as exemplified by the recent subdivision of Pacific giant salamanders into three species and the Olympic salamanders into four species within the range of the northern spotted owl (Good 1989, Good and Wake 1992). Continuing research may result in other wide-ranging species being subdivided into separate species. This high degree of variability is probably a result of their specific habitat associations and limited mobility. There is evidence of population declines and range reductions in a number of amphibian populations (Blaustein and Wake 1990, Welch 1990). The specific habitat requirements, low mobility, high genetic variability, and restricted geographic ranges of amphibians make some of them likely candidates for federal listing.

Environmental Consequences

Methods Specific to Amphibians and Reptiles

The Assessment Team developed a list of species that are closely associated with late-successional forests based on the criteria of Thomas et al. (1993) which listed 28 amphibian and 10 reptilian species for initial consideration as associates with late-successional forests. Following application of a set of screening criteria to identify species closely associated with such forests, this list was reduced to 19 species of salamanders and frogs. No reptiles were retained and thus the assessment was restricted to amphibians. The Assessment Team dropped the California slender salamander from further consideration because only a very limited portion of its range occurs on federal lands within the range of the northern spotted owl. Therefore, the Assessment Team evaluated a total of 18 species (17 salamanders and 1 frog). In addition, the Assessment Team divided one species' range (Van Dyke's salamander) into two portions of its total range (Washington Cascade Range; Washington coast, including the Olympic Peninsula) and evaluated habitat conditions separately within each portion.

The Assessment Team recognized two general groups, those species associated with riparian habitats and those associated with terrestrial or upland habitats (Table 3&4-28). Within the riparian group, some species are found primarily in intermittent headwater streams including: Van Dyke's and Dunn's salamanders, two species of giant salamanders, four species of torrent salamanders, and the tailed frog. Other riparian associates (e.g., rough-skinned newt, northwestern salamander) breed in ponds or streams but forage in terrestrial habitats.

There were 19 amphibian species or ranges assessed in the FEMAT Report. Of these, 13 species (8 stream-dwelling and 5 terrestrial) were selected for additional analysis (and possible additional standards and guidelines) using the screening process described earlier.

Table 3&4-28. Projected future likelihood for amphibians habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Atlernative 7				Alternative 8				Alternative 9			
Amphibians	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Riparian																												
Black salamander	80	15	5	0	75	15	10	0	80	15	5	0	75	15	10	0	65	20	15	0	60	20	20	0	75	15	10	0
Cascade torrent salamander	85	15	0	0	70	24	5	1	85	15	0	0	70	24	5	1	23	41	34	3	34	39	25	3	70	24	5	1
Columbia torrent salamander	5	20	54	21	3	15	55	28	5	20	54	21	3	15	55	28	0	10	44	46	1	14	46	39	3	21	54	23
Cope's giant salamander	86	14	0	0	79	20	1	0	86	14	0	0	79	20	1	0	63	30	8	0	66	31	3	0	79	20	1	0
Dunn's salamander	91	9	0	0	81	18	1	0	91	9	0	0	81	18	1	0	71	26	3	0	66	30	4	0	81	18	1	0
Northwestern salamander	90	10	0	0	83	15	3	0	88	13	0	0	83	15	3	0	64	28	8	1	66	25	8	1	80	16	4	0
Olympic torrent salamander	86	13	1	0	81	16	3	0	86	13	1	0	81	16	3	0	74	21	5	0	71	24	5	0	81	16	3	0
Pacific giant salamander	93	8	0	0	86	13	1	0	93	8	0	0	86	13	1	0	68	30	3	0	70	28	3	0	84	14	3	0
Rough-skinned newt	94	6	0	0	89	10	1	0	94	6	0	0	89	10	1	0	73	25	3	0	81	16	3	0	88	11	1	0
Southern torrent salamander	81	19	0	0	74	23	3	1	79	21	0	0	74	23	3	1	41	36	20	3	48	31	19	3	74	23	3	1
Tailed frog	93	8	0	0	80	19	1	0	90	10	0	0	83	16	1	0	63	30	8	0	64	31	5	0	78	20	3	0
Van Dyke's salamander																												
(Cascades)	0	25	58	18	0	23	56	21	3	25	58	15	0	23	56	21	0	16	46	38	0	14	49	38	0	20	58	23
(Coastal, Oly. Penin.)	45	40	13	3	36	44	18	3	45	40	13	3	36	44	18	3	28	43	23	8	25	46	23	6	36	48	14	3
Terrestrial																												
Clouded salamander	93	6	1	0	91	8	1	0	81	18	1	0	81	18	1	0	71	26	3	0	74	24	3	0	81	18	1	0
Del Norte salamander	93	8	0	0	90	10	0	0	90	10	0	0	90	10	0	0	65	28	8	0	65	33	3	0	90	10	0	0
Larch Mountain salamander	80	20	0	0	70	25	5	0	70	25	5	0	65	25	10	0	45	30	20	5	45	30	20	5	75	20	5	0
Oregon Slender salamander	91	9	0	0	88	13	0	0	75	21	4	0	68	24	9	0	54	26	18	3	58	25	15	3	70	24	6	0
Shasta salamander	10	40	40	10	10	40	40	10	10	40	40	10	10	40	40	10	0	10	40	50	0	10	40	50	0	40	40	20
Siskiyou Mountains salamander	60	30	10	0	45	35	20	0	50	30	20	0	50	30	20	0	10	40	40	10	10	40	40	10	50	30	15	5

A-Well Distributed B-Locally Restricted C-Restricted to Refugia D-Risk of Extirpation

Likelihood values are expressed as percentages that total to 100 for a given species within an Alternative. Number displayed may vary due to rounding errors. The Species shown in the shaded portion of the table are those that were specifically considered when additional standards are guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the standards and guidelines. The ratings shown in the table have not been changed to reflect these additions to Alternative 9. See text for fuller explanation and discussion of the rating scale and for discussion of the additional species analysis under Alternative 9.

Effects of Alternatives

The species shown in the shaded portion of Table 3&4-28 are those that were specifically considered when additional standards and guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the added standards and guidelines. The ratings shown in Table 3&4-28 have not been changed to reflect these additions to the alternative.

The habitat components important to amphibians are those which would provide cool, moist old-growth conditions; cool water; reduced sedimentation; protection of headwater streams; coarse woody debris; riparian zones; and more extensive and interconnected late-successional and old-growth forest conditions. For the riparian groups, Alternatives 1, 4, and 9, would generally be the most favorable to amphibians because they provide the set of allocations and management practices that best produce the habitat components for amphibians. Alternatives 3 and 5 would provide somewhat lower levels of habitat protection. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for these amphibians. For the terrestrial groups, Alternatives 1 and 9 would generally be the most favorable to amphibians because they provide the set of allocations and management practices that best produce the habitat components for amphibians. Alternatives 3, 4, and 5 would provide somewhat lower levels of habitat protection. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for these amphibians. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

The effects on five species were similar and relatively low across alternatives (Columbia torrent salamander, Van Dyke's salamander [Cascades], Van Dyke's salamander [coastal, Olympic Peninsula], Shasta salamander, and Siskiyou Mountains salamander). These ratings are not primarily a result of alternative design or federal land management and are discussed below (see Cumulative Effects Including the Role of Nonfederal Land).

The effects of the alternatives on habitat conditions for the other 14 amphibians that were assessed are as follows: Alternative 1 has a 90 percent or greater likelihood of providing sufficient habitat well distributed when measured against their historic range across federal land for eight species or ranges, and an 80 percent or greater likelihood for six species or ranges. Alternative 4 provides a 90 percent or greater likelihood of achieving this outcome for five species or ranges, and an 80 percent or greater likelihood for six species or ranges. Alternative 9, with the standards and guidelines added between the Draft and Final SEIS, would provide a 90 percent or greater likelihood of providing sufficient habitat well distributed when measured against its historic range across federal land for 1 species or range, and an 80 percent or greater likelihood for 13 species or ranges. Alternative 3 would provide a 90 percent or greater likelihood of achieving this outcome for two species or ranges, an 80 percent or greater likelihood for seven species, and a 70 percent or greater likelihood for five species. Alternative 5 would provide an 80 percent or greater likelihood of providing sufficient habitat well distributed when measured against their historic ranges across federal land for eight species or ranges, and a 70 percent or greater likelihood for four species. Alternatives 7 and 8 rated lowest, with likelihoods of 60 percent or less for 10 species or ranges. Alternatives 1, 4, and 9 would generally provide better habitat conditions for the amphibians, while Alternatives 7 and 8 would provide fewer of these conditions.

The standard and guideline additions to Alternative 9 that were of greatest benefit to amphibian species are described below.

Stream-Dwelling Species

Of the eight stream-dwelling species, application of Riparian Reserve Scenario 1 is expected to provide additional habitat protection for five species (Black salamander, Cascade torrent salamander, Cope's giant salamander, Southern torrent salamander, and tailed frog). For three of the eight species or ranges (Washington Cascades and Washington Coast Ranges of Van Dyke's salamander, and Columbia torrent salamander), no additional standards and guidelines or selection of another alternative would effectively eliminate the assessed risks (see Cumulative Effects discussion below).

Terrestrial Species

Of the five terrestrial species, increased provision of coarse woody debris in the matrix is expected to provide additional habitat protection for two species (the Clouded salamander and Oregon slender salamander); the "survey and manage" standards and guidelines will benefit one additional species (the Larch Mountain salamander). For two remaining species (the Shasta salamander and Siskiyou Mountains salamander), no standards and guidelines could be devised, nor an alternative developed, that would fully eliminate the risks of extirpation from federal lands (see Cumulative Effects Including the Role of Nonfederal Lands discussion below).

Possible Mitigation Measures

Most of the alternatives contain standards and guidelines that are expected to benefit amphibians. As noted in the section earlier, to avoid or reduce impacts, a standard or guideline in one alternative could be added to another that currently does not include the measure. Those standards and guidelines that would provide cool, moist old-growth conditions; cool water; reduced sedimentation; protection of headwater streams; and coarse woody debris would be of greatest benefit to these species.

Cumulative Effects Including the Role of Nonfederal Lands

Cumulative effects are of concern for five species of amphibians. Land management activity on nonfederal lands will affect nearly all species of amphibians. Most of these species have less than 50 percent of their range on federal lands. Among riparian-associated species, only one species' range (tailed frog) overlaps federal lands by more than 50 percent. The range for terrestrial species on federal lands varies from 44 to 78 percent. Streamside protection measures on nonfederal lands will likely continue to have a strong influence on overall population viability of riparian-associated amphibian species.

For five species and ranges of amphibians, the influence of management on nonfederal lands is thought to be so significant that substantial risks of extirpation will remain even with significant conservation measures on federal lands. Van Dyke's salamander (in coastal Washington) and Columbia torrent salamander occur almost exclusively on nonfederal land, and no standard and guideline can assure their continued existence on the small portion of federal land inhabited by these species. Persistence of the Van Dyke's salamander population in the Cascade Range in Washington is questionable under any alternative because of its extremely limited distribution in very small, disjunct patches and the resulting risk of catastrophic loss of habitat. In addition, the small population size of this species may preclude its ability to recover as habitat conditions improve over time. The Shasta salamander and Siskiyou Mountains salamander are extremely local endemics associated with rocky habitat. Shasta salamander sites will essentially be fully protected. However, because these sites (primarily limestone outcrops) are disjunct and very small, some risk of extirpation from federal lands due to large-scale disturbance exists under all alternatives. The Siskiyou Mountains salamander is distributed in small, disjunct populations, and no standard and guideline could avoid all risk of extirpation from federal lands to this species.

Birds

Affected Environment

The Assessment Team assessed 36 species of birds closely associated with late-successional and old-growth forests as identified in the "short list" of the Scientific Analysis Team Report (Thomas et al. 1993: Appendix 5-D). The marbled murrelet and northern spotted owl were addressed in separate assessments for three reasons: both were listed as threatened under the Endangered Species Act; neither species had a final recovery plan; and both species have been major focus points in the scientific, political, legal, and social arenas surrounding the management of late-successional and old-growth forests. The bald eagle, which is federally listed as "threatened" under the Endangered Species Act in Oregon and Washington and "endangered" in California, is included in this assessment. All alternatives incorporate the guidelines suggested in the Pacific States Bald Eagle Recovery Plan (USDI FWS 1986).

The Assessment Team's list included three species (Vaux's swift, white-headed woodpecker, and chestnut-backed chickadee) that are broadly endemic to the Pacific Northwest. Twelve of the species are cavity-nesters (pileated woodpecker, white-headed woodpecker, three-toed woodpecker, black-backed woodpecker, hairy woodpecker, red-breasted sapsucker, Williamson's sapsucker, chestnut-backed chickadee, winter wren, red-breasted nuthatch, white-breasted nuthatch, and flammulated owl) that require snags for nesting and/or forage. Optimal habitat for cavity-nesters consists of old-growth forests where the occurrence of large snags is the greatest. Additional species of waterfowl, birds of prey, and passerines are also on the Assessment Team's list.

Environmental Consequences

Methods Specific to Birds

Essential considerations for bird assessment ratings were: (1) provision of a system of large reserves, (2) provision of standards and guidelines for riparian protection and analysis as identified for watershed guidelines in the Scientific Analysis Team Report (Thomas et al. 1993), and (3) provisions for retention of green trees, snags, and coarse woody debris within the matrix. When one or more of these factors was judged to be weaker in an alternative, some subset of the total species usually rated lower.

The Assessment Team interpreted the term "refugia" (Outcome C) to indicate remnant populations that were not genetically or demographically well connected. Well-distributed populations and well-distributed populations with gaps when measured against their historic ranges, on the other hand, were situations in which the populations or groups would continue to interact both genetically and demographically (although at different rates).

There were 36 species of birds assessed in the FEMAT Report. Two species (black-backed woodpecker and common merganser) were selected for additional analysis. The black-backed woodpecker was evaluated based on its original rating on federal land in the FEMAT Report. The common merganser was analyzed because such a small portion of its range occurs on federal land, and there is potential for adverse cumulative effects (see Cumulative Effects Including the Role of Nonfederal Lands discussion below).

Effects of Alternatives

The species shown in the shaded portion of Table 3&4-29 are those that were specifically considered when additional standards and guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the added standard and guidelines. The ratings shown in Table 3&4-29 have not been changed to reflect these additions to the alternative.

The habitat components important to birds are those which would increase large reserves, riparian protection and analysis, and retain green trees, snags, and coarse woody debris within the matrix. Alternatives 1, 3, 4, 5, and 9, would generally be the most favorable to birds because they provide the set of allocations and management practices that best produce the habitat components for birds. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for birds. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Alternatives 1, 3, and 4 rate highest in providing habitat for birds, with a 90 percent or greater likelihood of providing sufficient habitat for the 36 assessed bird populations to stabilize, well distributed when measured against their historic ranges across federal land. Alternative 5 would have a 90 percent or greater likelihood of providing sufficient quality habitat for assessed bird populations to allow 35 species to stabilize, well distributed when measured against their historic ranges across federal land, and an 83 percent likelihood for one species (refer to Table 3&4-29). With the standards and guidelines added between the Draft and Final SEIS, Alternative 9 would have a 90 percent or greater likelihood of providing these conditions for 34 bird species, and an 80 percent or greater likelihood for two species. Alternative 7 would provide a 90 percent or greater likelihood of providing sufficient habitat well distributed when measured against their historic ranges across federal land for 28 species, an 80 percent or greater likelihood for seven species, and a 77 percent likelihood for one bird species. Alternative 8 rated lowest with likelihoods ranging between 53 and 77 percent for seven species.

Table 3&4-29. Projected future likelihood for bird habitat outcomes under land management alternatives in the Draft SEIS

Birds	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Bald eagle	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Barred owl	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Barrow's goldeneye	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	80	20	0	0	100	0	0	0	100	0	0	0
Black-backed woodpecker	100	0	0	0	93	7	0	0	93	7	0	0	93	7	0	0	93	7	0	0	53	47	0	0	73	27	0	0
Brown creeper	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Bufflehead	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	87	13	0	0	100	0	0	0	100	0	0	0
Chestnut-backed chickadee	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Common merganser	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	93	7	0	0	87	13	0	0	100	0	0	0
Flammulated owl	100	0	0	0	93	7	0	0	93	7	0	0	93	7	0	0	93	7	0	0	70	30	0	0	93	7	0	0
Golden-crowned kinglet	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Great gray owl	93	7	0	0	90	10	0	0	90	10	0	0	83	17	0	0	80	20	0	0	73	27	0	0	83	17	0	0
Hairy woodpecker	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Hammond's flycatcher	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Harlequin duck	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	80	20	0	0	100	0	0	0	100	0	0	0
Hermit thrush	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Hermit warbler	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Hooded merganser	100	0	0	0	93	7	0	0	93	7	0	0	93	7	0	0	90	10	0	0	77	23	0	0	93	7	0	0
Northern flicker	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Northern goshawk	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	93	7	0	0	83	17	0	0	100	0	0	0
Northern pygmy-owl	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	80	20	0	0	100	0	0	0
Pileated woodpecker	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	93	7	0	0	100	0	0	0
Pygmy nuthatch	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	80	20	0	0	70	30	0	0	100	0	0	0
Red crossbill	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Red-breasted nuthatch	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Red-breasted sapsucker	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Three-toed woodpecker	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	80	20	0	0	100	0	0	0
Varied thrush	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Vaux's swift	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	93	7	0	0	83	17	0	0	100	0	0	0
Warbling vireo	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Western flycatcher (Pacific slope flycatcher)	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
White breasted nuthatch	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	93	7	0	0	93	7	0	0	100	0	0	0
White-headed woodpecker	100	0	0	0	97	3	0	0	97	3	0	0	97	3	0	0	77	23	0	0	67	33	0	0	100	0	0	0
Williamson's sapsucker	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	80	20	0	0	67	33	0	0	100	0	0	0
Wilson's warbler	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Winter wren	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0

Table 3&4-29. Projected future likelihood for bird habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Birds	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Wood duck	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	87	13	0	0	100	0	0	0	100	0	0	0

A-Well Distributed B-Locally Restricted C-Restricted to Refugia D-Risk of Extirpation

Likelihood values are expressed as percentages that total to 100 for a given species within an Alternative. Number displayed may vary due to rounding errors. The Species shown in the shaded portion of the table are those that were specifically considered when additional standards are guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the standards and guidelines. The ratings shown in the table have not been changed to reflect these additions to Alternative 9. See text for fuller explanation and discussion of the rating scale and for discussion of the additional species analysis under Alternative 9.

Based on the original FEMAT Report assessments, all rated alternatives have a 100 percent likelihood of providing habitat of sufficient quality, distribution, and abundance to allow the assessed bird species populations to stabilize, but with significant gaps in the historic species' distributions across federal lands.

The additional standards and guidelines described in Chapter 2 and Appendix B11, and incorporated into Alternative 9, would provide an 80 percent or greater likelihood of providing sufficient habitat to achieve Outcome A for the black-backed woodpecker. In particular, the provisions for clumping snags and green trees in the matrix will benefit the black-backed woodpecker, as will clarification of the mitigations identified in Thomas et al. (1993).

Possible Mitigation Measures

Most of the alternatives contain standards and guidelines that are expected to benefit birds. As noted in the section earlier, to avoid or reduce impacts, a standard or guideline in one alternative could be added to another that currently does not include the measure. Of greatest benefit to these species would be those standards and guidelines that would increase large reserves, riparian protection and analysis, and retain green trees, snags, and coarse woody debris within the matrix.

The following possible mitigation measure is not represented in the alternatives, but could benefit birds:

> Mitigation for the black-backed, white-headed and Williamson's woodpeckers could include adoption of more restrictive guidelines for salvage of dead trees in the eastern Cascade Range.

Cumulative Effects Including the Role of Nonfederal Lands

All of the 36 birds in the FEMAT Report assessment occur on both federal and nonfederal lands; federal lands comprise less than 50 percent of the wintering or breeding ranges of 26 of these species. Some (flammulated owl, Hammond's flycatcher, hermit warbler, warbling vireo, western flycatcher, Wilson's warbler, and Vaux's swift) are neotropical migrants that spend the winter in Mexico or central America. All six of the waterfowl on the list winter on lowland ponds, bays, rivers, estuaries, or surf zones where they are subject to hunting and other forms of disturbance. For all of these migratory species, habitat on the winter range is likely as important as breeding habitat in maintaining viable populations. In addition, for those waterfowl that are subject to hunting, state and federal regulatory mechanisms play a critical role in their population biology.

Because the common merganser occupies low elevation waterways and riparian habitat primarily on nonfederal lands, its persistence cannot be adequately ensured by any of the alternatives considered in this SEIS. No measure on federal land can provide habitat to mitigate the potential cumulative effects on this species from loss of riparian habitat on nonfederal lands.

The other waterfowl addressed by the Assessment Team winter in lowland areas where they are subject to hunting and other forms of disturbance. The persistence of these species is only partially a function of the quality of habitat on federal lands.

Mammals Other Than Bats

Affected Environment

Temperate coniferous forests of the Pacific Northwest provide habitat for a diverse array of mammal species. The Assessment Team initially identified 15 mammal species or species complexes as being associated with late-successional forests (FEMAT Report, Table IV-A-6, p. IV-232). These included forest carnivores (fisher, American marten, and lynx), elk, rodents (several species of squirrels, mice, voles, and a woodrat), and insectivores (several shrews and the shrew-mole).

These mammals interact and are interrelated with the late-successional and old-growth ecosystem. The foliage and fungi-eating mammals have important functional roles in these coniferous forests (Maser and Trappe 1984, Trappe and Maser 1976). Spores of hypogeous fungi (fungi that fruit below the ground) are primarily dispersed by small mammals in their fecal pellets. At least one study has shown that passage of spores through the digestive tracts of small mammals enhances spore germination (Cork and Kenagy 1989). Fecal pellets contain not only fungal spores, but also nitrogen-fixing bacteria and yeast which are deposited onto the forest floor. These mammals also serve an important role in physically distributing lichens throughout the forest (Rosentreter 1991).

Many of these small mammals are important prey for larger animals within the forest community. Northern flying squirrels, woodrats, red tree voles, and red-backed voles (*Clethrionomys* spp.) are the primary prey of northern spotted owls throughout their range (Thomas et al. 1990). Microtine voles (*Microtus* spp.) and red-backed voles are important prey for American martens (Strickland and Douglas 1987). These small mammals depend on fir needles, fungi, and lichens in coniferous forests and in turn serve as food sources to predators that eat them.

Environmental Consequences

Methods Specific to Mammals Other Than Bats

The FEMAT Report's list of species associated with late-successional forests was updated from the list originally developed by Thomas et al. (1993) and the list that appeared in the Final Draft Spotted Owl Recovery Plan (USDI unpub.). There are some differences among all three lists (see FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment).

The lynx was included on the list of species associated with late-successional forests in Thomas et al. (1993), but it was dropped from the Assessment Team's list and thus was not rated. This species is rare, occurs within a small portion of the range of the northern spotted owl, and is not closely associated with late-successional forests for most of its life history. Much of the range of the lynx within that of the northern spotted owl occurs in Congressionally Reserved Areas and in Late-Successional Reserves under all alternatives. Another species that is not included on the Assessment Team's list is the Baird's shrew. This species was recently separated from the vagrant shrew species complex and identified as a separate species. Little is known about this shrew, but it is closely related to *Sorex monticolus* which is not associated with late-successional forests.

A total of 15 species were originally assessed in the FEMAT Report. Of these, four species were subject to additional analysis (and possible additional mitigation). These species were evaluated using the criteria described earlier in Methods for Additional Species Analysis and more fully in Appendix J.

Effects of Alternatives

The species shown in the shaded portion of Table 3&4-30 are those that were specifically considered when additional standards and guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the added standards and guidelines. The ratings shown in Table 3&4-30 have not been changed to reflect these additions to the alternative.

Habitat components important to mammals other than bats include: dead, standing wood; dead, down wood; live, old-growth trees; and riparian zones. Large, decayed logs and snags are important to many mammals as resting and denning sites. Large expanses of live, old-growth trees are important to some mammals such as the fisher because they provide continuous canopy cover. Fisher may be negatively affected by forest fragmentation. Riparian zones provide potential habitat (including large snags and cover) for mammals such as fishers and American martens. In general, those alternatives that provide for greater amounts of this habitat resulted in higher ratings for mammal species. Alternatives 1, 3, and 9, would generally be the most favorable to mammals, because they provide the set of allocations and management practices that best produce the habitat components for mammals. Alternatives 4 and 5 would provide somewhat lesser levels of habitat conditions. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for mammals. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Based on the original FEMAT Report assessments, Alternative 1 would provide a 97 percent or greater likelihood of sufficient habitat for stable, well-distributed (when measured against their historic ranges) populations of 13 of these mammals, and an 83 and 85 percent likelihood of providing these conditions for the two remaining mammal species. Alternative 3 would provide a 95 percent or greater likelihood of sufficient habitat for stable, well-distributed (when measured against their historic ranges) populations of 13 of these mammals; and an 82 and 73 percent likelihood for the two remaining species.

As a result of adding standards and guidelines to Alternative 9 (see Appendix B11), that alternative would have at least an 88 percent or greater likelihood of providing sufficient habitat for stable, well-distributed (when measured against their historic ranges) populations of 11 of these mammal species, and at least an 80 percent likelihood of providing these conditions for fisher, marten, and both species of red tree voles. With the added standards and guidelines, Alternative 9 would likely rate similarly to the original ratings for Alternatives 1 and 3 for fisher, marten and voles. Implementation of Riparian Reserve Scenario 1 is a key standard and guideline addition for two species, the American marten and red tree vole. Increased coarse woody debris is a key addition for the American marten and fisher. For the fisher, provision of residual habitat areas around

Table 3&4-30. Projected future likelihood for mammals habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Mammals	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Deer mouse	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Douglas squirrel	98	2	0	0	97	3	0	0	97	3	0	0	93	7	0	0	83	15	2	0	88	12	0	0	88	12	0	0
Dusky-footed woodrat (Klamath Province)	98	2	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Elk	97	3	0	0	98	2	0	0	98	2	0	0	100	0	0	0	96	4	0	0	96	4	0	0	96	4	0	0
Fisher	85	15	0	0	82	18	0	0	73	27	0	0	70	30	0	0	67	33	0	0	63	37	0	0	63	37	0	0
Forest deer mouse	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0	100	0	0	0
Marten	83	17	0	0	73	23	3	0	77	23	0	0	67	27	7	0	57	33	7	3	67	30	3	0	67	27	3	3
Northern flying squirrel	100	0	0	0	100	0	0	0	100	0	0	0	98	2	0	0	90	10	0	0	90	10	0	0	93	7	0	0
Red tree vole (P.longicaudus)	98	2	0	0	95	5	0	0	95	5	0	0	82	18	0	0	58	33	8	0	60	35	5	0	73	25	2	0
Red tree vole (P.pomo)	100	0	0	0	95	5	0	0	93	8	0	0	88	13	0	0	68	30	3	0	75	25	0	0	78	23	0	0
Shrew-mole	100	0	0	0	100	0	0	0	100	0	0	0	96	4	0	0	84	16	0	0	96	4	0	0	98	2	0	0
Southern red-backed vole	100	0	0	0	98	2	0	0	100	0	0	0	98	2	0	0	96	4	0	0	98	2	0	0	98	2	0	0
Chipmunk complex	100	0	0	0	100	0	0	0	100	0	0	0	98	2	0	0	97	3	0	0	97	3	0	0	98	2	0	0
Pacific/Fog shrew complex	100	0	0	0	100	0	0	0	100	0	0	0	98	2	0	0	92	8	0	0	96	4	0	0	96	4	0	0
Western red-backed vole	100	0	0	0	98	2	0	0	100	0	0	0	93	7	0	0	73	22	5	0	85	15	0	0	90	10	0	0

A-Well Distributed B-Locally Restricted C-Restricted to Refugia D-Risk of Extirpation

Likelihood values are expressed as percentages that total to 100 for a given species within an Alternative. Number displayed may vary due to rounding errors. The Species shown in the shaded portion of the table are those that were specifically considered when additional standards are guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the standards and guidelines. The ratings shown in the table have not been changed to reflect these additions to Alternative 9. See text for fuller explanation and discussion of the rating scale and for discussion of the additional species analysis under Alternative 9.

spotted owl activity centers is also a key mitigation. The "survey and manage" standard and guideline would be important for the red tree vole to help provide for well-distributed breeding colonies.

Alternatives 4, 5, 8, and 7, in decreasing order, would provide less favorable habitat conditions for the mammals. Alternative 7 would provide a 90 percent or greater likelihood of providing sufficient habitat for stable, well-distributed (when measured against their historic ranges) populations of eight species, an 83 to 89 percent likelihood of these conditions for two species, a 73 percent likelihood of these conditions for one mammal, and less than a 70 percent likelihood of these conditions for four mammal species.

All rated alternatives have a greater than 90 percent likelihood of providing habitat of sufficient quality, distribution, and abundance to allow all mammal species' populations to stabilize, either well distributed when measured against their historic ranges or distributed with significant gaps in the historic species distributions across federal lands.

Possible Mitigation Measures

Most of the alternatives contain standards and guidelines that are expected to benefit mammals. As noted in the section earlier, to avoid or reduce impacts, a standard or guideline in one alternative could be added to another that currently does not include the measure. Of greatest benefit to these species would be those standards and guidelines that would: increase large reserves; provide riparian protection and analysis; retain live, old-growth trees; and retain green trees, snags, and coarse woody debris within the matrix .

Cumulative Effects Including the Role of Nonfederal Lands

The ranges of 12 of the 15 species of mammals evaluated by the Assessment Team are mostly (more than 50 percent) within nonfederal lands. For these species, management practices on nonfederal lands that reduce the amount or quality of late-successional forest will influence the species' population viability within the range of the northern spotted owl. For two species, the American marten and the Oregon red tree vole, these effects may be especially important. One subspecies of the marten, the Humbolt marten (*Martes americana humboltensis*) is quite rare and much of its range is on nonfederal land. Similarly, a subspecies of the Oregon red tree vole (*Phenacomys longicaudus silvicolus*) occurs in the northern Coast Range of Oregon, primarily on nonfederal land.

Population sizes of the American marten and fisher are quite low in portions of the species' ranges, causing some uncertainty that populations will recover even if habitat conditions are sufficient to support well-distributed, stable populations. The Humbolt marten in northern California is thought to have undergone a reduction in numbers and total range for reasons that are not understood. Martens are also relatively rare on the Olympic Peninsula and the Oregon Coast Range. The fisher is rare throughout Washington. Past habitat loss is a likely contributor to the species' rarity, but other factors such as overharvest and disease may also have contributed to the declines in populations. The fisher was apparently never abundant in Oregon, as indicated by low trapping success from historical fur harvest records. Because of the species' low reproductive rate and small population size, recovery of the fisher populations will likely be slow.

BATS

Affected Environment

Bats are a diverse order of mammals. There may be more species of bats in North American temperate forests than any other group of mammals. All forest-dwelling bats in the Pacific Northwest are insectivores. Bats that forage in riparian areas and fly to upland forests to roost may serve as dispersers of nutrients. Because of their large population numbers, bats may play an important role in nutrient cycling within forests (Christy and West 1993). Bats also serve an important role as predators of insects (Whitaker et al. 1977).

Population declines that have been documented worldwide are attributed to loss of habitat and disturbance of maternity colonies and hibernacula (Cockrum 1969, Edgerton et al. 1966, McCracken 1988, Mohr 1948, Tuttle 1979).

Large snags and large green trees are important because bats use them for maternity roosts, day roosts, temporary night roosts, and hibernacula (Barbour and Davis 1969, Kunz 1982, Rainey et al. 1992). Bats in the Pacific Northwest seem to prefer old forests, presumably due to the presence of potential roost sites under bark, in crevices, or in hollows of large, old trees (Perkins and Cross 1988, Thomas and West 1991). Suitable roost sites require access to water (for drinking and foraging), protection from predators, and favorable temperature and moisture regimes (Christy and West 1993). Temperature regimes are important to bats (Fenton and Barclay 1980, van Zyll de Jong 1985), and thermal stability may be influenced by structural characteristics within large snags or trees. The hoary bat is the only foliage-roosting bat (Barclay 1985, Constantine 1966) on the list of species closely associated with late-successional forests. Hoary bats are not very maneuverable during flight, thus requiring tall trees with foliage high above the ground which enable them to drop to gain momentum for flight.

Environmental Consequences

METHODS SPECIFIC TO BATS

The list of species closely associated with late-successional forests was originally derived from Thomas et al. (1993) and the Final Draft Spotted Owl Recovery Plan (USDI unpub.). As a result of additional review, there are some differences between the Assessment Team's list of species and these previous efforts.

The Assessment Team identified 11 species of bats associated with late-successional forests, including 7 species of Myotis, and the big brown, pallid, silver-haired, and hoary bats (FEMAT Report, Table IV-A-6, p. IV-232).

In evaluating the effects of the alternatives on bats, a number of factors were considered. Large acreages of Late-Successional Reserves distributed throughout the landscape were considered critical for bats because of the importance of large, green trees and snags for roosting sites. Late-Successional Reserves would be an increasingly important source of large trees and snags. The proposed management for the matrix was also a key factor in the ratings, primarily due to concerns regarding adequate density of snags. Alternatives containing the Riparian Reserve Scenario 1 standards and guidelines were consistently rated as having a higher likelihood of habitat for species well distributed across federal lands when measured against their historic ranges than alternatives containing less protection. The Riparian Reserve Scenario 1 standards and guidelines provide protection of intermittent streams and small lakes and ponds (less than 1 acre) with a full tree height reserve (described in greater detail in the FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment). These ratings reflect the degree of potential bat habitat that would be provided by the presence of additional trees within the reserve. For additional detail, see the general discussion of panel assumptions and the process for evaluating and describing the results earlier in this chapter.

A total of 11 species of bats were assessed in the FEMAT Report. Of these, seven species were selected for additional analysis because of their original ratings in the FEMAT Report (see Methods for Additional Species Analysis). These species are fringed myotis, hoary bat, Keen's myotis, long-eared myotis, long-legged myotis, pallid bat, and silver-haired bat.

Effects of the Alternatives

The species shown in the shaded portion of Table 3&4-31 are those that were specifically considered when additional standards and guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the added standards and guidelines. The ratings shown in Table 3&4-31 have not been changed to reflect these additions to the alternative.

The habitat components important to bats are those which would increase Late-Successional Reserves, riparian protection and retain green trees, snags, and coarse woody debris within the matrix. Alternatives 1, 3, and 9, would generally be most favorable to bats, because they provide the set of allocations and management practices that best produce the habitat components for bats. Alternatives 4 and 5 would provide somewhat lesser levels of habitat conditions. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for bats. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Alternative 1 would have a 97 percent or greater likelihood of providing habitat of sufficient quality, distribution and abundance to allow species populations to stabilize, well distributed when measured against species' historic ranges across federal lands for all bat species assessed. Alternative 3 would provide an 87 percent or greater likelihood for all species (refer to Table 3&4-31). With the standards and guidelines added between the Draft and Final SEIS, Alternative 9 would provide 80 percent or greater likelihood of sufficient habitat well distributed when measured against species' historic ranges across federal land for all species. The two additional standards and guidelines most important for maintaining sufficient habitat for bats are: provide additional protection to cave entrances, mines and other structures; and emphasize retaining clumped green trees and snags in matrix management. Alternative 4 would provide an 83 percent or greater likelihood of providing adequate habitat for well-distributed (when measured against species' historic ranges) populations for seven species, and between a 75 and 78 percent likelihood for three species. Alternative 9 would likely rate overall between Alternatives 3

Table 3&4-31. Projected future likelihood for bats habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Bats	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Big brown bat	100	0	0	0	95	5	0	0	93	8	0	0	93	8	0	0	27	25	3	0	68	30	3	0	83	18	0	0
California myotis	100	0	0	0	100	0	0	0	95	5	0	0	95	5	0	0	75	25	0	0	74	26	0	0	85	15	0	0
Fringed myotis	97	3	0	0	87	13	0	0	77	23	0	0	70	30	0	0	33	57	10	0	33	53	10	3	47	47	5	2
Hoary bat	98	3	0	0	91	9	0	0	83	18	0	0	68	33	0	0	45	50	5	0	40	53	8	0	53	48	0	0
Keen's myotis	100	0	0	0	95	5	0	0	75	25	0	0	65	35	0	0	45	45	5	5	35	50	10	5	50	40	5	5
Little brown myotis	100	0	0	0	96	4	0	0	91	9	0	0	90	10	0	0	73	28	0	0	70	28	3	0	84	16	0	0
Long-eared myotis	98	3	0	0	93	8	0	0	80	20	0	0	68	33	0	0	50	45	5	0	48	48	5	0	64	35	1	0
Long-legged myotis	100	0	0	0	90	10	0	0	83	18	0	0	69	31	0	0	45	48	8	0	41	51	8	0	55	45	0	0
Pallid bat	100	0	0	0	96	4	0	0	85	15	0	0	73	25	3	0	48	41	9	2	45	44	10	2	63	35	3	0
Silver-haired bat	98	3	0	0	91	9	0	0	78	23	0	0	68	33	0	0	45	50	5	0	40	53	8	0	53	48	0	0
Yuma myotis	100	0	0	0	95	5	0	0	90	10	0	0	89	11	0	0	70	29	1	0	73	28	0	0	83	18	0	0

A-Well Distributed B-Locally Restricted C-Restricted to Refugia D-Risk of Extirpation

Likelihood values are expressed as percentages that total to 100 for a given species within an Alternative. Number displayed may vary due to rounding errors. The Species shown in the shaded portion of the table are those that were specifically considered when additional standards are guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the standards and guidelines. The ratings shown in the table have not been changed to reflect these additions to Alternative 9. See text for fuller explanation and discussion of the rating scale and for discussion of the additional species analysis under Alternative 9.

and 4 as a result of the additional standards and guidelines. Alternative 5 would provide an 89 percent or greater likelihood of providing well-distributed (when measured against species' historic ranges) habitat for four species, and would provide a 65 to 75 percent likelihood of providing such habitat for seven species. Alternatives 7 and 8 rated lowest with likelihoods of 50 percent or less of providing sufficient habitat well distributed when measured against species' historic ranges across federal lands for seven species.

All alternatives provide at least 85 percent likelihood of providing habitat of sufficient quality, distribution and abundance to allow all rated bat species' populations to stabilize, either well distributed when measured against species' historic ranges or with significant gaps in the historic species distribution on federal land.

Possible Mitigation Measures

Most of the alternatives contain standards and guidelines that are expected to benefit bats. As noted in the section earlier, to avoid or reduce impacts, a standard or guideline in one alternative could be added to another that currently does not include the measure. Of greatest benefit to these species would be those standards and guidelines that would: increase large reserves; provide riparian protection and analysis; retain live, old-growth trees; and provide for retention of green trees, snags, and coarse woody debris within the matrix.

The following possible mitigation measure is not represented in the alternatives, but could benefit bats:

> Cave entrances could be gated in such a way that air flow patterns are maintained (Tuttle 1977), people are excluded, and bats can freely enter and exit.

Cumulative Effects Including the Role of Nonfederal Lands

Effects of nonfederal land management practices are important for two species of bats, Keen's myotis and pallid bat, across all alternatives. The Keen's myotis is extremely rare, is found exclusively in the Pacific Northwest, and occupies a restricted range within western Washington, western British Columbia, and southeastern Alaska. Within the range of the northern spotted owl, Keen's myotis seems to occur only in dense, low elevation forest near Puget Sound and on the Olympic Peninsula. Suitable habitat has declined substantially due to urbanization in lowland areas around Puget Sound. Concern still persists under all alternatives due to the occurrence of this species primarily on nonfederal lands, its rarity and restricted distribution, and because of the almost complete lack of information available on its ecology and population status.

Two species (hoary bat and silver-haired bat) migrate to southern California or Mexico in winter, so habitat conditions on their wintering ranges are important. The pallid bat is found in dry forests including mature oak woodlands in California and ponderosa pine forests of southern Oregon and northern California. Because much of this habitat is on nonfederal lands, forest management on those lands will likely have a significant influence on population viability of the species.

Bats in general may be vulnerable to the effects of insecticides, especially through accumulation from insect prey. Large-scale pesticide applications may be detrimental through direct toxicity and through depression of prey species. Loss of caves and abandoned buildings, especially on nonfederal lands, may be detrimental to those species roosting in such structures, but effects of such losses of habitat on population viability are unknown.

Aquatic Species

Affected Environment

There are an estimated 307 anadromous fish stocks at risk within the range of the northern spotted owl, 257 of these occur on federal lands (Table 3&4-32) (Higgins et al. 1992, Nehlsen et al. 1991, Nickelson et al. 1992, and Wash. Dept. of Fisheries 1993). At-risk fish stocks are stocks that are at high-to-moderate risk of extinction. The Endangered Species Committee of the American Fisheries Society estimated that there are 214 stocks in California, Idaho, Oregon and Washington requiring special management considerations because of low or declining numbers (Nehlsen et al. 1991). The subsequent reports released on the status of West Coast anadromous salmonid stocks provide more detailed stock assessments, and in some cases, subdivide many of the stocks listed by Nehlsen et al. (1991). More than 100 unique stocks are already extinct. Currently, there are six petitions for listing, pursuant to the Endangered Species Act, that are pending before the National Marine Fisheries Service for anadromous fish in California, Oregon, and Washington. Five of the six petitions include stocks within the range of the northern spotted owl.

Primary factors contributing to the decline of anadromous salmonid stocks include: (1) degradation and loss of freshwater and estuarine (where freshwater and salt water mix) habitats, (2) timing and overexploitation in commercial and recreational fishing, (3) migratory impediments such as dams, and (4) loss of genetic integrity due to the effects of hatchery practices and introduction of nonlocal stocks. Often the interaction of two or more of these factors is responsible for a decline in population numbers.

Some resident fish populations show declines similar to those of anadromous salmonid stocks. Habitat loss and degradation are principal factors in the decline of these fishes. In addition, the introduction of nonnative fish and the practice of artificial propagation have impacted resident trout populations. Like anadromous salmonid stocks, many of these fishes have been adversely affected by hatchery practices or overharvesting.

Environmental Consequences

Methods Specific to Aquatic Species

In evaluating the alternatives, the Assessment Team considered five factors: (1) habitat conditions for the individual races/species/groups considered by the assessment panel; (2) the amount of Riparian Reserves and type and level of management activity allowed within them; (3) the extent of other reserves (such as Congressionally Reserved Areas and Late-Successional Reserves) and type and level of land management allowed within them; (4) the presence of a watershed restoration program; and (5) prescriptions for management of the matrix.

Table 3&4-32. Number of stocks at risk[1] on federal and nonfederal lands within the range of the northern spotted owl from Higgins et al. (1992), Nehlsen et al. (1991), Nickelson et al. (1992), and Washington Department of Fisheries (1993)

Race	Forest Service[2]	Bureau of Land Management[2, 3]	National Park Service[3]	Total on Federal Lands	Total on Nonfederal Lands
Spring/Summer Chinook salmon	36	3	0	39	1
Fall Chinook salmon	32	3	1	36	2
Coho salmon	59	11	1	71	26
Sockeye salmon	0	0	1	1	3
Chum salmon	21	2	1	24	4
Pink salmon	5	1	0	6	0
Winter Steelhead	34	5	1	40	14
Summer Steelhead	35	0	0	35	0
Sea-run Cutthroat trout	5	0	0	5	0
Total	227	25	5	257	50

[1] At risk is defined here as stocks rated as either 1 or 2 by one or more of the reports used in constructing this chart.

[2] Includes basins in which the lands administered by the Forest Service and/or Bureau of Land Management lands are not accessed by anadromous fish due to natural barriers, dams, or location of federal land within the basin. Many of these are important in maintaining water quality for anadromous fish runs.

[3] Includes basins in which the Bureau of Land Management or National Park Service manages land only if the Forest Service does not.

The Assessment Team emphasized the first three factors in determining the score for an outcome under each alternative. The Assessment Team believed that these three factors most strongly influence the preservation, maintenance, and restoration of aquatic ecosystems and habitat. The latter two factors would be relatively constant for all the alternatives and the Assessment Team evaluated the alternatives based on this. Stream habitat depends on condition of riparian areas; both are influenced by conditions and processes occurring within watersheds. Thus, the amount of management activity within a watershed can directly and indirectly influence aquatic ecosystems (see Current Aquatic Conditions earlier in this chapter).

The assessment panel considered 21 races/species/groups of fish. A total of 29 species were contained in these groupings. The races/species/groups of fish were determined based on similar life histories and habitat requirements. Five of the 29 species considered had petitions pending for listing under the Endangered Species Act during the period the assessments were conducted. In addition to the petitions for listing five of these fish pursuant to the Endangered Species Act, Williams et al. (1989) identified one as needing special management consideration because of low or declining populations.

Members of the assessment panel decided to fully evaluate only seven of the 21 races/species/groups originally presented (Table 3&4-33). Reasons for not considering the 14 remaining races/species/groups were: (1) insufficient information on the ecology to make a valid assessment; (2) limited distribution of the races/species/groups on federal lands within the range of the northern spotted owl; and (3) based on available information, possible habitat alterations that may occur as a result of management activities on federal lands that would have negligible or no effect on the habitat of the races/species/groups. The panel commented on what they believed may be the potential outcome of an alternative on some races/species/groups for which they had limited knowledge. The Assessment Team evaluated only the seven races/species/groups fully considered by the assessment panel.

All assessed fish were salmonids. The seven races/species/groups evaluated were: coho salmon, fall chinook salmon, spring chinook salmon/summer steelhead trout, winter steelhead trout, sea-run cutthroat trout, resident rainbow/cutthroat trout, and bull trout. Most occur in streams of late-successional forests on federal lands throughout the range of the northern spotted owl. They use a broad range of stream sizes: chinook salmon use larger streams and resident cutthroat and rainbow trout use headwater streams. All species require cool water, diverse and complex habitat, and clean gravel to reproduce successfully. As discussed previously, habitat features for these fish are susceptible to impacts from management activities and, consequently, these fish serve as reasonable indicators of aquatic ecosystem health.

The assessment panel considered the likelihood of attaining a set of outcomes for habitat of the seven races/species/groups of fish on federal lands for each alternative. This outcome-based scale was developed to express the range of possible trends and future habitat conditions on federal land (FEMAT Report, Chapter V, Aquatic Ecosystem Assessment). The panel compared alternatives by assessing the likelihood of each alternative to achieve habitat of sufficient quality, distribution, and abundance to allow the species population to stabilize, well distributed across federal lands.

During the assessments, the panel was instructed to assume that the Aquatic Conservation Strategy would be fully implemented. The Aquatic Conservation Strategy has four main components (Appendix B6): (1) establish Riparian Reserves, (2) establish Key Watersheds, (3) conduct watershed analysis, and (4) institute a comprehensive program of watershed restoration. The components include:

- Riparian Reserves to maintain ecological functions and protect stream and riparian habitat and water quality.
- A network of 164 Key Watersheds with management restrictions to protect at-risk fish stocks (143 Tier 1 Key Watersheds) or basins with outstanding water quality (21 Tier 2 Key Watersheds). No new roads will be constructed in any inventoried roadless areas in Key Watersheds to prevent further sedimentation and changes in hydrology due to the increased road network.
- Watershed analysis, which is an analytical procedure used to support planning further protection or management (including restoration practices within a basin).
- Watershed restoration to speed ecosystem recovery in areas of degraded habitat and to prevent further degradation.

Table 3&4-33. Fish races/species/groups presented to, but not considered by, the assessment panel

	Reason Not Considered	
Fish Species	Insufficient Information on Ecology	Limited Distribution on Federal Lands
Pacific lamprey	X	
Sockeye salmon[1]		X
Pink salmon[1]		X
Chum salmon[1]		X
Redband trout		
White River, OR	X	
McCloud, CA[2]	X	
Jenny Creek, OR	X	
Mountain whitefish	X	
Dolly Varden		X
Umpqua squawfish[3]		X
Umpqua chub		X
Oregon chub[2]	X	
Olympic mudminnow[2]	X	
Salish sucker[4]	X	
Jenny Creek sucker[2]	X	
Reticulate sculpin	X	
Paiute sculpin	X	
Riffle sculpin	X	
Shorthead sculpin	X	
Torrent sculpin	X	
Mottled sculpin	X	
Coast Range sculpin	X	
Longnose dace	X	
Millicoma dace	X	

[1] Stocks within the range of the northern spotted owl listed by Nehlsen et al. (1991) as needing special management considerations because of low or declining populations.
[2] Candidate for listing under federal Endangered Species Act.
[3] Species for which there would be no effect from land management practices on federal lands.
[4] Listed by Williams et al. (1989) as needing special management considerations because of low or declining populations.

The term "scenarios" was used to describe varying widths of the Riparian Reserves. Riparian Reserve Scenarios 1, 2, and 3 have similar widths for fish-bearing streams. Scenarios 1 and 2 have similar widths for permanently flowing non fish-bearing streams with Scenario 3 requiring a smaller Riparian Reserve width for similar streams. The most notable difference among scenarios is the widths for intermittent streams. Scenario 1 has a Riparian Reserve width equal to the height of one site-potential tree on all intermittent streams. Scenario 2 is characterized by a Riparian Reserve width equal to half the height of one site-potential tree on intermittent streams in Tier 2 Key Watersheds and non-Key Watersheds. Scenario 3 has a Riparian Reserve width equal to one-sixth the height of a site-potential tree on all intermittent streams, and provides less protection on nonfish-bearing perennial streams. Ecological functions and processes required for the creation and maintenance of fish habitat were provided by Riparian Reserves. The greater the amount of Riparian Reserves, the more they contributed to the rating. Riparian Reserves under Scenario 1 provide the fullest array of functions and processes and thus contributed to higher ratings than did Scenarios 2 and 3.

The panel considered the likelihood of attaining the set of outcomes for the individual races/species/groups of fish for each alternative. The panel was presented with descriptions of the four possible outcomes used to rate the level of habitat to support populations and alternatives. They were also asked to partition out the effects of factors that do not affect the quality and distribution of habitat on federal lands within the range of the spotted owl, thereby, focusing the assessment on habitat factors under management authority of the affected federal agencies. These external effects include habitat conditions on nonfederal land, land ownership patterns, and oceanic conditions. Each panelist made their own assessment. Like the terrestrial ecosystem assessment, the assessment panel was only asked to assess Alternatives 1, 3, 4, 5, 7, 8, and 9. The Assessment Team then used this information as part of its assessment of the alternatives. The assessment panel was not asked to consider Alternatives 2, 6 and 10. Assessment of these alternatives was done by fish experts within the Aquatic/Watershed Group for the Assessment Team.

For the assessments of fish stocks, the Assessment Team assumed that the boundaries of Riparian Reserves, particularly on intermittent streams, would change following watershed analysis. This does not imply, however, that watershed analysis would always reduce the boundaries of Riparian Reserves in intermittent streams. The Assessment Team considered the prescribed widths on permanently-flowing streams to approximate those necessary for attaining Aquatic Conservation Strategy objectives. Post-watershed analysis Riparian Reserve boundaries for intermittent streams are expected to be different from the existing boundaries. The reason for the expected difference is the high variability of hydrologic, geomorphic and ecologic processes in a watershed affecting intermittent streams. Thus, the post-watershed analysis Riparian Reserve boundaries for permanently-flowing streams should not vary appreciably from the boundaries prescribed in this SEIS, whereas post-watershed analysis Riparian Reserve boundaries for intermittent streams can be quite different than the prescribed boundaries. Therefore, it is possible to meet Aquatic Conservation Strategy objectives with post-analysis reserve boundaries for intermittent streams that are quite different from those conforming to the definitions. In all cases, the Assessment Team assumed that the post-watershed analysis Riparian Reserves widths would provide the necessary range of ecological functions and processes that create and maintain high quality fish habitat and meet Aquatic Conservation Strategy objectives. Design of Riparian Reserves is likely to be a hybrid of decisions based on consideration of sites of special ecological value, slope stability, wildlife dispersal corridors, endemic species considerations and natural disturbance processes. Thus, expanding Riparian Reserve objectives to include other factors such as wildlife dispersal corridors could lead to Riparian Reserve widths wider than are necessary to meet Aquatic Conservation Strategy objectives. The other objectives cannot result in Riparian Reserves that are narrower than those needed to meet Aquatic Conservation Strategy objectives.

Regardless of stream type, changes to Riparian Reserves must be based on scientifically sound reasoning, and be fully justified and documented. Adjustments to Riparian Reserves for intermittent streams are to be based on hydrologic and geomorphic characteristics or other factors that may affect meeting Aquatic Conservation Strategy objectives. If adjusting Riparian Reserves is based on hydrologic and geomorphic conditions, then the resulting post- watershed analysis Riparian Reserves would be similar regardless of the initial Riparian Reserve scenario. The greater risk to aquatic and riparian habitat from the narrower reserve widths, Scenario 1 versus Scenario 2, is based on the standards and guidelines for Key Watersheds, roadless areas, and Riparian Reserves. The standards and guidelines for Key Watersheds, roadless areas, and Riparian Reserves require completing watershed analyses before initiating certain management actions (Appendix B6). In the matrix in non-Key Watersheds, management activities must respect the prescribed Riparian Reserve boundaries (Appendix B6, Aquatic Conservation Strategy). The risk is that potential Riparian Reserve trees would be harvested prior to completing the watershed analysis and their possible subsequent inclusion within the adjusted Riparian Reserve. This could negatively affect the aquatic habitat and could delay achieving full function and processes of that particular riparian area and aquatic habitat.

The Assessment Team determined that reserves such as Congressionally Reserved Areas and Late-Successional Reserves would provide two benefits to aquatic habitat and ecosystems. First, given that management activities would be limited in these areas, the reserves would provide a high level of protection for all streams. In addition to limiting activities within riparian areas, benefits would accrue from limiting management activities within large areas of watersheds containing the streams. This would in turn provide the ecological functions and processes necessary for the creation and maintenance of high quality fish habitat. Second, streams in reserves could serve as cores of high quality habitat within a landscape containing large areas of low quality habitat. They would serve as refugia and population centers for recolonization during the recovery of degraded areas. This would be particularly important for locally-distributed fish species and races. The greater the amount of reserves, the greater the level of protection for existing aquatic ecosystems and habitat.

The distribution and amount of land within the Key Watersheds is very important for fish habitat protection. Thus, the inclusion of Key Watersheds affected the assessments.

The other factors, watershed restoration and matrix management prescriptions, were given less weight. However, the assessment panel and the Assessment Team acknowledged that a comprehensive watershed restoration program was needed to restore aquatic habitat, particularly in the short term. The Assessment Team assumed that all the alternatives except Alternative 7 would include similar levels of watershed restoration. Among alternatives, matrix management prescriptions were weighted according to the amount of area in the matrix and required management guidelines such as length of harvest rotation and green-tree retention. The more restrictive the green-tree retention requirements, and/or the longer the rotation, the greater the contribution to the rating.

Effects of Alternatives

The assessments of the alternatives on the seven assessed races/species/groups are displayed in Table 3&4-34. The seven were further categorized into two groups to facilitate displaying effects: (1) anadromous and resident salmonids and (2) bull trout. The anadromous and resident salmonids category is an average of the six races/species/groups other than bull trout (Table 3&4-35). Alternatives 1 and 4 have an 80 percent or higher likelihood of attaining sufficient habitat to support widely-distributed populations for all races/species/groups on federal lands throughout the range of the northern spotted owl (Table 3&4-35).

All seven of the seven races/species/groups of fish evaluated were selected for additional analysis (Appendix B11). All seven are shaded in Table 3&4-34 to indicate that they were reviewed during the additional analysis. Of the seven races/species/groups evaluated, six were selected for additional analysis based on both their initial rating from the FEMAT Report and on the likelihood of negative effects from nonfederal habitat management. The seventh, bull trout, was selected for additional analysis based on the potential for cumulative effects.

Incorporating Riparian Reserve Scenario 1 into Alternative 9 is expected to reduce the long-term risk to aquatic and riparian habitat outside of Tier 1 Key Watersheds. Including this standard and guideline in Alternative 9 would result in an 80 percent or greater likelihood of providing sufficient aquatic habitat to support stable, well-distributed populations of the seven salmonid races/species/groups evaluated. Alternative 9 already had an 85 percent likelihood of providing habitat of sufficient quality, distribution and abundance for bull trout. Incorporating this standard and guideline in Alternative 9 will benefit fish stocks in the coastal basins. The stocks receiving the most benefits occur in the coastal basins within the Franciscan, Washington/Oregon Coast Range, and Olympic Peninsula Aquatic Physiographic Provinces (Figure 3&4-1). The benefits are notable for these provinces because of the large number of at-risk anadromous fish stocks (Table B6-2), large areas of unstable land, and a lower proportion of land within Key Watersheds compared to the rest of the range of the northern spotted owl. The relatively high likelihood for these alternatives is a factor of the large amount of area in reserves and application of the Riparian Reserve Scenario 1 strategy to all federal lands within the range of the northern spotted owl.

Table 3&4-34. Projected future likelihood for fish habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 2				Alternative 3				Alternative 4				Alternative 5			
Fish	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Coho Salmon	80	15	5	0	70	20	10	0	65	25	10	0	80	15	5	0	65	25	10	0
Fall Chinook Salmon	85	15	0	0	75	20	5	0	70	25	5	0	80	15	5	0	70	20	10	0
Spring Chinook Salmon/ Summer Steelhead Trout	85	15	0	0	75	20	5	0	70	25	5	0	80	15	5	0	70	20	10	0
Winter Steelhead Trout	80	15	5	0	70	20	10	0	65	25	10	0	80	15	5	0	65	25	10	0
Sea-Run Cutthroat Trout	80	15	5	0	70	20	10	0	65	25	15	0	80	15	5	0	65	25	10	0
Resident Rainbow/Cutthroat Trout	80	20	0	0	70	20	10	0	60	25	15	0	80	15	5	0	60	25	15	0
Bull Trout	90	10	0	0	85	15	0	0	85	15	0	0	85	15	0	0	85	15	0	0

	Alternative 6				Alternative 7				Alternative 8				Alternative 9				Alternative 10			
Fish	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Coho Salmon	65	25	10	0	10	20	50	20	20	30	40	10	65	20	15	0	65	25	10	0
Fall Chinook Salmon	70	25	5	0	15	25	45	15	30	35	35	0	65	25	10	0	70	25	5	0
Spring Chinook Salmon/ Summer Steelhead Trout	70	25	5	0	15	25	45	15	30	35	35	0	65	25	10	0	70	25	5	0
Winter Steelhead Trout	65	25	10	0	10	20	50	20	25	30	35	10	65	25	10	0	65	25	10	0
Sea-Run Cutthroat Trout	65	25	10	0	10	15	45	30	25	25	45	10	65	25	15	0	65	25	15	0
Resident Rainbow/Cutthroat Trout	60	25	15	0	10	15	45	30	20	25	45	10	60	25	15	0	60	25	15	0
Bull Trout	85	15	0	0	35	35	20	10	45	25	25	5	85	15	0	0	85	15	0	0

A-Well Distributed B-Locally Restricted C-Restricted to Refugia D-Risk of Extirpation

Note: Likelihood for Alternatives 2,6 and 10 are internal assessments by the assessment team; these alternatives were not by export panels.

Likelihood values are expressed as percentages that total to 100 for a given species within an Alternative. Number displayed may vary due to rounding errors. The Species shown in the shaded portion of the table are those that were specifically considered when additional standards are guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the standards and guidelines. The ratings shown in the table have not been changed to reflect these additions to Alternative 9. See text for fuller explanation and discussion of the rating scale and for discussion of the additional species analysis under Alternative 9.

Table 3&4-35. Average of outcomes for Outcome A for anadromous and resident salmonids. The races/species/groups included in this average are coho salmon, fall chinook salmon, spring chinook salmon/summer steelhead trout, winter steelhead trout, sea-run cutthroat trout, and resident rainbow and cutthroat trout. The discussion of effects is based on the average of these six and referred to as anadromous and resident salmonids in the text.

	Alternative									
	1	2	3	4	5	6	7	8	9	10
Anadromous and resident salmonids	82	72	66	80	66	66	12	25	64	66

The 80 percent or higher likelihood of attaining aquatic habitat of sufficient quality, distribution and abundance on federal land for each of the seven salmonid races/species/groups evaluated for Alternatives 1, 4, and 9 results from combining lower timber harvest levels with wider prescribed Riparian Reserve widths on intermittent streams in Tier 2 Key Watersheds and non-Key Watersheds. For example, Alternative 5 received a 65 percent likelihood of attaining sufficient aquatic habitat to support well-distributed populations of anadromous and resident salmonids while Alternatives 1, and 4 and Alternative 9 which includes the standard and guidelines incorporated since the Draft SEIS received a greater than 80 percent likelihood of achieving the same outcome for the evaluated salmonids.

These outcomes, in part, reflect the amount of land designated as matrix. The potential effects from timber harvest relate to the amount of land allocated to the matrix. Alternative 5 designates 2.0 times more acres in matrix than Alternative 1, 1.3 times more acres than Alternative 4, and 1.4 times more acres than Alternative 9. Under Alternative 5, 32 percent of the remaining late-successional forest occurs in the matrix, compared to nearly zero percent in Alternative 1. Alternatives 1, and 4 and Alternative 9 which includes the standard and guidelines incorporated since the Draft SEIS, had higher likelihood of attaining sufficient aquatic habitat to support well-distributed populations of anadromous and resident salmonids than the other alternatives due to the inclusion of Riparian Reserve Scenario 1 for all intermittent streams outside of Tier 1 Key Watersheds. Additionally, Riparian Reserve Scenario 2 is applied to all intermittent streams outside of Tier 1 Key Watersheds in Alternatives 2, 3, 5, 6 and 10. The narrower widths on intermittent streams under Riparian Reserve Scenario 2 compared to Scenario 1 increase the risks to these streams due to management-induced disturbances. This difference is reflected in the outcomes displayed in Table 3&4-35, except for Alternative 9 which would have at least an 80 percent or higher likelihood of attaining sufficient aquatic habitat to support well-distributed populations of anadromous and resident salmonids because this alternative now includes Riparian Reserve Scenario 1.

The primary difference between Riparian Reserve Scenarios 1 and 2 is the prescribed width required for Riparian Reserves on intermittent streams in Tier 2 Key Watersheds and non-Key Watersheds. Under both scenarios, the prescribed widths for intermittent streams in Tier 1 Key Watersheds are equal to the height of one site-potential tree. Prescribed Riparian Reserves widths for these streams in Tier 2 Key Watersheds and non-Key Watersheds are delineated using widths equal to the height of one site-potential tree in Riparian Reserve Scenario 1, and equal to half the height of a site-potential tree in Riparian Reserve Scenario 2. In non-Key Watersheds, management activities can proceed outside Riparian Reserves before conducting a watershed analysis, thus the risk to aquatic and riparian habitat is, in part, determined by the prescribed width of these reserves.

Alternatives 2, 3, 5, 6, 9, and 10 generally had a 60 to 70 percent likelihood of attaining sufficient aquatic habitat to support well-distributed populations of the seven races/species/groups of anadromous and resident salmonids evaluated (Table 3&4-35). Alternative 9, with the standards and guidelines incorporated since the Draft SEIS, would have at least an 80 percent or higher likelihood of attaining sufficient aquatic habitat to support well-distributed populations of anadromous and resident salmonids. Alternatives 2, 3, 5, 6, and 10 had a lower likelihood of attaining sufficient aquatic habitat to support well-distributed populations of anadromous and resident fish than Alternatives 1, 4, and 9. The lower likelihoods for attaining sufficient aquatic habitat to support well-distributed populations is due to less area designated as reserves (Table 2-3) and the application of Riparian Reserve Scenario 2, which has prescribed Riparian Reserve widths equal to half the height of a site-potential tree in intermittent streams outside Tier 1 Key Watersheds.

The likelihood of attaining sufficient aquatic habitat to support well-distributed populations for bull trout was 85 percent in Alternatives 2, 3, 4, 5, 6, 9, and 10. As far as the Assessment Team could discern from available distribution maps, the vast majority of, if not all, bull trout habitat on federal land within the range of the northern spotted owl occurred within Tier 1 Key Watersheds. The high level of protection provided by Riparian Reserve Scenario 1, the high proportion of other reserves within Key Watersheds, and the standards and guidelines specific to Key Watersheds resulted in a high level of protection for bull trout habitat. The additional standards and guidelines added to Alternative 9 (Appendix B11) would reduce the risk of cumulative effects from management-induced disturbances in areas outside the Tier 1 Key Watersheds where the bull trout occur. The standards and guidelines would result in at least an 85 percent likelihood of attaining sufficient aquatic habitat to support well-distributed populations for bull trout.

Resident rainbow and cutthroat trout had a 60 percent likelihood of attaining sufficient aquatic habitat to support well-distributed populations of resident salmonids under Alternatives 2, 3, 5, 6, and 10 (Table 3&4-34). These fish inhabit small, headwater streams. Incorporating Riparian Reserve Scenario 1 into the standards and guidelines for Alternative 9 would achieve an 80 percent or higher likelihood of attaining sufficient aquatic habitat to support well-distributed populations of resident salmonids. The Assessment Team believed that the prescribed Riparian Reserve Scenario 2 boundaries outside Tier 1 Key

Watersheds for Alternatives 2, 3, 5, 6, and 10 would reduce the level of protection for the habitat of these fish. It is likely that habitats of other fish found in these streams, such as many of the sculpins and longnose dace, would be similarly affected by these alternatives.

The likelihood of achieving sufficient aquatic habitat to support well-distributed populations of the seven races/species/groups of anadromous and resident salmonids for fish habitat is lower for Alternatives 2, 3, 5, 6, and 10 than for Alternatives 1, 4, and 9. However the Assessment Team believed that all the alternatives except Alternatives 7 and 8 would reverse the trend of degradation and begin the recovery of aquatic ecosystems and fish habitat on federal lands within the range of the northern spotted owl. Even if changes in land management practices and comprehensive restoration are initiated, it is possible that no alternative would completely recover all degraded aquatic systems within the next 100 years. The likelihood of attaining a functional and interconnected late-successional and old-growth forest ecosystem in the next 100 years is reduced because some characteristics of these terrestrial ecosystems will not be obtained for at least 200 years.

Alternatives 7 and 8 had the lowest likelihoods of attaining sufficient aquatic habitat to support well-distributed populations of the seven races/species/groups of anadromous and resident salmonids. These two alternatives received higher ratings for achieving other habitat conditions with significant gaps in the species historic distribution and the species being restricted to refugia than the other alternatives (Table 3&4-34). The ratings in the categories of achieving habitat conditions with significant gaps in the species historic distribution and the species being restricted to refugia were equivalent to or higher than the ratings on the likelihood of attaining sufficient aquatic habitat to support well-distributed populations. These are also the only two alternatives that were rated as having a likelihood of attaining habitat conditions potentially resulting in the extirpation of the species from federal land. For example, the resident salmonids received a 25 percent likelihood of attaining sufficient aquatic habitat to support stable populations but with significant gaps in their historic distribution for Alternative 7. Resident salmonids also received a 30 percent likelihood of attaining habitat conditions resulting in their extirpation from federal lands under Alternative 7. The likelihood of attaining sufficient aquatic habitat to support well- distributed populations of the seven races/species/groups of anadromous and resident salmonids for Alternative 7 was between 10 and 15 percent, the exception being bull trout which was rated as having a 35 percent likelihood (Table 3&4-34).

Alternative 7 rated low primarily because of the small amount of riparian area that would receive special management consideration and the amount of activity that would be allowed in this area under current plans and draft plan preferred alternatives. It should be noted that the Assessment Teams considered these plans as a group and not as individual plans, because they varied widely. The ratings for Alternative 7 reflect this. Many individual plans stated that fish habitat would continue to degrade due to management activities, while other plans maintain existing conditions as well as direct watershed restoration. Alternative 7 does not contain the comprehensive elements of the Aquatic Conservation Strategy. For example, some current plans and draft plan preferred alternatives may have guidance for watershed restoration but it is not consistently applied and therefore, does not contribute to the restoration of watersheds on a regionwide basis.

While the likelihood of attaining sufficient aquatic habitat to support well-distributed populations of the seven races/species/groups of anadromous and resident salmonids was slightly higher for Alternative 8 than for Alternative 7, it was notably less than for the other alternatives. For Alternative 8, the likelihood of attaining sufficient aquatic habitat to support well-distributed populations of the seven races/species/groups of anadromous and resident salmonids ranged from 20 to 25 percent for all groups except bull trout, which rated at a 45 percent likelihood. Alternative 8 has a lower likelihood of attaining sufficient aquatic habitat to support well-distributed populations of the seven races/species/groups of anadromous and resident salmonids than all alternatives except Alternative 7. The principal reasons are the reduced size of Riparian Reserves for non fish-bearing perennial streams and for intermittent streams.

The Aquatic Conservation Strategy would reverse the trend of aquatic and riparian habitat degradation and begin recovery of these habitats on federal lands for all alternatives except Alternatives 7 and 8. The recovery of aquatic habitats on federal lands would be greater for Alternatives 1, 4, and 9 than for Alternatives 2, 3, 5, 6, and 10 based on the results of the assessment outcomes pertaining to fish and other riparian-dependent species.

Possible Mitigation Measures

Earlier in this chapter, the section titled "Range of Mitigation Measures Considered" lists the mitigation measures developed during the additional species analysis. Appendix B11 lists the measures incorporated as standards and guidelines into Alternative 9. Three mitigation measures were developed during the additional species analysis to protect Key Watersheds and inventoried roadless areas but were not incorporated into the alternatives. These measures propose to: (1) designate all Tier 1 Key Watersheds as Late-Successional Reserves; (2) prohibit constructing new roads in Tier 1 Key Watersheds; and (3) designate all inventoried roadless areas as Late-Successional Reserves. These measures would provide additional benefits to aquatic and riparian-dependent species by decreasing risks from management-related disturbances in Key Watersheds and roadless areas. This would particularly benefit the at-risk anadromous fish stocks. The benefits accrue due to ensuring that the refugia system established by Key Watersheds and high quality habitat contained within roadless areas is subjected to limited disturbance from timber harvest and related activities (e.g., road and landing construction). The measures would be particularly valuable in the short term, since the relatively small amount of high quality habitat remaining is predominantly found in Key Watersheds and within inventoried roadless areas. These measures would strengthen the integrity of the refugia system contained within Key Watersheds and roadless areas.

The proposed mitigation measures to designate Tier 1 Key Watersheds and inventoried roadless areas would each be sufficient to increase the likelihood of attaining sufficient aquatic habitat to support well-distributed populations of the seven races/species/groups of anadromous and resident salmonids habitat to at least 80 percent for all alternatives except 7. The third strategy of prohibiting new road construction in Tier 1 Key Watersheds would benefit the seven races/species/groups but to a lesser degree than the other two proposed mitigation measures.

No mitigation measure can successfully resolve the potential risks due to nonfederal habitat management and other factors (e.g., commercial and recreational harvest) affecting fish populations within the range of the northern spotted owl.

Cumulative Effects Including the Role of Nonfederal Lands

The habitat assessment of federal habitat does not directly correspond to population viability of the species considered. This is due, in part, to impacts from nonfederal activities and activities in other habitat sectors where the species might spend a portion of their life cycles. Furthermore, with anadromous fish, there is a very limited science available to establish direct relationships between land management actions and population viability due, in part, to other impacts such as predation and artificial propagation, and the complexity of translating these impacts into population numbers.

For each of the alternatives, the Assessment Team evaluated the ability of federal lands to provide sufficient quality, distribution, and abundance of habitat to allow populations of fish species to stabilize, well distributed across federal lands. Two key points are important when considering the effects of any federal land management under each alternative on anadromous fish. First, there may be other factors such as overharvest in commercial and recreational fisheries, disease, hatchery practices, and other habitat impacts not related to timber harvest such as hydropower and irrigation developments, that have caused and will continue to affect the declines of anadromous salmonid populations. Second, a plan for managing federal lands will not necessarily correct problems on nonfederal lands, and anadromous fish are, in many cases, adversely affected by nonfederal actions.

The Aquatic Conservation Strategy is a habitat-based approach to maintaining and restoring aquatic and riparian habitats and watersheds on federal lands within the range of the northern spotted owl. The success of the strategy does not depend on actions on nonfederal lands. Many of the federal watersheds occur upstream of nonfederal watersheds. Thus, the strategy can succeed at maintaining and restoring the aquatic and riparian habitats regardless of what happens on nonfederal lands, but that would not ensure population viability of many of the fish stocks evaluated in this SEIS. This statement is less true in multiownership watersheds, particularly for lands administered by the BLM that are juxtaposed between nonfederal parcels. For these reasons, it is not possible to determine whether any of the alternatives in this SEIS would preclude listing a fish species under the Endangered Species Act.

Current state forest practices rules do not adequately protect ecological effectiveness nor provide any margin for error to accommodate natural disturbances or uncertainties in knowledge. Thus, reliance on federal lands to supply habitat for aquatic species and fish stocks will increase. Federal lands currently provide most of the highest quality water and fish habitat within the range of the northern spotted owl. Habitat conditions on private and state lands are inadequate to provide well-distributed, stabilized populations of salmonids. If measures are not taken to improve management practices on state and private lands, options for federal land management may become more limited.

The cumulative effect of implementing the Aquatic Conservation Strategy proposed in this SEIS would be that federal lands that currently provide some of the higher quality riparian and aquatic habitats to support anadromous salmonids would continue to provide these habitat elements. Many of the habitats downstream of federal lands have been degraded due to developments in floodplains and forest practices on non federal lands. All the alternatives, except Alternatives 7 and 8, are more restrictive of management activities and thus, are more protective of water quality, fish habitat, and riparian areas than state requirements. Best management practices are tactics used to protect water quality and the beneficial uses of water including fish and water-dependent wildlife on state and private lands. Oregon and Washington both have forest practices acts and regulations that include best management practices intended to protect aquatic riparian habitats. However, California Forest Practices Rules have not yet been certified as best management practices under the Clean Water Act.

Two major differences between current state requirements and proposed federal requirements are apparent. First, the states allow significant harvest within the riparian management areas. Second, the riparian protection widths are smaller in state programs. This is particularly true for intermittent and smaller perennial streams. None of the states require protection of riparian areas for intermittent streams. The proposed federal Aquatic Conservation Strategy provides protection through Riparian Reserves that are sufficient to maintain important functions of large wood delivery, leaf and particulate organic matter input, shade, riparian microclimate, slope stability and water quality.

Species Associated with Early-Successional Forests

Affected Environment

A variety of fish, wildlife, plant and invertebrate species within the range of the northern spotted owl use early-successional forests as primary habitat for breeding and/or feeding (see Brown [1985] and Thomas et al. [1979] for lists of vertebrate species within the range of the northern spotted owl and ratings of habitat quality in combinations of successional stage and forest cover type).

The amount of early-successional forest on the landscape within the range of the northern spotted owl is probably greater now than at any time in the past. Under pre-European settlement conditions, fire frequencies in the western slopes of the Cascade Range probably averaged 250 years or more (FEMAT Report, p. IV-5). Any species that find optimum habitat in burned forests must have had the dispersal and reproductive capabilities to find and reproduce in these dispersed and infrequent patches of habitat. In general, species associated with early-successional conditions are good dispersers, have high reproductive rates, and are able to persist in small patches of habitat that result from small-scale disturbance (Hunter 1990, Smith 1966). Raphael et al. (1988) estimated that in northern California about 13 percent of the land area (on average) was historically in brush or sapling condition. In contrast, about 50 percent of the land area is in that stage today.

Compared to their historic populations, species associated with these early-successional conditions have increased in abundance. For example, Raphael et al. (1988) estimated that populations of 11 species of birds have probably tripled over historic numbers, and another 4 species have more than doubled. Raphael et al. (1988) and Raphael (1988) compared the estimated abundance of amphibians, reptiles, birds, and mammals from historic times to their present abundance and concluded that the early-successional associates that have increased over time were associated with more open, drier conditions; were widely distributed (larger total geographic ranges than species associated with late-successional conditions); and, had wider ecological tolerances (i.e., they occupy a greater variety of habitat types). As noted by Harris (1984), birds associated with early-successional forest are more often migrants whereas late-successional associates are generally permanent residents. These studies also show that whereas some species associated with early-successional conditions reach their maximum abundance in early-successional forest, none of the species were restricted to that successional stage.

Plant species composition also changes with stand maturity. Early-successional stages are dominated by annual plants, whereas perennial species dominate in older stages. This, in turn, influences animals that might be associated with particular plant species. The larvae of many species of moths and butterflies, for example, are associated with particular host plants. As those plants are displaced through forest succession, the animals are displaced as well. In California, *Ceanothus velutinus* is a common shrub that occurs on burned or cutover forest. Ten different species of moths and butterflies are known to feed only on that species.

The creation of early-successional conditions as a result of logging has produced a different pattern on the landscape than the pattern that likely would have resulted solely from natural disturbance. Patches of early-successional forest are now more evenly distributed across the landscape, and sizes of patches are smaller. This pattern may have resulted in a more widespread distribution of early-successional species than in the past.

Environmental Consequences

Alternative 7 provides the greatest amount of habitat in the youngest successional stages because of the higher level of timber harvest that would occur. Alternatives 8, 9, 5, 4, 3 and 1 would provide decreasing amounts of this habitat, respectively. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7. Alternatives that provide for the greatest amount of habitat in the youngest successional stages would generally result in greater abundance of early-successional species.

Under all alternatives except Alternative 1, some existing late-successional forest will be harvested, creating early-successional habitat. In addition, there is currently additional acreage of early-successional forest intermixed in a fragmented pattern within all of the Late-Successional Reserves and Riparian Reserves on federal lands within the range of the northern spotted owl. As well, natural disturbances will continue to create early-successional conditions.

The federal forest lands occur within a broader landscape of nonfederal lands where additional early-successional forest will be created through logging and other management activity. These lands will contribute to the maintenance of early-successional forest over time.

Threatened, Endangered and Proposed Species

All federal agencies have responsibilities to further the purposes of the Endangered Species Act (ESA) in utilization of their authorities. These responsibilities include, but are not limited to: efforts to promote the conservation of listed species; provision of means to conserve the ecosystems upon which listed species are dependent; consultation with the Secretary of the Interior or Commerce on actions or commerce which may affect listed species or designated critical habitat; and conference with the appropriate Secretary on actions likely to jeopardize the continued existence of any species proposed for listing or those likely to result in destruction or adverse modification of proposed critical habitat. In accordance with these responsibilities, the BLM and Forest Service conducted Section 7 consultation with the Fish and Wildlife Service and National Marine Fisheries Service. For the purposes of this SEIS, formal consultation occurred on the preferred alternative, Alternative 9. The consultation was conducted to solicit Fish and Wildlife Service and National Marine Fisheries Service opinions as to whether Alternative 9 would be not likely to jeopardize the continued existence of any listed species or to result in the destruction or adverse modification of designated critical habitat for any listed species. The letter of concurrence from the National Marine Fisheries Service and the Biological Opinion from the Fish and Wildlife Service are included as Appendix G of this Final SEIS, as is the biological assessment. When local or province planning occurs, additional consultation will occur, as deemed appropriate.

The Forest Service and BLM NEPA documents that are being amended or supplemented by this Final SEIS contain lists and discussions of threatened, endangered, proposed, candidate and "special status" species (as determined by agency policy and direction). In this SEIS, the lists of threatened, endangered and proposed species are updated and combined.

A number of anadromous salmonid stocks that may occur within the range of the northern spotted owl are currently under status review by the National Marine Fisheries Service. These are coastal steelhead, coastal coho salmon, North and South Umpqua Rivers searun cutthroat trout and mid-Columbia River summer chinook salmon. In deciding whether to list any anadromous salmonid stocks, two key points will be considered by the National Marine Fisheries Service. First, the agency will consider factors that have caused and continue to cause the decline of salmonids such as overharvest, diseases, artificial propagation, and habitat impacts such as hydropower and irrigation developments. The second consideration will be the fact that anadromous salmonids are also heavily affected by nonfederal actions: therefore, a plan for managing federal lands of itself cannot necessarily significantly improve overall conditions for anadromous salmonids. For these reasons, implementation of any of the alternatives might not necessarily avert a listing of anadromous fishes under the Endangered Species Act.

The Fish and Wildlife Service and National Marine Fisheries Service assisted the SEIS Team in developing a list of federally listed and proposed species which may occur within the range of the northern spotted owl (Table 3&4-36). The June 1993 species list from the Fish and Wildlife Service identified nine species whose habitat use is known to include late-successional forest, or their occurrence is directly associated with such habitat. With this information, 23 of the listed and proposed species were eliminated from detailed discussion in this SEIS for one of three reasons: (1) they are not known to occur on the federal lands of the planning area, (2) they do not inhabit coniferous forests, or (3) their presence in the spotted owl's range is transitory or essentially unaffected by forest management activities. It has been determined that the alternatives considered in this Final SEIS will have no effect on these species, as noted in Table 3&4-36. The exception to this is four salmon species which are included in the narrative discussion to more completely describe the reasons for the determinations. The Fish and Wildlife Service and National Marine Fisheries Service have concurred with these determinations (Appendix G).

Listed and Proposed Species Associated with Late-Successional Forests

BALD EAGLE

Affected Environment

The northern bald eagle (*Haliaeetus leucocephalus*) is federally listed as endangered in California and threatened in Washington and Oregon. Breeding and wintering populations occur throughout the planning area and are addressed in the Pacific States Bald Eagle Recovery Plan (USDI FWS 1986). The recovery plan recommended the development of site-specific management plans to effectively manage the species, its habitat, and potential threats. These plans allow flexibility in selecting the size and shape of protection zones and management areas, based on site-specific information, including stand characteristics, known individual tolerances of birds, prevalent weather patterns, location of key use areas, and flight paths (Anthony and Isaacs 1989). Management guidelines delineated in these plans address the potential loss of habitat from timber harvest activities, the distribution goals identified in the recovery plan, and to some extent, human disturbance.

Prey of the bald eagle consists primarily of fish during the breeding season and waterfowl or carrion during the fall and winter. As a result, the eagle's foraging is closely tied to water habitats and the species would benefit from management that would maintain and improve these habitats. However, bald eagles nest in forested habitats, and nests are often in old-growth forests or

Table 3&4-36. Federally listed threatened, endangered and proposed species which may occur within the range of the northern spotted owl on National Forests and BLM Districts included in this analysis

Status	Occurrence	Important Habitat Needs	Crit. Hab.[1]	Det.[2]
Endangered				
Brown Pelican *(Pelecanus occidentalis)*	Documented on Siuslaw NF and Salem BLM District.	Beaches and offshore islands.	No	No[2,3]
American Peregrine Falcon *(Falco peregrinus anatum)*	Throughout planning area.	Cliffs/bluffs with suitable nesting ledges, prey base important year-round.	No	Yes
Northern Bald Eagle (CA) *(Haliaeetus leucocephalus)*	Throughout planning area.	Nests and roosts in large old-growth trees near water.	No	Yes
Gray Wolf *(Canis lupus)*	Documented on Gifford Pinchot, Mt. Baker-Snoqualmie, Wenatchee, and Okanogan NFs; unverified sightings in Oregon Cascades and Rogue River areas.	Many habitat types uses; prey base and seclusion important.	No	Yes
Point Arena Mountain Beaver *(Aplodontia rufa nigra)*	Mendocino County, CA; not known on federal lands.	Coastal scrub, coniferous forest, riparian and stabilized dunes.	No	No[1]
Columbian White-tailed Deer *(Odocoileus virginianus leucurus)*	Roseburg BLM District, other lands outside planning area.	Riparian habitat in coniferous forests; oak woodland/grassland.	No	Yes
Shortnose Sucker *(Chasmistes brevirostris)*	Documented on Winema NF and Klamath Falls BLM Resource Area, suspected on Klamath NF.	Aquatic	No	Yes
Lost River Sucker *(Deltistes luxatus)*	Documented on Winema NF and on Klamath Falls BLM Resource Area.	Aquatic	No	Yes
Snake River Sockeye Salmon *(Oncorhynchus nerka)*	Columbia River through planning area.	Aquatic	No	No[3]
Leatherback Sea Turtle *(Dermochelys coriacea)*	Ocean adjacent to planning area.	Ocean	No	No[1,2,3]
Shasta Crayfish *(Paciasfastacus fortis)*	Documented on Lassen and Shasta-Trinity NFs.	Aquatic	No	No[3]
California Freshwater Shrimp *(Syncaris pacifica)*	Does not occur on Forest Service or BLM lands.	Aquatic	No	No[1]
Myrtle's Silverspot Butterfly *(Speyeria zerene myrtleae)*	Does not occur on Forest Service or BLM lands.		No	No[1]
Lotis Blue Butterfly *(Incisalia mossii bayensis)*	Does not occur on Forest Service or BLM lands.		No	No[1]
MacDonald's Rockcress *(Arabis macdonaldiana)*	Documented on Arcata BLM Resource Area; suspected on Six Rivers NF.	Serpentine soils	No	Yes

Table 3&4-36. (continued)

Status	Occurrence	Important Habitat Needs	Crit. Hab.[1]	Det.[2]
Bradshaw's Lomatium *(Lomatium bradshawii)*	Willamette Valley, OR. Documented on Eugene BLM District, FWS (Finley NWR), Army Corps of Eng. (Fern Ridge Reserve), City of Eugene, private.	Wet prairies	No	$No_{2,3}$
Threatened				
Northern Bald Eagle (OR, WA) *(Haliaeetus leucocephalus)*	All lands in planning area.	Nests and roosts in large old trees near water.	No	Yes
Aleutian Canada Goose *(Branta canadensis leucopareia)*	Documented on Siuslaw NF and Coos Bay BLM District.	Wintering habitat - wetlands, open areas, large bodies of water.	No	$No_{2,3}$
Northern Spotted Owl *(Strix occidentalis caurina)*	Throughout planning area.	Coniferous forests, late successional preferred.	Yes	Yes
Western Snowy Plover *(Charadrius alexandrinus novisus)*	Documented on Siuslaw NF.	Coastal dunes.	No	No_{2}
Marbled Murrelet *(Brachyramphus marmoratus)*	Documented on Mt. Baker-Snoqualmie, Olympic, Siuslaw, Siskiyou and Six Rivers NFs; Coos Bay, Salem, Eugene, Roseburg BLM Districts.	Nests on moss and lichen-covered large lateral branches of old-growth trees, generally within 50 miles of salt water.	No	Yes
Grizzly Bear *(Ursus arctos)*	Documented on Mt. Baker-Snoqualmie, Okanogan and Wenatchee NFs.	Many habitat types used; food sources, seclusion important.	No	Yes
Northern Sea Lion *(Eumetopias jubatus)*	Ocean adjacent to planning area.	Ocean	No	$No_{2,3}$
Sacramento River winter Chinook Salmon *(Oncorhynchus tshawytscha)*	Headwaters of Sacramento River.	Ocean/freshwater aquatic	No	No_{3}
Snake River spring/summer Chinook Salmon *(Oncorhynchus tshawytscha)*	Columbia River through planning area.	Ocean/freshwater aquatic	No	No_{3}
Snake River fall Chinook Salmon *(Oncoryhnchus tshawytscha)*	Columbia River through planning area.	Ocean/freshwater aquatic	No	No_{3}
Green Sea Turtle *(Chelonia mydas)*	Ocean adjacent to planning area.	Ocean	No	$No_{2,3}$
Loggerhead Sea Turtle *(Caretta caretta)*	Ocean adjacent to planning area.	Ocean	No	$No_{2,3}$
Olive Ridley Sea Turtle *(Lepidochelys olivacea)*	Ocean adjacent to planning area.	Ocean	No	$No_{2,3}$
Valley Elderberry Longhorn Beetle *(Desmocerus californicus dimorphus)*	Mendocino, Shasta-Trinity, Lassen NFs and BLM-administered lands.		No	No_{3}
Oregon Silverspot Butterfly *(Speyeria zerene hippolyta)*	Documented on Siuslaw NF.	Restricted to salt-spray meadows and adjacent forests.	Yes	Yes

Table 3&4-36. (continued)

Status	Occurrence	Important Habitat Needs	Crit. Hab.[1]	Det.[2]
Nelson's Sidalcea *(Sidalcea nelsoniana)*	Known on BLM Salem, FWS Finley NWR, private (incl. Willamette Industries timberland).	Wetlands	No	Yes
Proposed				
Oregon Chub *(Oregonichthys crameri)*	Documented in Middle Fork Willamette River drainage on Willamette NF, and in Santiam River.	Aquatic	No	Yes
Vernal Pool Fairy Shrimp *(Branchinecta lynchi)*	Does not occur on Forest Service or BLM-administered lands.	Aquatic	No	No$_1$
Vernal Pool Tadpole Shrimp *(Lepidurus packardi)*	Does not occur on Forest Service or BLM-administered lands.	Aquatic	No	No$_1$
California Linderiella *(Linderiella occidentalis)*	Does not occur on Forest Service or BLM-administered lands.	Aquatic	No	No$_1$
Conservancy Fairy Shrimp *(Branchinecta conservatio)*	Does not occur on Forest Service or BLM-administered lands.	Aquatic	No	No$_1$
Western Lily *(Lilium occidentale)*	Coastal Oregon and California; not known on federal lands.	Sphagnum bogs, coastal scrub and prairies.	No	No$_1$
Water Howellia *(Howellia aquatilis)*	Possibly extinct in OR and CA. Not known on federal lands in NSO range.	Shallow ponds.	No	No$_1$
Marsh Sandwort *(Arenaria paludicola)*	Only extant site on private land in San Luis Obispo County, CA. Historical range WA coast and central coastal CA.	Swamps and freshwater marshes.	No	No$_1$

[1] Critical Habitat = Does critical habitat for this species exist on lands administered by the Forest Service or BLM within the range of the northern spotted owl?

[2] Determination = Conclusion as to whether the alternatives may affect the species.

1 = not known to occur on the federal lands of the planning area
2 = does not inhabit coniferous forests
3 = presence in the northern spotted owl's range is transitory or unaffected by forest management

Key to Abbreviations:

NF - National Forest
BLM - Bureau of Land Management
CA - California
OR - Oregon
WA - Washington
NSO - northern spotted owl
FWS - U.S. Fish and Wildlife Service
NWR - National Wildlife Refuge

forests that possess components of old-growth forests. The eagles roost communally (usually during winter) in these same habitat types. These nesting and roosting areas are considered essential habitat features for the species.

Effects of Alternatives

Federal forest land management activities affecting the bald eagle may result from timber harvest activities, road management, recreation development, mineral exploration, grazing allotments, and increased recreation pressure and development, including off-road vehicle use (USDI FWS 1986). Effects of these activities may include loss of potential roosting or nest sites, disturbance of nesting, and loss or reduction of prey.

The Pacific Bald Eagle Recovery Plan (USDI FWS 1986) recognizes the importance of older forests in providing nesting and roosting habitat for bald eagles, and the plan restricts timber harvest in these areas. The BLM and Forest Service currently follow guidance in the recovery plan and this direction will continue. Therefore, regardless of the alternative selected, bald eagle conservation will continue. As a result, the Assessment Team concluded that bald eagles would have a 100 percent likelihood of continuing to occur well distributed on federal lands. The expected improvement in riparian habitat and water quality, which will result from all alternatives except Alternative 7, will be beneficial to bald eagle recovery by providing an increasing number of potential nest sites and an improved prey base. None of the alternatives is likely to adversely affect bald eagles.

Possible Mitigation Measures

For all the alternatives there is no mitigation identified other than continued compliance with the Pacific Bald Eagle Recovery Plan.

Cumulative Effects Including the Role of Nonfederal Lands

The Assessment Team determined that 42 percent of the bald eagle's range in the planning area is on federal lands. Bald eagles are protected from take on nonfederal lands under the Endangered Species Act; therefore, nonfederal land management should provide for protection in addition to that conferred by federal lands under any of the alternatives.

Oregon Chub

Affected Environment

The Oregon chub (*Oregonichthys crameri*) was proposed as endangered on November 19, 1990. The Oregon chub is a small cyprinid fish that formerly inhabited sloughs, overflow ponds, and other slackwater habitats throughout the Willamette River in Oregon. Remaining populations are primarily restricted to a 30-kilometer stretch of the Middle Fork Willamette River drainage, just 2 percent of its historical range. New populations have been found on the Santiam River and Fish and Wildlife Service easement property. Existing populations are potentially threatened by: (1) direct mortality from chemical spills or applications adjacent to habitat; (2) competition with, or predation by, nonindigenous fishes; and (3) continued loss and physiochemical alterations of habitat.

Effects of Alternatives

Adoption of any of the alternatives is not likely to adversely affect the Oregon chub. This is due to the fact that management direction would not change from established direction which is to continue development of the current management plan for the Oregon chub. The alternatives will result in improved water quality, except for Alternative 7 which would provide less riparian protection and would result in poorer water quality than the other alternatives. Primary concerns for the species, such as chemical spills and effects of nonnative fish, are unrelated to forest management.

Cumulative Effects Including Role of Nonfederal Lands

Management of nonfederal lands and cumulative effects are affecting this species, which cannot be altered by federal land management. The decline of the Oregon chub is attributed to the loss of its backwater habitat through construction of flood control projects which eliminated much of the Willamette River's braided channel. The population effects of the introduction of nonindigenous species (e.g., bass, crappie, mosquito fish) may have exacerbated the species' decline and may limit the potential for the Oregon chub to expand beyond its present restricted range (USDI FWS 1993). Other effects occur from chemical spills or applications adjacent to existing habitat.

Northern Spotted Owl

Affected Environment

The northern spotted owl (*Strix occidentalis caurina*) was listed as a threatened species effective July 23, 1990 (55 FR 26114). An expected reduction in numbers of owls as a result of the continuing decline in the amount of nesting habitat (primarily old-growth forests) was the primary reason for listing (USDI 1992). Critical habitat for the spotted owl was designated effective February 14, 1992 (57 FR 1796). Detailed accounts of the taxonomy, biology, and habitat of the spotted owl are found in the *Final Draft Recovery Plan for the Northern Spotted Owl* (USDI unpub.), the *Draft Recovery Plan for the Northern Spotted Owl* (USDI 1992), the *Report of the Interagency Scientific Committee* (Thomas et al. 1990), the 1989 *Status Review Supplement* (USDI FWS 1989), the Fish and Wildlife Service *Status Reviews* (USDI FWS 1987, 1990a), and the above-mentioned Federal Register notices.

Extensive studies of the owl during the last 20 years have shown it to be strongly associated with late-successional forests throughout much of its range. In northern California and on the east slope of the Cascade Range in Washington, the spotted owl is also fairly common in some types of relatively young forest, especially where those forests are structurally similar to older forests, or where patches of older forest remain within a matrix of younger stands. On lands administered by the Forest Service and BLM outside of Wilderness, late-successional and old-growth forests are typically highly fragmented by past logging, resulting in a mosaic of stands of younger trees and older stands. Late-successional and old-growth forests in Congressionally Reserved Areas tend to occur in larger blocks, but even in these areas there is considerable natural fragmentation of older stands due to historical disturbance patterns and poor growth conditions. On private and state lands, late-successional and old-growth forests tend to occur in small patches surrounded by cutover areas and young stands. In areas where little federal land is present, such as the Washington Western Lowlands Province, old-growth forests have been largely eliminated by harvest (see Cumulative Effects Including the Role of Nonfederal Lands below).

Approximately 20.6 million acres of federal forest acres occur within the range of the northern spotted owl (Table 3&4-37). Of this total, an estimated 7.4 million acres are considered suitable habitat for the northern spotted owl (Table 3&4-38). Suitable habitat (also referred to as nesting, roosting, and foraging habitat) for the northern spotted owl is defined as an area of forest vegetation with the age class, species of trees, structure, sufficient area, and adequate food source to meet some or all of the life needs of the northern spotted owl (USDA FS 1992).

Northern spotted owls nest in cavities or platforms in trees. They feed on a variety of forest mammals, birds, and insects. They are long-lived, territorial birds, often spending their entire adult life in the same territory. In high quality habitat, pairs are typically spaced about 1 to 2 miles apart.

Data summarized by the USDI Northern Spotted Owl Recovery Team indicated that spotted owls were located at approximately 4,600 sites on all land ownerships between 1987 and 1991. This data included confirmed pairs at 3,602 sites, and territorial single owls at 957 sites. The actual population is undoubtedly larger than the number of individuals confirmed, because a significant portion of the range of the owl has yet to be surveyed (USDI unpub.). Although the majority of spotted owls occur on federal lands, significant numbers also occur on private lands, especially in northwestern California.

Spotted Owl Demography

Researchers have been monitoring northern spotted owl populations for almost a decade. Their data have been gathered from a network of study areas located across much of the northern spotted owl's range. These demographic studies consist of marking spotted owls with identification tags, then periodically revisiting the study area to resight the marked owls to determine whether they have survived. Data from these visits are analyzed for each study area, and data from all study areas are analyzed together in what is called a "meta-analysis." Overall, the results of spotted owl survey data indicate that the population levels of northern spotted owls have declined and that survival rates of adult owls have also declined.

The following pages provide a highly technical summary of the demographic study process and the results of recent analysis. Even more detail is contained in Appendix J, *Estimation of Vital Rates of the Northern Spotted Owl* by K.P. Burnham, D.R. Anderson and G.C. White. The following discussion focuses on calculations of rate of population growth. A rate of 1.0 indicates a population that is neither increasing nor decreasing; a rate greater than 1.0 indicates a population that is increasing; and a rate less than 1.0 indicates a population that is decreasing. Populations of owls have decreased in the recent past, so most of the discussion involves rates of population growth less than 1.0. Therefore, the reader should understand that population growth rates which are less than 1, for example a rate of 0.99, actually reflects a population which is declining at 1 percent per year.

Table 3&4-37. Estimated total federal acres and federal forest acres within the range of the northern spotted owl, by state and physiographic province

State/ Physiographic Province	Federal Land Acres			Federal Forest Acres *		
	Total	Congressionally Reserved Areas	Administratively Withdrawn Areas	Total	Congressionally Reserved Areas	Administratively Withdrawn Areas
Washington						
Eastern Cascades	3,470,400	1,479,400	585,800	2,495,700	986,500	409,200
Western Cascades	3,719,400	1,753,500	630,700	3,081,100	1,377,300	531,800
Western Lowlands	126,300	126,300	0	1,700	1,700	0
Olympic Peninsula	1,530,000	989,300	90,800	1,451,200	970,900	84,400
Total:	8,846,100	4,348,500	1,307,300	7,029,700	3,336,400	1,025,400
Oregon						
Klamath	2,118,900	261,300	331,800	1,956,200	225,100	298,700
Eastern Cascades	1,573,600	427,700	323,900	1,461,900	381,700	292,100
Western Cascades	4,488,100	723,700	547,700	4,235,900	662,600	518,700
Coast Range	1,411,900	23,800	76,600	1,351,200	22,000	47,900
Willamette Valley	26,200	8,700	200	16,700	0	200
Total:	9,618,700	1,445,200	1,280,200	9,021,900	1,291,400	1,157,600
California						
Coast Range	471,300	189,500	95,800	272,100	163,400	45,100
Klamath	4,511,700	1,291,200	1,176,000	3,595,400	1,024,000	938,700
Cascades	1,007,500	46,200	209,900	730,700	18,500	144,200
Total:	5,990,500	1,526,900	1,481,700	4,598,200	1,205,900	1,128,000
3 State Total:	24,455,300	7,320,600	4,069,200	20,649,800	5,833,700	3,311,000

* Acre values for Forest Service, Bureau of Land Management, and National Park Service administered lands only.

Table 3&4-38. Allocation of acres of habitat for northern spotted owls and marbled murrelets on federal lands by Alternative 1

Physiographic Province	Total Acres Spotted Owl NRF* Habitat	Total Acres Marbled Murrelet Nesting Habitat	Congressionally Reserved Areas: Spotted Owl NRF* Habitat	Congressionally Reserved Areas: Marbled Murrelet Nesting Habitat	Administratively Withdrawn Areas: Spotted Owl NRF* Habitat	Administratively Withdrawn Areas: Marbled Murrelet Nesting Habitat	Acres of Spotted Owl NRF* Habitat in: Late-Successional Reserves	Acres of Spotted Owl NRF* Habitat in: Managed Late-Successional Areas	Acres of Spotted Owl NRF* Habitat in: Riparian Reserves	Acres of Spotted Owl NRF* Habitat in: Matrix	Acres of Marbled Murrelet Nesting Habitat in: Late-Successional Reserves	Acres of Marbled Murrelet Nesting Habitat in: Managed Late-Successional Areas	Acres of Marbled Murrelet Nesting Habitat in: Riparian Reserves	Acres of Marbled Murrelet Nesting Habitat in: Matrix
Washington														
Eastern Cascades	712,400	6,600	213,500	3,300	15,000	0	400,100	0	32,500	51,300	3,300	0	0	0
Western Cascades	1,114,000	363,100	345,200	122,100	32,300	10,100	654,400	0	32,300	49,700	204,100	0	8,000	18,800
Western Lowland:	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olympic Peninsul:	564,000	608,500	341,300	396,700	700	900	212,700	0	4,700	4,600	186,400	0	12,400	12,100
Total:	2,390,400	978,200	900,000	522,100	48,000	11,000	1,267,200	0	69,500	105,600	393,800	0	20,400	30,900
Oregon														
Klamath	799,000	522,700	75,100	70,900	7,200	5,500	658,400	0	25,200	33,100	407,700	0	17,700	20,800
Eastern Cascades	443,200	0	102,800	0	15,700	0	245,700	0	28,000	50,900	0	0	0	0
Western Cascades	2,072,800	1,100	243,800	0	25,000	0	1,508,100	0	127,400	168,500	1,100	0	0	0
Coast Range	539,400	441,000	13,000	13,000	500	400	477,000	0	27,200	21,800	398,300	0	17,800	11,500
Willamette Valley	6,000	600	0	0	0	0	3,100	0	1,300	1,500	600	0	0	0
Total:	3,860,400	965,400	434,700	83,900	48,400	5,900	2,892,300	0	209,100	275,800	807,700	0	35,500	32,300
California		√												
Coast range	7,700	20,200	1,300	1,700	200	100	5,900	0	100	200	15,700	0	900	1,800
Klamath	1,075,500	588,400	310,900	132,200	4,000	2,300	736,300	0	10,400	13,900	444,600	0	3,900	5,500
Cascades	75,500	0	1,000	0	1,600	0	66,900	0	2,500	3,500	0	0	0	0
Total:	1,158,700	608,600	313,200	133,900	5,800	2,400	809,100	0	13,000	17,600	460,300	0	4,800	7,300
Three-State Total:	7,409,500	2,552,200	1,647,900	739,900	102,200	19,300	4,968,600	0	291,600	399,000	1,661,800	0	60,700	70,500

* NRF = Nesting, roosting, and foraging

Table 3&4-38. (continued) Alternative 2

Physiographic Province	Total Acres Spotted Owl NRF* Habitat	Total Acres Marbled Murrelet Nesting Habitat	Congressionally Reserved Areas: Spotted Owl NRF* Habitat	Congressionally Reserved Areas: Marbled Murrelet Nesting Habitat	Administratively Withdrawn Areas: Spotted Owl NRF* Habitat	Administratively Withdrawn Areas: Marbled Murrelet Nesting Habitat	Acres of Spotted Owl NRF* Habitat in: Late-Successional Reserves	Managed Late-Successional Areas	Riparian Reserves	Matrix	Acres of Marbled Murrelet Nesting Habitat in: Late-Successional Reserves	Managed Late-Successional Areas	Riparian Reserves	Matrix
Washington														
Eastern Cascades	712,400	6,600	213,500	3,300	24,400	0	350,200	0	38,800	85,500	3,300	0	0	0
Western Cascades	1,114,000	363,100	345,200	122,100	54,700	17,500	586,800	0	43,300	84,000	178,500	0	11,900	33,300
Western Lowland:	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olympic Peninsul:	564,000	608,500	341,300	396,700	900	1,000	210,500	0	5,000	6,300	183,900	0	11,900	15,000
Total:	2,390,400	978,200	900,000	522,100	80,000	18,500	1,147,500	0	87,100	175,800	365,700	0	23,800	48,300
Oregon														
Klamath	799,000	522,700	75,100	70,900	12,000	9,100	468,800	0	72,900	170,200	326,800	0	41,600	74,300
Eastern Cascades	443,200	0	102,800	0	22,400	0	221,600	0	25,800	70,600	0	0	0	0
Western Cascades	2,072,800	1,100	243,800	0	45,500	0	1,213,800	0	193,600	376,100	900	0	100	100
Coast Range	539,400	441,000	13,000	13,000	1,500	1,300	404,400	0	47,300	73,300	338,700	0	35,100	52,900
Willamette Valley	6,000	600	0	0	0	0	1,600	0	1,600	2,700	400	0	100	100
Total:	3,860,400	965,400	434,700	83,900	81,400	10,400	2,310,200	0	341,200	692,900	666,800	0	76,900	127,400
California														
Coast range	7,700	20,200	1,300	1,700	300	300	2,900	0	1,200	2,000	13,300	0	1,500	3,400
Klamath	1,075,500	588,400	310,900	132,200	89,900	60,100	474,000	0	75,000	125,700	284,300	0	40,500	71,300
Cascades	75,500	0	1,000	0	4,700	0	50,900	0	5,800	13,200	0	0	0	0
Total:	1,158,700	608,600	313,200	133,900	94,900	60,400	527,800	0	82,000	140,900	297,600	0	42,000	74,700
Three-State Total	7,409,500	2,552,200	1,647,900	739,900	256,300	89,300	3,985,500	0	510,300	1,009,600	1,330,100	0	142,700	250,400

* NRF = Nesting, roosting, and foraging

Table 3&4-38. (continued) Alternative 3

Physiographic Province	Total Acres Spotted Owl NRF* Habitat	Total Acres Marbled Murrelet Nesting Habitat	Congressionally Reserved Areas: Spotted Owl NRF* Habitat	Congressionally Reserved Areas: Marbled Murrelet Nesting Habitat	Administratively Withdrawn Areas: Spotted Owl NRF* Habitat	Administratively Withdrawn Areas: Marbled Murrelet Nesting Habitat	Acres of Spotted Owl NRF* Habitat in: Late-Successional Reserves	Acres of Spotted Owl NRF* Habitat in: Managed Late-Successional Areas	Acres of Spotted Owl NRF* Habitat in: Riparian Reserves	Acres of Spotted Owl NRF* Habitat in: Matrix	Acres of Marbled Murrelet Nesting Habitat in: Late-Successional Reserves	Acres of Marbled Murrelet Nesting Habitat in: Managed Late-Successional Areas	Acres of Marbled Murrelet Nesting Habitat in: Riparian Reserves	Acres of Marbled Murrelet Nesting Habitat in: Matrix
Washington														
Eastern Cascades	712,400	6,600	213,500	3,300	21,800	0	221,800	154,800	31,100	69,300	2,100	1,200	0	0
Western Cascades	1,114,000	363,100	345,200	122,100	54,700	17,500	549,600	37,200	43,300	84,000	174,700	3,800	11,900	33,300
Western Lowland:	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olympic Peninsul:	564,000	608,500	341,300	396,700	900	1,000	210,500	0	5,000	6,300	183,900	0	11,900	15,000
Total:	2,390,400	978,200	900,000	522,100	77,400	18,500	981,900	192,000	79,400	159,600	360,700	5,000	23,800	48,300
Oregon														
Klamath	799,000	522,700	75,100	70,900	12,000	9,100	405,600	63,200	72,900	170,200	301,900	24,900	41,600	74,300
Eastern Cascades	443,200	0	102,800	0	21,200	0	152,900	73,600	25,200	67,500	0	0	0	0
Western Cascades	2,072,800	1,100	243,800	0	45,500	0	923,600	290,200	193,600	376,100	900	0	100	100
Coast Range	539,400	441,000	13,000	13,000	1,500	1,300	403,100	1,400	47,300	73,300	337,900	800	35,100	52,900
Willamette Valley	6,000	600	0	0	0	0	1,500	100	1,600	2,700	400	0	100	100
Total:	3,860,400	965,400	434,700	83,900	80,200	10,400	1,886,700	428,500	340,600	689,800	641,100	25,700	76,900	127,400
California														
Coast range	7,700	20,200	1,300	1,700	300	300	2,900	0	1,200	2,000	13,300	0	1,500	3,400
Klamath	1,075,500	588,400	310,900	132,200	89,900	60,100	441,000	33,100	75,000	125,700	262,800	21,400	40,500	71,300
Cascades	75,500	0	1,000	0	4,700	0	39,100	11,800	5,800	13,200	0	0	0	0
Total:	1,158,700	608,600	313,200	133,900	94,900	60,400	483,000	44,900	82,000	140,900	276,100	21,400	42,000	74,700
Three-State Total	7,409,500	2,552,200	1,647,900	739,900	252,500	89,300	3,351,600	665,400	502,000	990,300	1,277,900	52,100	142,700	250,400

* NRF = Nesting, roosting, and foraging

Table 3&4-38. (continued) Alternative 4

Physiographic Province	Total Acres Spotted Owl NRF* Habitat	Total Acres Marbled Murrelet Nesting Habitat	Congressionally Reserved Areas: Spotted Owl NRF* Habitat	Congressionally Reserved Areas: Marbled Murrelet Nesting Habitat	Administratively Withdrawn Areas: Spotted Owl NRF* Habitat	Administratively Withdrawn Areas: Marbled Murrelet Nesting Habitat	Acres of Spotted Owl NRF* Habitat in: Late-Successional Reserves**	Acres of Spotted Owl NRF* Habitat in: Managed Late-Successional Areas	Acres of Spotted Owl NRF* Habitat in: Riparian Reserves	Acres of Spotted Owl NRF* Habitat in: Matrix	Acres of Marbled Murrelet Nesting Habitat in: Late-Successional Reserves**	Acres of Marbled Murrelet Nesting Habitat in: Managed Late-Successional Areas	Acres of Marbled Murrelet Nesting Habitat in: Riparian Reserves	Acres of Marbled Murrelet Nesting Habitat in: Matrix
Washington														
Eastern Cascades	712,400	6,600	213,500	3,300	19,900	0	354,800	29,200	33,800	61,300	3,300	0	0	0
Western Cascades	1,114,000	363,100	345,200	122,100	50,200	13,800	570,900	22,200	53,600	71,700	180,800	12,100	10,800	23,600
Western Lowland:	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olympic Peninsul:	564,000	608,500	341,300	396,700	600	600	213,200	0	4,500	4,400	187,800	0	11,900	11,600
Total:	2,390,400	978,200	900,000	522,100	70,700	14,400	1,138,900	51,400	91,900	137,400	371,900	12,100	22,700	35,200
Oregon														
Klamath	799,000	522,700	75,100	70,900	16,900	12,300	435,400	7,600	97,300	166,700	311,400	3,800	49,600	74,700
Eastern Cascades	443,200	0	102,800	0	28,800	0	187,500	5,600	41,000	77,500	0	0	0	0
Western Cascades	2,072,800	1,100	243,800	0	60,700	0	989,200	0	323,400	455,600	900	0	100	100
Coast Range	539,400	441,000	13,000	13,000	1,600	1,300	419,300	7,800	47,800	50,000	350,900	6,200	34,800	35,000
Willamette Valley	6,000	600	0	0	0	0	1,500	0	2,000	2,400	400	0	100	100
Total:	3,860,400	965,400	434,700	83,900	108,000	13,600	2,032,900	21,000	511,500	752,200	663,600	10,000	84,600	109,900
California														
Coast range	7,700	20,200	1,300	1,700	300	400	3,000	0	1,300	1,700	14,600	0	1,300	2,300
Klamath	1,075,500	588,400	310,900	132,200	90,500	61,700	444,500	3,500	100,600	125,500	262,600	200	56,600	75,200
Cascades	75,500	0	1,000	0	2,400	0	57,900	0	6,200	8,000	0	0	0	0
Total:	1,158,700	608,600	313,200	133,900	93,200	62,100	505,400	3,500	108,100	135,200	277,200	200	57,900	77,500
Three-State Total	7,409,500	2,552,200	1,647,900	739,900	271,900	90,100	3,677,200	75,900	711,500	1,024,800	1,312,700	22,300	165,200	222,600

* NRF = Nesting, roosting, and foraging

Table 3&4-38. (continued Alternative 5

Physiographic Province	Total Acres Spotted Owl NRF* Habitat	Total Acres Marbled Murrelet Nesting Habitat	Congressionally Reserved Areas: Spotted Owl NRF* Habitat	Congressionally Reserved Areas: Marbled Murrelet Nesting Habitat	Administratively Withdrawn Areas: Spotted Owl NRF* Habitat	Administratively Withdrawn Areas: Marbled Murrelet Nesting Habitat	Acres of Spotted Owl NRF* Habitat in: Late-Successional Reserves**	Acres of Spotted Owl NRF* Habitat in: Managed Late-Successional Areas	Acres of Spotted Owl NRF* Habitat in: Riparian Reserves	Acres of Spotted Owl NRF* Habitat in: Matrix	Acres of Marbled Murrelet Nesting Habitat in: Late-Successional Reserves**	Acres of Marbled Murrelet Nesting Habitat in: Managed Late-Successional Areas	Acres of Marbled Murrelet Nesting Habitat in: Riparian Reserves	Acres of Marbled Murrelet Nesting Habitat in: Matrix
Washington														
Eastern Cascades	712,400	6,600	213,500	3,300	51,800	0	299,800	38,300	32,800	76,200	3,300	0	0	0
Western Cascades	1,114,000	363,100	345,200	122,100	62,600	15,200	502,100	31,900	64,500	107,700	172,200	16,200	10,200	27,200
Western Lowland:	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olympic Peninsul:	564,000	608,500	341,300	396,700	600	600	213,200	0	4,000	4,900	187,800	0	10,400	13,100
Total:	2,390,400	978,200	900,000	522,100	115,000	15,800	1,015,100	70,200	101,300	188,800	363,300	16,200	20,600	40,300
Oregon														
Klamath	799,000	522,700	75,100	70,900	24,800	16,400	378,300	16,900	93,600	210,300	284,100	9,400	51,800	90,100
Eastern Cascades	443,200	0	102,800	0	48,400	0	106,700	8,700	47,000	129,600	0	0	0	0
Western Cascades	2,072,800	1,100	243,800	0	116,500	0	630,000	600	364,400	717,600	200	600	100	200
Coast Range	539,400	441,000	13,000	13,000	1,600	1,300	376,700	49,100	38,800	60,200	320,700	36,000	28,100	42,000
Willamette Valley	6,000	600	0	0	200	0	700	0	1,900	3,200	400	0	100	100
Total:	3,860,400	965,400	434,700	83,900	191,500	17,700	1,492,400	75,300	545,700	1,120,900	605,400	46,000	80,100	132,400
California														
Coast range	7,700	20,200	1,300	1,700	300	400	3,000	0	1,100	1,900	14,600	0	1,100	2,500
Klamath	1,075,500	588,400	310,900	132,200	105,200	67,700	379,400	4,300	101,400	174,300	234,700	200	54,800	98,800
Cascades	75,500	0	1,000	0	2,700	0	54,300	300	5,300	11,800	0	0	0	0
Total:	1,158,700	608,600	313,200	133,900	108,200	68,100	436,700	4,600	107,800	188,000	249,300	200	55,900	101,300
Three-State Total	7,409,500	2,552,200	1,647,900	739,900	414,700	101,600	2,944,200	150,100	754,800	1,497,700	1,218,000	62,400	156,600	274,000

* NRF = Nesting, roosting, and foraging

Table 3&4-38. (continued) Alternatives 6 and 10

Physiographic Province	Total Acres Spotted Owl NRF* Habitat	Total Acres Marbled Murrelet Nesting Habitat	Congressionally Reserved Areas: Spotted Owl NRF* Habitat	Congressionally Reserved Areas: Marbled Murrelet Nesting Habitat	Administratively Withdrawn Areas: Spotted Owl NRF* Habitat	Administratively Withdrawn Areas: Marbled Murrelet Nesting Habitat	Acres of Spotted Owl NRF* Habitat in: Late-Successional Reserves	Acres of Spotted Owl NRF* Habitat in: Managed Late-Successional Areas	Acres of Spotted Owl NRF* Habitat in: Riparian Reserves	Acres of Spotted Owl NRF* Habitat in: Matrix	Acres of Marbled Murrelet Nesting Habitat in: Late-Successional Reserves	Acres of Marbled Murrelet Nesting Habitat in: Managed Late-Successional Areas	Acres of Marbled Murrelet Nesting Habitat in: Riparian Reserves	Acres of Marbled Murrelet Nesting Habitat in: Matrix
Washington														
Eastern Cascades	712,400	6,600	213,500	3,300	32,100	0	325,600	0	43,900	97,300	3,300	0	0	0
Western Cascades	1,114,000	363,100	345,200	122,100	74,600	20,600	529,700	0	59,200	105,200	171,600	0	13,100	35,800
Western Lowland	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olympic Peninsul	564,000	608,500	341,300	396,700	900	1,000	210,500	0	5,000	6,300	183,900	0	11,900	15,000
Total:	2,390,400	978,200	900,000	522,100	107,600	21,600	1,065,800	0	108,100	208,800	358,800	0	25,000	50,800
Oregon														
Klamath	799,000	522,700	75,100	70,900	20,700	13,400	396,900	0	89,500	216,800	297,500	0	50,100	90,800
Eastern Cascades	443,200	0	102,800	0	36,700	0	171,500	0	36,000	96,200	0	0	0	0
Western Cascades	2,072,800	1,100	243,800	0	73,100	0	896,100	0	287,000	572,800	900	0	100	100
Coast Range	539,400	441,000	13,000	13,000	1,800	1,400	402,700	0	47,700	74,200	337,800	0	35,300	53,500
Willamette Valley	6,000	600	0	0	0	0	1,500	0	1,600	2,800	400	0	100	100
Total:	3,860,400	965,400	434,700	83,900	132,300	14,800	1,868,700	0	461,800	962,800	636,600	0	85,600	144,500
California														
Coast range	7,700	20,200	1,300	1,700	300	300	2,900	0	1,200	2,000	13,300	0	1,500	3,400
Klamath	1,075,500	588,400	310,900	132,200	110,800	75,500	420,100	0	87,300	146,500	247,500	0	48,000	85,200
Cascades	75,500	0	1,000	0	5,100	0	49,600	0	6,100	13,800	0	0	0	0
Total:	1,158,700	608,600	313,200	133,900	116,200	75,800	472,600	0	94,600	162,300	260,800	0	49,500	88,600
Three-State Total	7,409,500	2,552,200	1,647,900	739,900	356,100	112,200	3,407,100	0	664,500	1,333,900	1,256,200	0	160,100	283,900

* NRF = Nesting, roosting, and foraging

Table 3&4-38. (continued) Alternative 7

Physiographic Province	Total Acres Spotted Owl NRF* Habitat	Total Acres Marbled Murrelet Nesting Habitat	Congressionally Reserved Areas: Spotted Owl NRF* Habitat	Congressionally Reserved Areas: Marbled Murrelet Nesting Habitat	Administratively Withdrawn Areas: Spotted Owl NRF* Habitat	Administratively Withdrawn Areas: Marbled Murrelet Nesting Habitat	Acres of Spotted Owl NRF* Habitat in: Late-Successional Reserves**	Acres of Spotted Owl NRF* Habitat in: Managed Late-Successional Areas	Acres of Spotted Owl NRF* Habitat in: Riparian Reserves	Acres of Spotted Owl NRF* Habitat in: Matrix	Acres of Marbled Murrelet Nesting Habitat in: Late-Successional Reserves**	Acres of Marbled Murrelet Nesting Habitat in: Managed Late-Successional Areas	Acres of Marbled Murrelet Nesting Habitat in: Riparian Reserves	Acres of Marbled Murrelet Nesting Habitat in: Matrix
Washington														
Eastern Cascades	712,400	6,600	213,500	3,300	51,800	0	299,800	38,300	7,500	101,600	3,300	0	0	0
Western Cascades	1,114,000	363,100	345,200	122,100	78,800	23,200	468,000	31,900	15,300	174,800	154,100	16,200	2,600	45,000
Western Lowland:	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olympic Peninsul:	564,000	608,500	341,300	396,700	5,500	4,100	184,600	0	2,700	29,900	163,900	0	3,700	40,100
Total:	2,390,400	978,200	900,000	522,100	136,100	27,300	952,400	70,200	25,500	306,300	321,300	16,200	6,300	85,100
Oregon														
Klamath	799,000	522,700	75,100	70,900	58,600	50,000	217,300	16,900	28,100	402,900	135,300	9,400	17,800	239,300
Eastern Cascades	443,200	0	102,800	0	48,400	0	105,400	8,700	9,900	167,900	0	0	0	0
Western Cascades	2,072,800	1,100	243,800	0	116,600	0	618,900	600	75,000	1,018,000	0	600	0	500
Coast Range	539,400	441,000	13,000	13,000	3,200	2,900	282,900	48,500	15,400	176,400	236,600	35,800	12,400	140,400
Willamette Valley	6,000	600	0	0	200	0	200	0	400	5,200	0	0	0	400
Total:	3,860,400	965,400	434,700	83,900	227,000	52,900	1,224,700	74,700	128,800	1,770,400	371,900	45,800	30,200	380,600
California														
Coast range	7,700	20,200	1,300	1,700	300	400	2,900	0	200	2,900	14,500	0	200	3,400
Klamath	1,075,500	588,400	310,900	132,200	130,300	93,000	300,400	4,300	23,500	306,200	155,000	200	14,100	193,90C
Cascades	75,500	0	1,000	0	2,700	0	54,300	300	1,300	15,900	0	0	0	0
Total:	1,158,700	608,600	313,200	133,900	133,300	93,400	357,600	4,600	25,000	325,000	169,500	200	14,300	197,300
Three-State Total	7,409,500	2,552,200	1,647,900	739,900	496,400	173,600	2,534,700	149,500	179,300	2,401,700	862,700	62,200	50,800	663,000

* NRF = Nesting, roosting, and foraging

Table 3&4-38. (continued) Alternative 8

Physiographic Province	Total Acres Spotted Owl NRF* Habitat	Total Acres Marbled Murrelet Nesting Habitat	Congressionally Reserved Areas: Spotted Owl NRF* Habitat	Congressionally Reserved Areas: Marbled Murrelet Nesting Habitat	Administratively Withdrawn Areas: Spotted Owl NRF* Habitat	Administratively Withdrawn Areas: Marbled Murrelet Nesting Habitat	Acres of Spotted Owl NRF* Habitat in: Late-Successional Reserves	Acres of Spotted Owl NRF* Habitat in: Managed Late-Successional Areas	Acres of Spotted Owl NRF* Habitat in: Riparian Reserves	Acres of Spotted Owl NRF* Habitat in: Matrix	Acres of Marbled Murrelet Nesting Habitat in: Late-Successional Reserves	Acres of Marbled Murrelet Nesting Habitat in: Managed Late-Successional Areas	Acres of Marbled Murrelet Nesting Habitat in: Riparian Reserves	Acres of Marbled Murrelet Nesting Habitat in: Matrix
Washington														
Eastern Cascades	712,400	6,600	213,500	3,300	32,100	0	325,600	0	25,500	115,700	3,300	0	0	0
Western Cascades	1,114,000	363,100	345,200	122,100	74,600	20,600	529,700	0	36,700	127,700	171,600	0	7,600	41,400
Western Lowland:	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olympic Peninsul:	564,000	608,500	341,300	396,700	900	1,000	210,500	0	3,700	7,600	183,900	0	8,900	18,000
Total:	2,390,400	978,200	900,000	522,100	107,600	21,600	1,065,800	0	65,900	251,000	358,800	0	16,500	59,400
Oregon														
Klamath	799,000	522,700	75,100	70,900	20,700	13,400	396,900	0	54,700	251,700	297,500	0	28,800	112,000
Eastern Cascades	443,200	0	102,800	0	36,700	0	171,500	0	19,600	112,600	0	0	0	0
Western Cascades	2,072,800	1,100	243,800	0	73,100	0	896,100	0	159,000	700,800	900	0	0	100
Coast Range	539,400	441,000	13,000	13,000	1,800	1,400	402,700	0	31,200	90,700	337,800	0	23,400	65,400
Willamette Valley	6,000	600	0	0	0	0	1,500	0	1,100	3,400	400	0	0	100
Total:	3,860,400	965,400	434,700	83,900	132,300	14,800	1,868,700	0	265,600	1,159,200	636,600	0	52,200	177,600
California														
Coast range	7,700	20,200	1,300	1,700	300	300	2,900	0	600	2,600	13,300	0	800	4,100
Klamath	1,075,500	588,400	310,900	132,200	110,800	75,500	420,100	0	50,900	182,900	247,500	0	28,400	104,900
Cascades	75,500	0	1,000	0	5,100	0	49,600	0	4,100	15,800	0	0	0	0
Total:	1,158,700	608,600	313,200	133,900	116,200	75,800	472,600	0	55,600	201,300	260,800	0	29,200	109,000
Three-State Total	7,409,500	2,552,200	1,647,900	739,900	356,100	112,200	3,407,100	0	387,100	1,611,500	1,256,200	0	97,900	346,000

* NRF = Nesting, roosting, and foraging

Table 3&4-38. (continued) Alternative 9

Physiographic Province	Total Acres Spotted Owl NRF* Habitat	Total Acres Marbled Murrelet Nesting Habitat	Congressionally Reserved Areas: Spotted Owl NRF* Habitat	Congressionally Reserved Areas: Marbled Murrelet Nesting Habitat	Administratively Withdrawn Areas: Spotted Owl NRF* Habitat	Administratively Withdrawn Areas: Marbled Murrelet Nesting Habitat	Acres of Spotted Owl NRF* Habitat in: Late-Successional Reserves	Acres of Spotted Owl NRF* Habitat in: Adaptive Management Areas	Acres of Spotted Owl NRF* Habitat in: Managed Late-Successional Areas	Acres of Spotted Owl NRF* Habitat in: Riparian Reserves	Acres of Spotted Owl NRF* Habitat in: Matrix	Acres of Marbled Murrelet Nesting Habitat in: Late-Successional Reserves	Acres of Marbled Murrelet Nesting Habitat in: Adaptive Management Areas	Acres of Marbled Murrelet Nesting Habitat in: Managed Late-Successional Areas	Acres of Marbled Murrelet Nesting Habitat in: Riparian Reserves	Acres of Marbled Murrelet Nesting Habitat in: Matrix
Washington																
Eastern Cascades	712,400	6,600	213,500	3,300	42,000	0	270,600	44,900	24,700	46,700	69,900	3,300	0	0	0	0
Western Cascades	1,114,000	363,100	345,200	122,100	49,300	12,300	516,400	41,700	0	70,000	91,300	182,200	4,300	0	13,900	28,400
Western Lowland	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olympic Peninsul	564,000	608,500	341,300	396,700	100	100	213,900	8,100	0	300	300	184,700	26,500	0	300	300
Total:	2,390,400	978,200	900,000	522,100	91,400	12,400	1,000,900	94,700	24,700	117,000	161,500	370,200	30,800	0	14,200	28,700
Oregon																
Klamath	799,000	522,700	75,100	70,900	13,000	11,300	377,400	72,000	0	98,600	162,800	297,700	11,500	0	51,800	79,500
Eastern Cascades	443,200	0	102,800	0	37,700	0	146,100	0	0	54,900	101,600	0	0	0	0	0
Western Cascades	2,072,800	1,100	243,800	0	86,400	0	774,000	134,100	0	335,200	499,400	400	0	0	300	400
Coast Range	539,400	441,000	13,000	13,000	1,300	1,000	422,400	13,600	0	41,400	47,800	355,000	4,500	0	31,700	35,800
Willamette Valley	6,000	600	0	0	100	0	600	100	0	2,400	2,800	400	0	0	100	100
Total:	3,860,400	965,400	434,700	83,900	138,500	12,300	1,720,500	219,800	0	532,500	814,400	653,500	16,000	0	83,900	115,800
California																
Coast range	7,700	20,200	1,300	1,700	100	300	3,300	0	0	1,300	1,600	14,400	0	0	1,400	2,400
Klamath	1,075,500	588,400	310,900	132,200	81,200	55,600	438,600	54,900	0	85,700	104,200	257,700	27,700	0	49,700	65,500
Cascades	75,500	0	1,000	0	1,900	0	51,500	6,900	4,800	4,000	5,400	0	0	0	0	0
Total:	1,158,700	608,600	313,200	133,900	83,200	55,900	493,400	61,800	4,800	91,000	111,200	272,100	27,700	0	51,100	67,900
Three-State Total	7,409,500	2,552,200	1,647,900	739,900	313,100	80,600	3,214,800	376,300	29,500	740,500	1,087,100	1,295,800	74,500	0	149,200	212,400

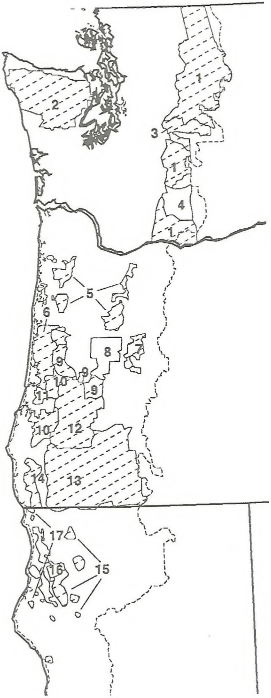
Northern spotted owl populations have been monitored in demographic studies since 1985 with 14 studies established across much of the range of the owl. Data have been analyzed for 11 study areas that were established between 1985 and 1990. The location, size and duration of these studies are shown in Figure 3&4-13 and Table 3&4-39. Data from five of these studies (Northwest California, Roseburg, Southern Cascades and Siskiyou Mountains, H.J. Andrews, and Olympic National Forest and Park) were analyzed in 1991 and presented in the *Final Draft Recovery Plan for the Northern Spotted Owl* (USDI unpub.). Results of that analysis were also reviewed in the Scientific Analysis Team Report (Thomas et al. 1993). The 1991 analysis was updated for this SEIS with 2 additional years of data (1992 and 1993) for the five areas and supplemented with data from six additional study areas. Full results of the analysis are reported in Appendix J.

Demographic studies are conducted by attaching identification bands to adult and juvenile birds, and then recording the confirmed or assumed fate of those birds through reobservations over time at selected sites. The primary parameters estimated in the analysis are: annual survival probability of adult birds; survival probability of juvenile birds for the first year following fledging; annual fecundity (defined as the number of female young fledged by each territorial female); and the overall rate of population growth for the territorial population. Estimates of these parameters were made for each of the individual study areas, and then averages were computed of fecundity, survival, and population growth rate. Radio-telemetry data derived from juvenile owls were used to correct the estimates of juvenile survival for emigration in the determination of a single overall rate of population growth. The meta-analysis was used to determine if there were time trends in survival and fecundity. In the meta-analysis, six long-term studies (those with 6 or more years of data) were separated from five shorter-term studies. Further discussion of analytical techniques is presented in Appendix J.

Results of the current analysis reiterate many of the findings reported in the *Final Draft Recovery Plan for the Northern Spotted Owl* (USDI unpub.). The estimated rate of population growth (termed "lambda"), with juvenile survival adjusted for emigration, is statistically significantly less than 1.0. A value of 1.0 would indicate a stable population. The 95 percent confidence interval for this estimate ranges from 0.9162 to 0.9934, with a midpoint at 0.9548. (This interval defines the range that would include lambda with 95 percent certainty, and any value within the range is considered equally likely). Estimated survival of adult females has continued to decline over time, and a declining trend was detected for the first time in the survival of adult females and males combined. However, this finding was restricted to the six study areas for which 6 or more years of data were available (Table 3&4-39). Because the estimated rate of population growth has been downward for the overall period of study, the estimated annual survival rate of adults has declined during that time, and there are no offsetting trends in fecundity or juvenile survival, it can be inferred that the population decline has actually accelerated.

As noted above, five study areas were part of both the current analysis and the analysis done by Anderson and Burnham and reported in the *Final Draft Recovery Plan for the Northern Spotted Owl* (USDI unpub.). If results from the two

Figure 3&4-13. Map showing the range of the northern spotted owl and the location of the 11 demographic study areas where data were made available for analysis. The study areas tend to be quite large and several are contiguous.



1. Wenatchee (NCASI)
2. Olympic Peninsula
3. Cle Elum
4. Yakima
5. Salem BLM
6. Siuslaw NF
7. H.J. Andrews
8. E.Eugene BLM
9. Eugene BLM
10. Coos Bay BLM
11. Elliot SF
12. Roseburg BLM
13. S.Cascades/Siskiyou
14. Siskiyou
15. NW California
16. Hoopa
17. Simpson

Examined in meta-analysis

Not examined in meta-analysis

Northern spotted owl range

Table 3&4-39. Summary information on 11 demographic study areas for the northern spotted owl

Study Area Location	Acronym	Approximate Size (sq. mi.)[1]	Years of Banding
Northwest California	CAL	1,000	1985-1993
Roseburg	RSB	1,700	1985-1993
Southern Cascades and Siskiyou Mountains	SCS	4,050	1985-1993
Salem BLM	SAL	1,484	1986-1993
H.J. Andrews	HJA	655	1987-1993
Olympic NF and Olympic National Park	OLY	3,150	1987-1993
Cle Elum	CLE	696	1989-1993
Eugene BLM	EUG	550	1989-1993
Coos Bay	COO	735	1990-1993
Siuslaw NF	SIU	1,050	1990-1993
Siskiyou NF	SIS	550	1990-1993

[1] Figures for northwest California, Olympic NF and Olympic National Park, Siuslaw NF, and Siskiyou NF are updated from Appendix J.

analyses were compared, it would appear that the population growth rate had increased (i.e., become closer to equilibrium) for three of the five areas and also for all of the areas combined. However, such comparisons are inappropriate because the recent analysis incorporates all the data from the previous analysis. Each additional year of data refines the estimates for all previous years. For example, the value calculated for adult survival from 1986 to 1987 in the current analysis would be refined from the value calculated for that same period in the earlier analysis. Thus, the change in the results from the 1991 analysis to the current analysis cannot be said to reflect a changed population trend in 1992 and 1993. Rather, it results from refinement of all the values that had been previously calculated. Thus, the two analyses are not independent, and the current analysis is simply a more powerful indicator of population trend than the previous estimate. Also, the rate of population growth reported for all areas combined in the current report is not comparable to that reported in 1992 because the current estimate includes additional study areas and also includes a correction for juvenile emigration.

Although strict comparison of the earlier analysis and current analysis is not appropriate, it is worth noting that juvenile survival estimates have tended to become greater as additional years of data have been collected. This apparently results from the eventual recapture on territories of banded juveniles that had not been reobserved for a number of years. It is not known if such birds left study areas and then returned to them, or simply were part of the nonterritorial population for a number of years and then became territorial. Franklin (1992) suggests that both phenomena take place. This may also partly explain why the six long-term areas (those with 6 or more years of data) are estimated to have higher juvenile survival and higher values of lambda than the five shorter-term areas (Table 3&4-40). The estimated mean rate of population growth for the long-term areas is 0.952, whereas the estimate for the shorter-term areas remains significantly lower at 0.894 ($t=2.4$; $p=0.04$). The estimate for the long-term areas is significantly less than 1 based on a simple t-test, with a 95 percent confidence interval from 0.920 to 0.984. (Note that these rates are not corrected for juvenile emigration. Such a correction would increase the values). Although this suggests that length of study has an influence on the estimates of juvenile survival, it is not a substantial proof. Other factors, such as the location of the areas and the quality of habitat, may play a role in the observed differences. If a longer study time period does result in a more accurate and higher estimate of juvenile survival, it will take several more years to determine if observed survival will continue to increase with additional years of study.

Table 3&4-40. Estimates of juvenile and adult annual survival and average annual rate of population growth on the 11 study areas

Study Area[1]	Juvenile Survival		Adult Survival		Population Growth	
	Estimate	Standard Error	Estimate	Standard Error	Estimate	Standard Error
CAL	0.330	0.043	0.868	0.012	0.9656	0.0165
RSB	0.418	0.042	0.843	0.010	0.9570	0.0146
SCS	0.320	0.038	0.824	0.009	0.9105	0.0121
SAL	0.402	0.105[2]	0.851	0.022[2]	1.0191	0.0729
HJA	0.288	0.052[2]	0.821	0.016[2]	0.9106	0.0212
OLY	0.245	0.064[2]	0.862	0.017[2]	0.9472	0.0255
CLE	0.140	0.026[2]	0.850	0.031[2]	0.9240	0.0323
EUG	0.232	0.078[2]	0.853	0.026[2]	0.9134	0.0314
COO	0.218	0.045[2]	0.862	0.019[2]	0.9274	0.0223
SIU	0.243	0.092	0.822	0.027	0.8738	0.0312
SIS	0.000	--[3]	0.830	0.045	0.8302	--[3]

[1] See Table 3&4-39 for study area names.
[2] Standard errors for these values are approximate estimates. See Appendix J for details.
[3] No theoretical standard error could be obtained for this area.

Within the overall findings, there are apparent variations that may be related to differences among the populations and the habitat conditions supporting them in various parts of the spotted owl's range. The rate of population growth for at least one study area, Salem, is not statistically different from 1, although the confidence limit around the estimate is large. Two other study areas, northwest California and Roseburg, have calculated rates of population growth greater than 0.95, and the Olympic study area has a calculated rate of growth slightly less than 0.95. It is possible that these rates, if corrected for juvenile emigration, might not be significantly different from 1. However, any inference based on an individual study area will be weaker than the inferences drawn from the combined study areas. Patterns observed for individual areas should be validated against additional knowledge that has been gained on those areas about parameters such as intensity of search effort in each year; years of particularly high or low reproduction; local rates of juvenile and adult emigration; climatic conditions during the years of study; and rates of habitat change during that period. Reports on each of the individual study areas are in preparation, and inferences about the individual studies are left to those reports.

The primary conclusions of the analysis, that the population of territorial adults is estimated to not be replacing itself and that estimates of adult survival rates have also declined, pertain to populations within the study areas during the years of the studies. Study areas now cover a substantial portion of the range of the northern spotted owl (Figure 3&4-13), therefore results of the analysis should be considered a strong indicator of general conditions in the overall population. However, there are several significant geographic areas not covered or poorly covered by this analysis, including the California Coast, the California Cascades, the Oregon Eastern Cascades, and the Washington Western Cascades Provinces. Coverage in the Oregon Western Cascades is also sparser than it is in other portions of the range, particularly in the mid-to-high elevation portion of the province. Caution should be used in expanding conclusions to those areas, particularly where there are very different habitat conditions, ownership patterns, or management regimes than in the 11 study areas.

Extrapolation of the results beyond the years of the study is not appropriate. As noted by Thomas et al. (1993), that caution is particularly strong in this case given that a substantial portion of the data was collected during a period of relatively rapid harvest of habitat. Rates of habitat loss for the five studies reported in the Draft Spotted Owl Recovery Plan (USDI 1992) were estimated between 0.9 percent and 3.1 percent per year from 1979 to 1992 (Thomas et al. 1993). The studies and results reported here simply do not allow the SEIS Team to make future projections about population trends when it is likely that conditions causing the trends will have changed. Thus, these studies do not provide a prediction of whether the population will reach equilibrium at any specified level. Additional analysis of population structure and rates of habitat modification might allow some extrapolation to the near future, but it would not be a strict statistical inference based on the studies.

As noted above, the statistical inference of these studies is based on territorial spotted owls within the study areas. However, the rate of population change estimated from these studies will not necessarily translate immediately into observable declines in territorial owls in the study areas. A portion of the owl's total population is composed of nonterritorial adult birds (termed "floaters"). Those nonterritorial birds can replace territorial birds that die or leave the study areas, and thus are believed to buffer the observable decline in territorial owls on study areas. While floaters may buffer the observable effects of population decline in territorial owls for a period of years, a true rate of population growth consistently less than 1 must eventually be reflected in actual change of the territorial population. Thus, while the rate of population growth estimated in these studies is based on territorial owls, that inference actually applies to the overall population, including both territorial and nonterritorial birds. Bart (in prep.) agrees that the model used for analysis of the demographic studies may be most appropriately interpreted as estimating trend in the total population rather than the territorial population; but argues that some analytical assumptions are not fully satisfied, resulting in a downward bias in estimated lambda. Franklin (1992) used a theoretical model to conclude that a slow decline in a spotted owl population might not be reflected in changes in density of territorial birds for as long as 15 to 25 years. Thomas et al. (1993) reported that directly observed changes in density of territorial owls were smaller than the changes estimated through the demographic studies and analysis. However, the finding of a relatively stable number of territorial owls does not necessarily conflict with a downward trend in total population, and likely reflects at least to a degree replacement of territorial owls by floaters.

The overall results of this analysis are, in many ways, not surprising. The northern spotted owl was listed as threatened because of declining habitat, with a strong inference that populations were also declining (Murphy and Noon 1992; USDI FWS 1990a). Although the loss of habitat has slowed in very recent years, some habitat loss continues. Given this history, it would be surprising if the rate of population growth of owls was equal to or greater than 1.0 with a stable population structure. In fact, under the strategies that they proposed, both the Interagency Scientific Committee (Thomas et al. 1990) and the Northern Spotted Owl Recovery Team (USDI unpub.) projected that owl habitat and owls would continue to decline for up to 50 years before reaching a new equilibrium. Thomas et al. (1993) argued that the results of the demographic studies did not provide information about if or when a new equilibrium would be reached in the owl population. However, such a prediction was not the objective of these studies.

The result from the studies that should be of most concern is the declining rate of adult survival. Evidence supporting this decline is more conclusive in the current analyses than it was in the analysis completed in 1991. This decline was not known explicitly by the Interagency Scientific Committee (ISC) (Thomas et al. 1990) when they crafted their original Conservation Strategy for northern spotted owls. It was, however, known to the Northern Spotted Owl Recovery Team (USDI unpub.); the Scientific Analysis Team (Thomas et al. 1993); and the Assessment Team (Appendix A). This knowledge argues for implementation of a relatively conservative plan for spotted owls, but it is not possible to say with certainty what specific actions should be matched to the knowledge of specific demographic results. Thomas et al. (1993) argue that the original Conservation Strategy developed by the Interagency Scientific Committee (Thomas et al. 1990) remains appropriate for the owl in light of the demographic results.

Seven of the alternatives reviewed here (1, 2, 3, 4, 5, 6, and 9) should provide significantly more benefit to northern spotted owls than did the *Final Draft Recovery Plan for the Northern Spotted Owl* (USDI unpub.) which is included in Alternative 7. The *Final Draft Recovery Plan for the Northern Spotted Owl* had represented an evolutionary step from the original ISC proposal (Thomas et al. 1990), by protecting approximately 10 percent more of the existing owl habitat and locations.

Finally, this analysis underscores the need to continue long-term demographic studies. Decisions are needed on the number, size, and location of study areas necessary to monitor the population. Most of the existing studies should be continued, and new studies may be needed in areas that are currently poorly represented. Discontinuation of any existing studies would have to be carefully justified, because these studies become most useful after demographic information has been collected for 8 to 9 years. Greater emphasis needs to be placed on consistent funding and direction for these studies, and analytical efforts must be expanded. Analysis should focus on critical questions such as the relationship between study size, study duration and results; and relationships of survival and rate of population change to habitat quality. Further work is needed to determine whether specific aspects of the design of demographic studies should be modified to better estimate rates of immigration and emigration. Radio telemetry could be used to help investigate these questions. In addition, the age distribution of floaters should be determined to better understand their role in spotted owl populations. Other related areas of research and analysis also need additional emphasis. These include alternative approaches for estimating population trends, and simulations that link population performance to habitat dynamics.

Population Viability Threshold and the "Transition Period"

All of the alternatives described in this SEIS have Late-Successional Reserve designs that are generally consistent with the underlying principles of the conservation strategy originally developed by the Interagency Scientific Committee (Thomas et al. 1990). That conservation strategy has been broadly accepted as establishing an adequate basis for long-term conservation of northern spotted owls (Carroll and Lamberson 1993, Murphy and Noon 1992, USDI unpub.). However, concerns have been raised about whether the population of northern spotted owls could survive over the short-term period until habitat conditions recover (Harrison 1992, Kareiva 1992, Orians 1992). Those concerns are based largely on the finding of declining survival rates for adult female spotted owls (USDI 1992, USDI unpub., Chapters 3&4 and Appendix J, this document). On the basis of such concerns, some have contended that an absolute moratorium on further harvest of suitable owl habitat should be imposed, at least on federal lands, for the foreseeable future. The primary concern raised is that the population of owls might either have already passed a threshold from which it can not recover, or pass such a threshold in the future due to the continued harvest of habitat during the transition period. The transition period is the term used for the period of transition of a population to a new, stable equilibrium (Thomas et al. 1993). For all of the alternatives, this will be a period during which habitat will slowly improve inside reserves while still being harvested in the matrix outside the reserves. As noted by Doak (1993), "The real question will then become not one of whether the owl population will stabilize after the transition period, but whether at that point there will be any viable owl population to stabilize." Population thresholds can be of two types: those that result from excessively small amounts of suitable habitat in the landscape, and those that result from low population densities (Thomas et al. 1993).

The assertions that the spotted owl population had passed or was about to pass a threshold were challenged by the Northern Spotted Owl Recovery Team (USDI unpub.) and Thomas et al. (1993). They argued that this conclusion could not be drawn from data collected during a period of declining habitat, and that it was unlikely that the owl population had fallen below a population threshold, except possibly in some small and isolated areas. This conclusion was reiterated in the FEMAT Report, and has subsequently been challenged by Doak (1993). This represents a substantial disagreement among scientists, and deserves additional discussion.

For the northern spotted owl population to be at or near a population threshold that would result in extirpation of the species from large parts of its range as a result of harvest activities under the selected alternative, four conditions would have to be met:

1. Owl populations would have to be declining throughout all or most of their range.
2. Within the general areas where overall declines were seen, there would have to be no significant source areas that could provide for demographic rescue.
3. The factor, or factors, causing the decline would have to be operating in a similar fashion throughout all or most of the range.
4. The decline would have to continue as a function of habitat conditions until owl population sizes and densities were reduced to the point that the populations could not recover.

The likelihood that each of those conditions would be met is discussed below.

Populations Declining Throughout All or Most of the Range. Evidence that spotted owl populations have been declining is presented in Appendix J and Chapters 3&4. The estimated rate of population growth across 11 study areas falls between 0.9162 and 0.9934. However, the mean growth rate for six long-term study areas was higher than the mean for five short-term areas. The rate of population growth for one of the six long-term areas (Salem) was not significantly different from 1.0, and the rates for two other areas (Northwest California and Roseburg) were within a range where a correction for juvenile emigration might result in a value not significantly different from 1.0 (Appendix J). A significant declining trend in adult female survival and survival of all adults was detected for the six long-term study areas, and a declining trend in adult female survival was found for the five short-term study areas. For individual areas, a statistically significant declining trend in adult survival could be demonstrated for four of the six long-term studies and one of the five short-term studies. Thus, while there is strong reason to believe that owl populations have declined across much of their range, there is also ample reason to believe that the pattern in population change is not the same everywhere.

Lack of Significant Source Areas. Most wide-ranging species occupy habitats that vary in quality or productivity across their range. As a result, the overall rate of population growth for the species represents a spectrum of different conditions, and different population growth rates, for various portions of the range. Areas that support stable or increasing populations are termed "sources," while areas in which populations are declining are termed "sinks." While there are no data available for owls that would allow the SEIS Team to define the habitat conditions that would support source populations, there is indirect evidence about contribution of habitat quality and local population size to owl productivity. First, Bart and Forsman (1992) investigated the relationship between habitat quality (measured as the percent of an area that could be defined as suitable habitat) and owl reproductive performance. They found that areas containing greater than 20 percent suitable habitat supported significantly greater production of young owls than did areas containing less than 20 percent suitable habitat. For areas containing greater than 60 percent suitable habitat, production of young was 50 times greater (per unit area) than in areas less than 20 percent suitable. This does not conclusively demonstrate that areas with greater than 60 percent suitable habitat act as sources, but it does suggest that such areas may be more valuable contributors to the owl population in the short term than are other areas. In all alternatives presented in this SEIS, there are a substantial number of reserves that contain relatively high percentages of suitable habitat. For example, in Alternative 9 the average percent of suitable habitat across all the Late-Successional Reserves and Managed Late-Successional Areas is 43 percent. Forty-eight of the 131 Late-Successional Reserves in this alternative with at least 10,000 acres of federal land also contain at least 50 percent suitable habitat. They are distributed throughout all the physiographic provinces except the California Coast and California Cascades Provinces (see discussion in Appendix G, Addendum to Biological Assessment). Eighteen of these Late-Successional Reserves contain greater than 60 percent suitable habitat on federal land (see Appendix G, Addendum to Biological Assessment).

Areas that contain larger numbers of contiguous or nearly contiguous pairs of owls may also make relatively greater contributions to the population. Modeling done by the Interagency Scientific Committee (Thomas et al. 1990) suggested that, under a given set of assumptions, "clusters" containing 15 or more pairs of owls might be more stable over time than clusters containing fewer pairs, and that additional numbers of sites within clusters should confer additional stability on the population within the cluster. With a different assumption about juvenile dispersal, there was an apparent threshold in cluster stability for clusters containing 30 or more sites. All alternatives examined here have significant numbers of large clusters. Alternative 9 offers an example, with 42 of the Late-Successional Reserves containing 15 or more currently known spotted owl activity centers. Twenty of these contain 20 to 29 known activity centers, and 9 contain 30 or more known activity centers. Six of the Late-Successional Reserves contain more than 50 known activity centers, and the largest contains 216 activity centers (see Appendix G, Addendum to Biological Assessment). This very large reserve also contains greater than 60 percent suitable habitat. Many of the other reserves have the capability to support 15 or more pairs of owls, but lack current inventories to document the actual number present. While there has been no demonstration that such clusters actually act as sources, there is reason to believe that these large Late-Successional Reserves with many pairs of owls can support self-sustaining populations while habitat recovery within the reserve system proceeds over time.

As a conclusion, it is clear that there are areas within the range of the spotted owl with characteristics thought to be important to the productivity and stability of local populations. Such areas could act as sources for the owl population even in the face of an overall population decline. In varying degrees, many such areas are within Late-Successional Reserves in the alternatives analyzed in this SEIS.

Decline is Operating in a Similar Fashion Throughout the Range. It was noted earlier that habitat conditions are heterogeneous throughout the range of the spotted owl. Also, the natural history of the owl changes significantly throughout the range, particularly the owl's prey base which differs from north to south in the owl's range. Additionally, it is believed that different types of habitat differ in their productivity for owls. For example, it is widely thought that low elevation habitats are most productive for owl populations (USDI unpub.). Thus, there is a reasonable basis to believe that local owl populations will respond to the alternatives presented here in different ways throughout the range. In particular, habitat recovery rates will likely vary throughout the range. They should be relatively most rapid in parts of the range where forests grow most rapidly, such as the central portion of the Oregon Coast Range, which is predominantly allocated to Late-Successional Reserves in all alternatives. Previously harvested forests in this area may begin providing substantial benefits for owls when they reach ages as young as 80 years (USDI unpub.).

Under all alternatives, Late-Successional Reserves would be established throughout the full range of habitat types and elevation zones within the northern spotted owl's range (FEMAT Table IV-14, p. IV-73). A primary reason for designating reserves throughout the range of conditions was to try to ensure that negative influences in one portion of the range or one type of habitat would not have a negative impact on the entire population. Risks to owl populations within each of the physiographic provinces were described by the Northern Spotted Owl Recovery Team (USDI unpub.), and these risks varied in their severity across the range of the owl. It is unlikely that any single factor, with the exception of habitat loss, is primarily responsible for declines in owl populations across the range. With the full range of environmental heterogeneity represented within reserves, there is reason to believe that owl population performance will vary in both positive and negative ways throughout the range. Given this heterogeneity, it would be inappropriate to make a simple extrapolation from the current estimated rates of decline in the owl population to a single future projection of irreversible decline.

Continuing Decline. It is generally agreed that the decline in spotted owl populations has resulted primarily from habitat reduction caused by logging. These habitat reductions have occurred over a 100-year period, with the most rapid reduction occurring in the last 40 years. The alternatives in the SEIS would reserve from timber harvest 68 percent (Alternative 7) to 95 percent (Alternative 1) of the spotted owl's remaining habitat on federal land, most of the reserved habitat would be contained within large reserves. Thus, not only will this portion of the existing habitat on federal lands remain unlogged, it will occur as part of larger reserves managed for continuing improvement of owl habitat. Many of these reserves are large enough that the dynamics of populations within them should be influenced much more strongly by conditions within the reserves rather than external activities. Habitat declines will continue only in the matrix lands, which range from 11 to 35 percent of the total federal forest across the alternatives. The harvest in that portion of the landscape would represent 0.8 to 5.0 percent of remaining spotted owl habitat per decade across the alternatives. For population declines to continue everywhere within the owl's range past some expected lag time of population response, those declines would have to be largely independent of the rate of habitat loss and remain so into the future. Also, because owls are still relatively numerous and exist in reasonably high densities wherever habitat remains, the accelerating decline in population, largely independent of the rate of habitat loss, would logically have to be a strong departure from past responses of spotted owl populations to habitat loss.

The actual rate of decline should be considered when thinking about the likelihood of decline continuing into the future. If the average decline projected from the demographic studies, about 4.5 percent per year, were to continue into the future, then the population would be reduced by half in about 15 years. This rate of decline could thus have very serious consequences in the near future. However, if that same rate were projected back over the 9-year period of the demographic studies, it would indicate that owl populations had declined by almost 35 percent during that period. This is inconsistent with observations from density study areas (Thomas et al. 1993), even if the observable change in the territorial population was buffered by recruitment of floaters. If a smaller rate of decline were projected backward, it could be consistent with other evidence of decline in the owl population. For example, a decline of 1.0 percent per year is within the 95 percent confidence limit of the projection made from the demographic studies, and if projected back 9 years, it would suggest that populations had declined approximately 8.5 percent over that period. As explained in the discussion of demographic results, such a decline could occur without being directly observable as a change in territorial population, and thus would be consistent with observations made of owl densities. Projected into the future, this rate of decline would result in a 40 percent loss of population over the next 50 years. Such a loss would be consistent with the worst-case prediction of Thomas et al. (1990). If the true rate of loss over the last decade is relatively small, then the magnitude of any acceleration of that loss must also be small, or the population must have started with a growth rate greater than 1.0, or both.

In conclusion, large rates of decline projected backward in time are inconsistent with other observations of population decline. More moderate rates of decline are consistent with both the empirical observations of changes in owl density and the predictions of future possible population loss made by both the Interagency Scientific Committee and the Northern Spotted Owl Recovery Team. Such rates would likely allow for significant habitat recovery to occur in reserves (Figure 3&4-2) while relatively large numbers of owls are still present. Projecting higher rates of population decline into the future than those which appear to have occurred in the past requires an assumption that the rate of population decline will increase as the rate of habitat loss declines and actually ceases over much of the range. While such a scenario could be extrapolated from the results of the demographic studies, those studies are not future projections and their authors caution that any extrapolation into the future must be done with caution. There is also no part of those studies that links them to either historic or projected rates of habitat change. There is no other evidence that owl population losses will accelerate in the future, and no empirical or theoretical basis for believing that the current habitat condition or condition of the owl population represents a unique threshold point.

Summary. The basis for believing that owl populations have passed, or will soon pass, some threshold is not strong. The primary support for this belief (Doak 1993) seems to be the evidence of declining populations and declining survival that comes from demographic studies (Chapter 3&4 and Appendix J, this document). The results from those studies are of concern, but the authors themselves caution that interpretation of the results should be restricted to the years of the studies (Appendix J). They do not form the basis for future projections. As noted by Thomas et al. (1993), projection of the results into the future is particularly inappropriate in this case because habitat loss, which is believed to have caused population decline, will be dramatically slowed by any alternative analyzed in this SEIS.

There are several additional reasons for believing that the accelerating rates of population decline detected through the demographic studies should not simply be projected into the future. First, there is some evidence within the demographic studies that population trend is not the same across the whole range of the owl, and that some portions of the range may be closer to stability than is indicated by the combined results for all study areas. Second, each of the alternatives described in this SEIS proposes some Late-Successional Reserves that may be particularly valuable as source areas for owl populations even if some population decline continues during the transition period. Third, the design of the reserve system in the alternatives, which is consistent with the fundamental principles underlying the original ISC Conservation Strategy (Thomas et al. 1990), provides for reserves across the full range of environmental conditions within the range of the owl. Rates of population change and habitat recovery should vary across those areas, and factors that cause risk to owl populations (i.e., predation, competition, natural disturbances, current population levels) also vary across the areas. And fourth, some relatively small rates of population decline could be consistent with both the confidence intervals on the analysis in Appendix J and with other evidence (Thomas et al. 1993). These rates would not necessarily conflict with earlier projections of possible habitat loss under the ISC Conservation Strategy (Thomas et al. 1990) or the *Final Draft Recovery Plan for the Northern Spotted Owl* (USDI unpub.). Such rates should allow populations to persist during the threshold period.

Finally, none of the principal investigators who oversee data collection on the long-term study areas (those for which there are at least 6 years of demographic data) have seen evidence, either in the form of available data or field knowledge, to indicate that the owl subpopulations in the study areas they administer have passed or will soon pass a threshold leading to irreversible decline (Forsman, E.; Franklin, A.; and Meslow, C. pers. comms.).

The discussion above does not minimize the importance of the findings from the demographic study areas portrayed in Appendix J. These findings argue for a conservative approach to owl management and continued monitoring and research efforts directed at northern spotted owls. Alternatives 1 through 6, and 9 embody such an approach, and represent a significant increase in protection for owls from the original plan of the Interagency Scientific Committee's Conservation Strategy.

Computer Modeling as a Method of Assessing Spotted Owl Population Dynamics

As the foregoing discussion indicates, the results of recent demographic analyses and density studies provide useful insight into how population parameters for the northern spotted owl likely have changed in the recent past. Neither kind of study, however, explicitly addresses expected future changes in the spotted owl's population over the long term, or the relationship between population dynamics and factors believed to affect such dynamics most directly, including changes in amount and distribution of habitat.

To confront such issues more directly, biologists have developed various kinds of "models" that attempt to simulate the effects on species' populations from various factors. The most sophisticated of these models are categorized as "spatially explicit" in that they attempt to replicate in digitized computer data bases an approximation of habitat distribution across the landscape. That is, instead of drawing inferences from only completed statistical analyses on demographic data, they attempt to model the relationship of population dynamics to habitat dynamics. There is not necessarily a correlative relationship between greater sophistication or complexity of a model and the usefulness of its results. In fact, the opposite often can be the case because the more potential "real-life" factors that are attempted to be worked into a model, the more estimates of variables and assumptions must be made to run the model. Nevertheless, spatially explicit computer models can be useful for exploring general relationships between species and their environments. If sufficiently well-conceived and tested, they may be able to shed some light on the factors that most affect population persistence. This information can supplement efforts to develop and assess various management alternatives. Models can also help form opinions on the possible responses of species populations to the dynamics of future landscapes and aid in generating new research hypotheses.

Currently, there are two basic spatially explicit models that were designed to address the population dynamics of the northern spotted owl (Carroll and Lamberson 1993, Lamberson et al. 1992, McKelvey 1992, McKelvey et al. 1992), as well as several variants. One of these models was developed to a large degree at the Forest Service's Pacific Southwest Forest and Range Experiment Station, Redwood Sciences Laboratory in Arcata, California (McKelvey 1992). This model (hereafter referred to as the "PSW Model") has been peer reviewed; its first iteration was published in 1991 (McKelvey 1992), and it has been since refined. In 1992, the Bureau of Land Management used the PSW Model to evaluate alternatives in its Draft Resource Management Plans, although the extent of its use was to compare the relative efficacy of the alternatives in continuing to provide sufficient habitat to support stable owl populations.

To date, the Forest Service has not used the PSW Model in its land management planning decision-making processes for three essential reasons. First, only recently has the PSW Model become fully developed and thoroughly tested. Second, the habitat mapping of present and projected future forest conditions throughout the range of the northern spotted owl has only recently been sufficiently standardized to allow for meaningful analysis. Third, the primary author of the PSW model informed the SEIS team that the model likely would not be especially useful in differentiating among all but the most extreme alternatives subject to analysis in this SEIS (McKelvey, K. pers. comm.).

Notwithstanding the foregoing, the Forest Service is moving forward with research efforts to run the PSW Model. The preliminary results of the demographic analysis conducted in December 1993 are now available and generally are more robust and powerful than those generated previously. In addition, assumptions concerning the amount and distribution of habitat and harvest areas are relatively more reliable with respect to the short term and the very long term because little additional old growth is expected to develop in the short term, and in the long term old-growth conditions are expected to be prevalent in Late-Successional Reserves. As a result, the research efforts underway presently intend to run the PSW Model to evaluate the effects of current and expected short-term and very long term habitat conditions on the population dynamics of the owl. To the extent the results prove to be useful and available, decision makers will consider such results in the selection of an alternative.

Nevertheless, the anticipated results are not necessary to allow for a reasoned comparison and selection among the alternatives. Examination of the results of recent demographic analyses and density studies, in conjunction with field observations, data concerning past and likely future changes in the amount and distribution of suitable owl habitat, and other factors, provide a solid foundation on which to base an informed professional judgment about expected future population trends and whether a particular configuration of habitat is likely to be adequate to support a viable population of northern spotted owls. Although precision in such judgments is not achievable because of the number and complexity of potentially applicable variables, projections with respect to the owl are well informed given that more relevant data currently exist concerning the owl than for almost any other species. Any spatially explicit model will have to rely on these same estimates and assumptions. Moreover, the results of the anticipated PSW Model run will not provide an authoritative answer to important issues like those relating to whether the owl will survive the transition period discussed above. It is reasonably hoped, however, that such results will help identify possible refinements to underlying assumptions and hypotheses and shed additional light on the relative importance that should be accorded each of the various parameters that go into assessing population viability of the owl. To the extent they do so, the results will form another layer of data for federal researchers, land management planners, and managers to consider in the adaptive management process that is a part of each of the alternatives.

A Note About Quantitative Population Viability Assessment

Although the anticipated running of the PSW Model will provide quantitative analysis of the possible effects on owl population dynamics in response to probable habitat dynamics, its use in this regard cannot be said to represent a comprehensive quantitative population viability assessment or quantitative risk assessment of viability. No such assessment has been conducted in conjunction with the analytical efforts represented in the FEMAT Report and this SEIS. Some have criticized the Forest Service for having failed to develop and utilize such an assessment in evaluating effects of various management scenarios on the northern spotted owl. The criticism merits discussion.

Population viability assessment is not a monolithic concept and the approach taken in constructing such an assessment can vary substantially. Only a few quantitative assessments, each far less than comprehensive in scope, have been attempted for animals or plants (USDI 1992). In the full sense, however, a comprehensive population viability assessment or risk assessment of viability would have to include consideration of all of the major factors believed to influence a species' viability. As discussed in the *Final Environmental Impact Statement on Management for the Northern Spotted Owl in the National Forests*, such factors include changes in demographic attributes of the population, degree of genetic variation within and among individuals in the population, consideration for certain behavioral attributes of individuals of the population, systematic and catastrophic losses of habitat, changes in distributional patterns of habitat, the degree and nature of interactions with other species, and disease, pathogens, and environmental contaminants (USDA FS 1992). It is beyond dispute that an assessment that reasonably accounted for most or all of these factors would be useful in evaluating prospective federal land management strategies for their effects on the northern spotted owl.

Although relatively extensive data on spotted owl population trends have been collected the last decade, available information nevertheless is insufficient or nonexistent concerning response of the owl to a great many of the factors thought to affect its population viability (FEMAT Report). In light of the lack of empirical knowledge necessary for a comprehensive quantitative population viability assessment or risk assessment of viability, the use of the qualitative methods upon which the Assessment Team and the SEIS team relied was appropriate. These qualitative assessments relied on quantitative data and analyses to the extent such exist and reflect a vast depth and array of professional experience. In addition, as discussed above, any modeling efforts directed toward quantitatively analyzing the effects on population dynamics from changing habitat conditions necessarily will rely to a significant degree on qualitative assumptions. Indeed, in conducting ecological analyses, some degree of continued reliance on professional judgment is inevitable, regardless of the degree of power achieved in the applicable data and the extent to which the agencies' understanding of central relationships becomes predicated on empirical data. This argues for continued reliance on both quantitative and qualitative methods to the extent practicable.

Spotted Owl Critical Habitat

Critical habitat was designated for the northern spotted owl in 1992. The designation includes 6.5 million acres of federal land, including 3.1 million acres of spotted owl nesting, roosting and foraging habitat (Appendix G, Addendum to Biological Assessment, Table G-1). Critical habitat occurs as 190 individual units (Critical Habitat Units or CHUs) distributed across the range of the owl on federal lands, with approximately 1.1 million acres in California, 3.3 million acres in Oregon, and 2.0 million acres in Washington.

The definition of critical habitat in the Endangered Species Act, is "(i) the specific areas within the geographic area occupied by a species on which are found those physical and biological features (I) essential to the conservation of the species, and (II) that may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by a species at the time it is listed, upon determination that such areas are essential for the conservation of the species."

The Fish and Wildlife Service determined that the primary constituent elements essential to the conservation of the northern spotted owl were those physical and biological features that support nesting, roosting, foraging, and dispersal behavior. Critical habitat was designated using concepts similar to the ISC Conservation Strategy (Thomas et al. 1990), including: (1) development and maintenance of large contiguous blocks of habitat for clusters of reproductive pairs of owls, (2) management of the habitat blocks to minimize forest fragmentation and improve habitat quality, (3) placement of habitat blocks to facilitate dispersal, and (4) maintenance of a rangewide distribution of habitat to facilitate recovery of the spotted owl. The Critical Habitat Units are designated to serve both a local role and a rangewide role in contributing to the conservation of the species.

Other Factors of Affected Environment

In some portions of the range, federal lands are not adequate to allow full implementation of a spotted owl conservation strategy. In these areas, nonfederal lands assume a more important role (see Cumulative Effects Including the Role of Nonfederal Lands below).

Effects of Alternatives

The effectiveness of an alternative in providing for northern spotted owl recovery on federal lands relies heavily on the spacing, size and location of the reserved habitat and management for owl dispersal between the reserved habitat areas. These measures are based on the scientific work that began with the Interagency Scientific Committee Conservation Strategy and was further developed in the *Final Draft Recovery Plan for the Northern Spotted Owl* (USDI unpub.). The spotted owl assessment panel convened by the Assessment Team reconfirmed the need for ". . . a significant network of late-successional reserves and . . . conditions adequate for dispersal of owls. . . " (FEMAT Report, p. IV-182). In addition, consideration must be given to potential management activities within some of the allocations (such as thinning of early-successional stands in late successional reserves), and losses of spotted owl habitat in areas with low populations. The following effects discussion addresses the points of consideration.

Protection of Known Spotted Owls on Federal Lands Proposed spotted owl management strategies were developed from the information on current habitat situations and owl populations (ISC Conservation Strategy and *Final Draft Recovery Plan for the Northern Spotted Owl*). The ISC Report was the first to propose two primary forest management strategies needed for spotted owl population maintenance: secure habitat necessary to support clusters of spotted owl pairs and, management of intervening lands to allow owl movement, or dispersal, among the clusters. All of the alternatives considered in this SEIS are designed, in varying degrees, to address these needs. Given the arrangement of federal land ownership, the pattern of remaining suitable habitat, and knowledge of spotted owl biology, there are limited opportunities to design fundamentally different alternatives. As a result, the SEIS alternatives have very similar "geometry" on the landscape, with reserves from one alternative often located in the same place as those of another alternative.

The number of known spotted owl home ranges (Figure 3&4-14 and Table 3&4-41) and the amount of owl habitat (Table 3&4-38) that would be protected in the alternatives provide a relative measure of how well each alternative would provide for clusters of spotted owl pairs. Spotted owl home ranges would be considered protected if a large acreage around the activity center was retained from timber harvest which could support a reproductive pair of owls. All of the alternatives were developed on a premise of providing clusters of reproductive owl pairs. For this reason, all alternatives delineated large reserves which could accommodate numerous interactive owl pairs (see Biological Principles in excerpts from *Final Draft Recovery Plan for the Northern Spotted Owl* in Appendix G, Part 3).

Figure 3&4-14. Number of currently confirmed sites occupied by northern spotted owls within reserves and the matrix by alternative. For this comparison, occupied sites in Managed Late-Successional Areas (Alternatives 3, 4, 5, 7 and 9) and some Adaptive Management Areas (Alternative 9) were included in the count of sites in reserves.

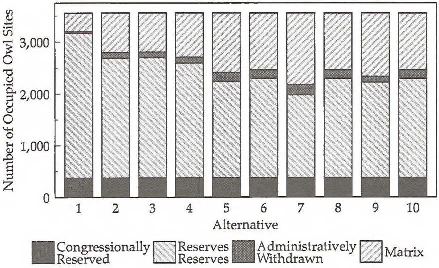


Table 3&4-41. Number of sites occupied by spotted owls on various land allocations for each alternative

	Total on Federal Land	Congressionally Reserved Areas	Late-Successional Reserves	Managed Late-Successional Areas	Admin. Withdrawn Areas	Adaptive Management Areas
Alternative 1						
Spotted Owl pairs	2,791	279	2,223		25	
Spotted Owl singles	766	98	564		7	
Alternative 2						
Spotted Owl pairs	2,791	279	1,859		89	
Spotted Owl singles	766	98	445		20	
Alternative 3						
Spotted Owl pairs	2,791	279	1,545	329	88	
Spotted Owl singles	766	98	378	68	20	
Alternative 4						
Spotted Owl pairs	2,791	279	1,775	36	87	
Spotted Owl singles	766	98	395	8	26	
Alternative 5						
Spotted Owl pairs	2,791	279	1,435	96	137	
Spotted Owl singles	766	98	310	16	42	
Alternatives 6, 8 and 10*						
Spotted Owl pairs	2,791	279	1,553		133	
Spotted Owl singles	766	98	368		33	
Alternative 7						
Spotted Owl pairs	2,791	279	1,235	93	156	
Spotted Owl singles	766	98	252	16	51	
Alternative 9						
Spotted Owl pairs	2,791	279	1,420	14	14	230
Spotted Owl singles	766	98	355	3	3	43

*Table information is the same for Alternatives 6, 8 and 10.

For all alternatives, an estimated 11 percent of the known federal spotted owl population and 1.6 million acres of nesting, roosting, foraging habitat will be protected within Congressionally Reserved Areas, often adjacent to Late-Successional Reserves. Another portion of the federal owl population would be protected in the Administratively Withdrawn Areas, but this acreage varies by alternative (Table 3&4-41). The protection offered by these lands would also vary with the direction for the particular areas; some of these withdrawn lands may be too small or fragmented to support reproductive pairs of owls.

The percentage of known owl home ranges on federal lands that would be protected in Congressionally Reserved Areas, Late-Successional Reserves and Managed Late-Successional Areas ranges from 56 percent of spotted owl sites under Alternative 7, to 89 percent of sites protected under Alternative 1 (Figure

3&4-14). Three Adaptive Management Areas in Alternative 9 have specific provisions to protect the spotted owls that inhabit them, and these sites have been added to the amounts shown for Late-Successional Reserve for that alternative in the figure.

For all alternatives, it is unknown how many owl locations would be protected within the Riparian Reserves in the matrix. The width and location of the Riparian Reserve will affect its ability to support reproductive pairs of owls. It is assumed that even the wider Riparian Reserves would not, in and of themselves, provide habitat in an appropriate pattern to support a reproductive pair of owls. This is due to their finger-like shape, which increases edge effects. However, the alternatives that have Riparian Reserve Scenario 1 (Alternatives 1, 4 and 9) would have a higher likelihood of supporting owl home ranges in Riparian Reserves, especially where these reserves are adjacent to other protected areas, such as Administratively Withdrawn Areas. In the short term, the potential effectiveness of the Riparian Reserves in supporting owls is reduced because a large part of the Riparian Reserve acreage is not currently spotted owl habitat; rangewide, approximately one-third of the Riparian Reserves are now dominated by medium and large conifer forest (Table 3&4-8). The remaining acreage in the Riparian Reserves will grow into spotted owl habitat with time, but will generally require more than 50 years to achieve appropriate habitat conditions. The major role of Riparian Reserves in spotted owl population maintenance will be in providing dispersal habitat evenly distributed throughout the range (see Dispersal discussion below).

Alternatives 4, 5, 7, and 9 have provisions to protect most spotted owl activity centers which occur in the matrix with 100-acre areas of suitable owl habitat. These areas, identified in the *Final Draft Recovery Plan for the Northern Spotted Owl* as Residual Habitat Areas, are not considered adequate acreage to maintain these areas as home ranges for reproductive pairs. While not providing for the long-term needs of owl pairs, these areas provide acreage of high quality habitat which are valuable for other species (see Appendix B11). They also would retain future options for managing owls throughout the landscape. In forest types that are managed through selective harvest (Klamath and eastside provinces), it is possible that these Residual Habitat Areas in the matrix could be carefully managed to maintain the site as an owl home range, while allowing timber harvest.

Management Activities Within Late-Successional Reserves   In Alternatives 2 through 7, and Alternatives 9 and 10, the standards and guidelines that direct forest management activities inside Late-Successional Reserves are considered compatible with spotted owl habitat management. The focus of this management is to develop, protect and maintain late-successional forest conditions within the reserves (see Appendices B2, B5, B7, B8, and B9). These conditions would provide suitable spotted owl habitat. Improvement of owl habitat which would occur under these alternatives will contribute to the owl management goal of providing large areas of contiguous suitable habitat.

Alternative 1 was considered by the assessment panel to have higher risk for owl habitat because of the potential for accumulation of fuels in eastside forests and the increased risk of catastrophic fire (see Chapter 3&4, Effects of

Alternatives on Terrestrial Ecosystems). Alternative 8 would be less compatible with owl habitat management due to its allowance of timber harvest in Late-Successional Reserves in stands up to 180 years old, which are likely to be suitable owl habitat.

Effects of Alternatives on Spotted Owl Dispersal Habitat

In addition to providing for clusters of reproductive pairs of owls, a measure of the effectiveness of the alternatives is their ability to provide dispersal habitat conditions among clusters (see Appendix G, Addendum to Biological Assessment, Biological Principles of Spotted Owl Recovery). One mechanism designed to provide for dispersal habitat is the 50-11-40 rule, which is incorporated into Alternatives 1 through 6 and modified for Alternative 7 (see Chapter 2). Alternatives 8 and 10 do not include the 50-11-40 rule, or any other control on the amount of dispersal habitat retained in the matrix, and this is reflected in the lower assessment ratings for these alternatives (Table 3&4-42). The 50-11-40 rule in Alternative 7 has been modified for the lands administered by the BLM and this modification was judged by the assessment panel to reduce the quality of dispersal habitat. The panel also questioned the ability of Alternative 9 to provide adequate dispersal habitat because it lacked a specific dispersal habitat provision. However, after the rating shown in Table 3&4-42 was determined, Alternative 9 was modified in several aspects, all of which would improve its effectiveness in providing for spotted owl dispersal. The primary modifications to Alternative 9 that will address dispersal concerns are the adoption of Riparian Reserve Scenario 1 and the addition of Managed Late-Successional Areas (see Appendix G, Addendum to Biological Assessment). With these changes, Alternative 9 would likely be rated similarly to Alternatives 2, 3, 4, and 5. Therefore, selection of Alternatives 1 through 6, or Alternative 9, would provide the Forest Service and BLM land allocations and standards and guidelines necessary to achieve recovery of the northern spotted owl.

Effects of Alternatives on Spotted Owl Critical Habitat

All 10 alternatives have partial overlap between the Late-Successional Reserves and designated critical habitat for the northern spotted owl. The degree of overlap varies with the alternative. The Addendum to the Biological Assessment in Appendix G provides a detailed analysis of the overlap between the Critical Habitat Units and the Late-Successional Reserves of Alternative 9. It provides an indication of the average overlap that would occur across the alternatives; more than 50 percent of the designated critical habitat would occur within the reserves of the various alternatives. In virtually all cases, it can be said that management of the Late-Successional Reserves would be compatible with the objectives identified for spotted owl critical habitat, except for Alternative 8, which would allow timber harvest in stands up to 180 years old. Under the selected alternative, the activities within designated critical habitat will undergo Section 7 consultation, as deemed appropriate.

Conclusion of Effects of Alternatives on Spotted OwlsIt was the conclusion of the Assessment Team that Alternatives 1 through 6, and 9 met or exceeded the biological principles for federal lands of the Final Draft Recovery Plan for the Northern Spotted Owl (USDI unpub.) (see excerpts in Appendix G, Addendum to Biological Assessment). The conclusion for Alternative 9 is strengthened by the modifications to that alternative since the Assessment Team rated it, which improve both population support and dispersal habitat conditions. Alternatives 7, 8, and 10 were found to have less assurance of spotted owl persistence on federal lands, primarily due to questions about the provision of dispersal habitat.

Table 3&4-42. Projected future likelihood for marbled murrelet and northern spotted owl habitat outcomes under land management alternatives in the Draft SEIS

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Marbled Murrelet	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Marbled Murrelet California (long-term)	90	10	0	0	82	18	0	0	82	18	0	0	82	18	0	0	5	28	67	0	33	35	30	2	80	20	0	0
Marbled Murrelet Oregon (long-term)	90	10	0	0	83	17	0	0	83	17	0	0	83	17	0	0	3	25	70	2	25	39	33	3	80	20	0	0
Marbled Murrelet Washington (long-term)	97	3	0	0	87	13	0	0	87	13	0	0	87	13	0	0	63	37	0	0	30	47	23	0	80	20	0	0
Three State Average	92	8	0	0	84	16	0	0	84	16	0	0	84	16	0	0	26	30	44	0	29	40	29	2	80	20	0	0

	Alternative 2				Alternative 6				Alternative 10			
	A	B	C	D	A	B	C	D	A	B	C	D
Three State Average	84	16	0	0	84	16	0	0	80	20	0	0

Note: Likelihoods for Alternatives 2, 6, and 10 are internal assessments by the Assessment Team; these alternatives were not rated by expert panels.

	Alternative 1				Alternative 3				Alternative 4				Alternative 5				Alternative 7				Alternative 8				Alternative 9			
Northern Spotted Owl	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Strix occidentalis caurina	89	10	1	0	90	10	0	0	91	9	0	0	88	13	0	0	71	25	4	0	65	35	0	0	83	18	0	0

	Alternative 2				Alternative 6				Alternative 10			
	A	B	C	D	A	B	C	D	A	B	C	D
Three State Average	90	10	0	0	85	15	0	0	73	27	0	0

Note: Likelihoods for Alternatives 2, 6, and 10 are internal assessments by the Assessment Team; these alternatives were not rated by expert panels.

A-Well Distributed B-Locally Restricted C-Restricted to Refugia D-Risk of Extirpation

Likelihood values are expressed as percentages that total to 100 for a given species within an Alternative. Number displayed may vary due to rounding errors. The Species shown in the shaded portion of the table are those that were specifically considered when additional standards are guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the standards and guidelines. The ratings shown in the table have not been changed to reflect these additions to Alternative 9. See text for fuller explanation and discussion of the rating scale and for discussion of the additional species analysis under Alternative 9.

Possible Mitigation Measures

All the alternatives are designed to provide for clusters of spotted owl pairs, and most alternatives include provisions to assure owl dispersal among these clusters. Those alternatives that have been judged to less adequately provide for owl dispersal (Alternatives 7, 8, and 10) could be mitigated by adding a landscape management scheme that would regulate the rate of harvest in the matrix.

In Alternatives 4, 5, 7, and 9, which have provisions to protect most spotted owl activity centers in the matrix with 100-acre areas of suitable owl habitat, special management of these sites could occur. In forest types that are managed through selective harvest (Klamath and eastside provinces), Residual Habitat Areas in the matrix could be carefully managed to maintain the site as an owl home range, while allowing timber harvest. This would maintain additional owl home ranges and lessen any demographic concerns in the short term.

In any alternative, spotted owl activity centers located in the matrix and Adaptive Management Areas could be managed as Reserved Pair Areas (USDI unpub.), in which the home range of the owl is used to delineate a protected zone. Forest management within the Reserved Pair Area would follow the same standards and guidelines as Late-Successional Reserves. This management would maintain the home range and further buttress the alternative against risks from declining spotted owl populations.

Cumulative Effects Including the Role of Nonfederal Lands

The need for nonfederal contributions to spotted owl recovery has been discussed in previous spotted owl management plans (ISC Report (Thomas et al. 1990) and *Final Draft Recovery Plan for the Northern Spotted Owl* (USDI unpub.)). The Assessment Team acknowledged the need for these contributions by stating:

> *In all options* [alternatives], *we recognize areas of special concern where current habitat conditions on federal lands are deficient in portions of the owl's range, or where private, state, and federal lands are intermingled or federal lands are absent. In these areas of special concern, contributions by nonfederal lands remain important to recovery of the species and should be addressed in the final recovery plan for the northern spotted owl.*

The role of nonfederal lands in spotted owl recovery is currently being addressed by the Fish and Wildlife Service. The Fish and Wildlife Service has published a Notice of Intent to prepare an environmental impact statement for a proposed special rule under section 4(d) of the Endangered Species Act to revise protective measures for the northern spotted owl on nonfederal lands. The 4(d) rule may authorize incidental take of some spotted owls on nonfederal land, and is expected to address the needs identified in other owl management plans. The 4(d) Notice of Intent described a goal of identifying those nonfederal areas where spotted owls would continue to be protected. "These areas were chosen to fill in gaps in Federal land ownership in support of the Federal owl conservation strategy outlined in Alternative 9. . ." (58 FR 69132).

Because of the age structure of nonfederal forests, nonfederal harvest levels will vary little in response to different SEIS alternatives. For the purposes of analysis of nonfederal effects on spotted owls among the SEIS alternatives, it was assumed that nonfederal lands would be managed in compliance with the Endangered Species Act and current state forest practices laws. This assumes that all spotted owls known to occur on nonfederal lands would be protected from take and would persist at least in the short term. Nonfederal landowner compliance with the take prohibition of the Endangered Species Act may not be the most effective method of maintaining spotted owl dispersal habitat, or providing for improvement of existing populations (Appendix G, Biological Opinion). The 4(d) rulemaking and potential Habitat Conservation Plans are expected to address these issues. The proposed action of the 4(d) EIS is expected to complement the alternatives analyzed in this SEIS and therefore it is not expected that adoption of such a rule would change in any significant manner any projected contribution of nonfederal lands to the owl made in the SEIS, especially at the programmatic level of its analysis. For example, the proposal set forth in the Rule 4(d) Notice of Intent would provide for continued application of the extant incidental take prohibitions on those nonfederal lands deemed to be of substantial importance to owl conservation, particularly in light of how it is envisioned they would complement the proposed federal lands management strategy analyzed in this SEIS.

Appendix D, Related Direction and Activities, provides a detailed discussion of spotted owl habitat and numbers on nonfederal lands in Washington, Oregon and California.

Cumulative Effects Specific to Spotted Owl Critical Habitat

Nonfederal lands were not included in the designation of spotted owl critical habitat. In addition, the Assessment Team did not place any appreciable reliance, if any at all, upon the current designation of owl critical habitat as a contributing factor in its evaluation of the alternatives.

Marbled Murrelet

Affected Environment

The marbled murrelet (*Brachyramphus marmoratus*) was federally listed as a threatened species on September 28, 1992 (57 FR 45328). A recovery plan is currently being developed, as is a Conservation Assessment which involves synthesizing available research on the species. The marbled murrelet ranges from Alaska (Aleutian Archipelago, Kodiak Island, and Kenai Peninsula) south to central California. Some wintering birds are found in southern California. The marbled murrelet is a seabird that feeds near shore at sea, but nests inland, and therefore is influenced by both marine and terrestrial environments. Its nesting range extends farther north and south than the range of the northern spotted owl. Based on recent surveys, estimates of marbled murrelet population size for Washington, Oregon, and California indicate that the three-state area has considerably lower numbers of murrelets than other areas within the species' range (e.g., British Columbia and Alaska). Estimated population sizes are 5,000 to 6,000 individuals in Washington; 3,000 individuals in Oregon; and 2,000 to 6,000 individuals in California (Miller, G. pers. comm.). Preliminary estimates of population trend suggest numbers are declining, perhaps significantly, but quantitative estimates are unavailable at this time. It should be noted, however, that an attempt to model the demography of the marbled murrelet to estimate population trends is under development as a part of the ongoing Conservation Assessment for the species. This initiative is being jointly sponsored by the Murrelet Recovery Team and the Forest Service. Preliminary runs of the model, which has not yet been peer-reviewed, may occur within the next month. It is hoped that these runs can provide a crude estimate of the rate of change of the murrelet population based upon available demographic information for the murrelet and other species in the same family (alcidae) of birds. The results will be considered as part of the adaptive management process that is a part of each of the alternatives analyzed in this SEIS. They also will be considered by the Murrelet Recovery Team as it continues its work on a species Recovery Plan.

The current estimates of marbled murrelet population size for the planning area, which indicate a low population when compared to other parts of the species' range, may be related to the reduction in the amount of old-growth and mature forests with old-growth components, especially at lower elevations in the coastal lowlands of Washington, Oregon, and California. During the last century, there has been a substantial reduction in the amount of old-growth forest within the range of the marbled murrelet. Federal lands in old-growth condition were identified by the Assessment Team as a key component of any marbled murrelet management strategy because the loss of nesting habitat was a principal reason for listing the species as threatened (57 FR 4538). An estimated 2.5 million acres of marbled murrelet nesting habitat currently exists on federal lands in Washington, Oregon, and California (Table 3&4-38). However, this reported acreage has not been verified as suitable nesting habitat and it is possible that the true acreage figure is much lower (Appendix G, Biological Opinions).

Suitable murrelet nesting habitat has been tentatively defined as old-growth forests, and mature forests with an old-growth component (large trees, 32 inches dbh and greater (USDI FWS 1991)). Trees must have suitable nesting platforms, usually large branches with thick moss coverings, which may not develop until trees are more than 175 years old. The typical marbled murrelet nest is a shallow depression hollowed out in moss or other debris, on a broad limb in the upper canopy of large trees. Twenty-two nests have been found in Washington, Oregon, and California (FEMAT Report, p. IV-15).

The apparent high failure rate of marbled murrelet nests in trees due to predators has led some to hypothesize that fragmentation of nest stands may cause murrelets to be more susceptible to predation. Forest fragmentation may result in increased visibility of murrelets and their nests to jays, crows, and ravens, which could lead in turn to higher mortality of adults, nestlings and eggs to these predators. This relationship is speculative at present, but observation of high rates of loss to predators, whatever the cause, is of concern.

The FEMAT Report (page IV-15) and the Biological Opinions (Appendix G) provide additional discussion on the natural history of the marbled murrelet and management implications for this species. Based on this knowledge of marbled murrelet habitat needs and population status, the Marbled Murrelet Recovery Team identified goals that would be applicable as the measure of effectiveness of any of the alternatives. These goals were: (1) stop the decline and stabilize the population by increasing recruitment, decreasing habitat loss, maintaining the marine environment, and decreasing mortality; (2) increase the population by maintaining suitable habitat in the short term, developing recruitment habitat, and increasing the quality of habitat; and (3) improve or maintain the distribution of populations and habitat.

Critical habitat was recently proposed by the Fish and Wildlife Service for the marbled murrelet. The proposal consisted of the federal lands within the Late-Successional Reserves of Alternative 9 in the range of the species.

Effects of Alternatives

In the short term, the alternatives will provide a range of acreage of mapped reserve protection for the population of murrelets occurring on lands administered by the Forest Service and BLM. The amount of currently suitable murrelet habitat protected in mapped reserves would range from 918,400 acres in Alternative 7 to 1,661,600 acres in Alternative 1 (Table 3&4-38). Eight alternatives (all but Alternatives 7 and 8) also have specific provisions now and in the future, for protection of murrelet sites found outside of mapped reserves (see Marbled Murrelet discussion in Chapter 2, Elements from the FEMAT Report Incorporated into the Alternatives). The full extent of this protection outside reserves is not known at this time because of the limited surveys conducted for this species. There may be many murrelet sites in the matrix or reserves of the alternatives which have not been discovered.

The murrelet habitat protected by Late-Successional and Riparian Reserves in the alternatives would be in addition to the estimated 739,900 acres of suitable murrelet nesting habitat in Congressionally Reserved Areas (Table 3&4-38). Also, Administratively Withdrawn Areas would provide murrelet habitat in variable amounts, depending on the alternative considered.

Over the long term, most alternatives would eventually provide substantially more suitable habitat for marbled murrelets than currently exists on federal lands. The portion of suitable habitat acres within Late-Successional Reserves ranges from 22 percent in Alternative 7, to 47 percent in Alternative 1. Over time, these reserves should provide large contiguous blocks of murrelet habitat, a pattern described as preferable by the Marbled Murrelet Working Group. The lands inside these reserves are currently characterized by fragmented blocks of late-successional forest interspersed with young managed stands that are generally less than 50 years old. The young managed stands in reserves are expected to require considerable time (more than 100 years) to develop into suitable nesting habitat for marbled murrelets.

The panel of experts assigned by the Assessment Team to review the marbled murrelet conducted two separate assessments of the alternatives. This was necessary because the survival of the murrelet is expected to be influenced by cumulative effects issues unrelated to federal forest management. One assessment reviewed the federal habitat situation, whereas the other considered the federal habitat within the context of the wider range of murrelet issues that affect the species' viability (see Cumulative Effects Including Role of Nonfederal Lands).

In the assessment limited to effects on habitat on federal lands, the Assessment Team concluded that Alternative 1 provided habitat that would allow a greater than 90 percent likelihood of providing habitat conditions to attain Outcome A (Table 3&4-20). Alternatives 2, 3, 4, 5, and 6 had ratings of an 84 percent likelihood of achieving this outcome, and Alternatives 9 and 10 were rated at 80 percent. The lowest ratings were assigned to Alternatives 7 and 8. Alternative 7 was rated lower because of its lack of specific protection of murrelet sites in the matrix and less protection of old growth in coastal areas. Alternative 8 rated lower because of poor protection of murrelet sites in the matrix, and also because of its allowance for timber harvest in stands up to 180 years old, which may degrade murrelet nesting habitat.

Alternative 9 is reported in Table 3&4-20 as having an 80 percent likelihood of achieving Outcome A. The modifications made to Alternative 9 between the Draft and Final SEIS have added protection of approximately 25,000 acres of Late-Successional Reserve in the Olympic Adaptive Management Area. Another change was made for the Finney and North Coast Adaptive Management Areas, which now have direction stating that this Late-Successional Reserve acreage may be reconsidered during development of the Adaptive Management Area plans, if the proposed actions are consistent with the Endangered Species Act requirements for the marbled murrelet. Other modifications that would likely improve the murrelet rating of Alternative 9 are: adoption of the Riparian Reserve Scenario 1, retention of 100 acres around spotted owl activity centers in the matrix, institution of survey and manage provisions for a variety of other species, and retention of old-growth fragments in watersheds where little remains (Appendix B11). These modifications would result in retention of more marbled murrelet habitat than the standards and guidelines for Alternative 9 described in the Draft SEIS. Based on the relative amount of Late-Successional Reserve acreage in the alternatives, it is likely that a rating of the modified Alternative 9 would fall between the rating for Alternatives 2, 3, 4, 5 and 6 (84 percent likelihood of Outcome A and the rating for Alternative 1 (92 percent likelihood).

These results are based in large part on the fact that all alternatives except 7 and 8 meet or exceed the recommendations of the Marbled Murrelet Working Group (FEMAT Report, p. IV-23). Alternatives 7 and 8 do not include the recommendations, and therefore were considered less protective of murrelets. However, in the immediate future (until the recovery plan addresses the issue), Section 9 of the Endangered Species Act would require equivalent protection for occupied sites of this species, regardless of the alternative.

Possible Mitigation Measures

The marbled murrelet was a focal point of the development of alternatives for this SEIS, and therefore is generally well accommodated in the alternatives. For all alternatives, an additional level of protection could be applied for murrelet sites found outside of mapped reserves. This protection would consist of retention of all suitable habitat which is contiguous with an occupied site, regardless of its distance from the site (i.e., habitat farther than 0.5-mile from the site would also be retained) (Miller, G. pers. comm.). Finally, for Alternatives 2 through 10, mitigation could be applied which would retain all old-growth habitat within Marbled Murrelet Zone 1. This would increase the amount of federal suitable nesting habitat protected from timber harvest and reduce short-term concerns for the murrelet.

Further information will be available when the marbled murrelet recovery plan is completed. At that time, Forest and BLM District Plans should be reviewed and modified, if necessary, to fully meet the requirements of the Endangered Species Act as they relate to this species.

Cumulative Effects Including the Role of Nonfederal Lands

An ecosystem plan for federal lands contributes to only one aspect of the marbled murrelet's life history requirements. With this species, both the marine environment (because the marbled murrelet is a seabird) and the contribution of state and private lands for nesting habitat must be considered in any assessment of the potential to achieve recovery of the species. These factors which are important to murrelet recovery, but not within the authority or scope of the proposed action in this SEIS (e.g., nesting habitat on nonfederal lands, mortality associated with gill-net fisheries and oil spills, and prey population conditions), will be addressed more specifically in other analytical or planning documents such as the marbled murrelet recovery plan. From a population standpoint, the greatest concern regarding marbled murrelets is maintaining the species over the next 50 to 100 years. This concern relates to both inland nesting habitat and possible adverse impacts in the marine environment.

There are currently no measures in place under Oregon State law for the protection of marbled murrelets. The State of Washington has listed the marbled murrelet as threatened. The State of California has listed the marbled murrelet as endangered, thus, requiring the California Department of Fish and Game to review proposed timber harvest plans in an attempt to ensure that no take of this species would occur. While this may prevent the removal of occupied sites, it allows the further fragmentation of the landscape in California upon which the species depends.

Because a significant portion of this species' range occurs on nonfederal lands, the recovery of this species will need to address these lands. Timber harvest that is currently occurring on nonfederal lands in all three states may be affecting the future ability to recover the marbled murrelet. This is of particular concern in California where substantial numbers of marbled murrelets and high-quality nesting habitat occur on nonfederal lands.

To provide an evaluation of all general factors that might influence murrelet populations, the murrelet panel conducted a second assessment focused on the principal factors thought to affect most directly murrelet population viability, in addition to the assessment of adequacy of habitation on federal lands. The second assessment indicated a much greater risk to murrelet populations than the assessment based only on federal habitat. When all major factors affecting the species are taken into account, including at-sea conditions and land ownership patterns, the murrelet panel concluded there is between a 50 and 75 percent likelihood that the murrelet population on federal lands will be stable and well distributed after 100 years, regardless of the alternative selected.

Listed and Proposed Species Indirectly Associated with Late-Successional Forests

The Fish and Wildlife Service July 2, 1993, letter identified six species that are not restricted to only late-successional forests or that are associated with unique or specialized habitats that may not be considered late successional, but which may be affected by forest management activities. Some of these species were not evaluated by the Assessment Team because of their lack of association with late-successional forests, however, they are addressed here to provide a complete accounting. In addition, the SEIS Interdisciplinary Team assessed the effects on four species of anadromous fish which are identified in Table 3&4-36 as not being affected by any of the alternatives. Finally, the SEIS Team assessed one mammal, one invertebrate and one plant which, while not closely associated with old-growth habitat, occur on federal forest lands in the planning area.

Oregon Silverspot Butterfly

Affected Environment

The Oregon silverspot butterfly (Speyeria zerene hippolyta) is a threatened subspecies of silverspot butterfly endemic to the coastal zone along the southern Washington and central and northern Oregon coast. A recovery plan was completed for the Oregon silverspot butterfly in January 1982, and critical habitat has been designated. Of 17 historically known populations, only 4 have been documented in recent years and 2 of these may no longer exist. The known viable colonies are located in Lane County and Tillamook County, Oregon.

The Oregon silverspot has adapted to a highly specialized and restricted environment, which is an early-successional meadow habitat highly modified by the physical influences of the Pacific Ocean and its attending climate. The climate is characterized by mild temperatures, heavy rainfall, and fog with a salt-spray influence from the adjacent ocean. The surrounding conifer forest also plays a role in the overall habitat requirements of this butterfly by providing cover from wind, an overwhelming force in or near ocean habitat. The most important feature of the habitat is the presence of the western blue violet (Viola adunca) which is normally the only plant on which the Oregon silverspot can successfully feed and develop as a larva (USDI FWS 1982b).

The major limiting factors affecting this subspecies are related to the limitation of suitable habitat (USDI FWS 1982b). The specialized salt-spray habitat presently occurs in a patchy distribution partially due to encroachment by urban development. Excessive use of these meadows by grazing animals or off-road vehicles has also directly eliminated habitat. Secondary impacts of human activities, introduction of exotic plants, and alteration of the natural fire regime with subsequent succession of meadows to brush and stunted woodland, have also contributed to a reduction in suitable habitat.

Environmental Consequences

Effects of Alternatives

Adoption of the any of the alternatives is not likely to adversely affect the Oregon silverspot butterfly. Guidance in the Recovery Plan is currently being followed. This subspecies is found in salt-spray meadows and adjacent forests and in meadow communities, and thus is not likely to be affected by timber management. Direction for management of critical habitat for the butterfly includes a goal of maintaining the habitat in a grassland condition. Therefore, none of the alternatives are likely to result in the adverse modification of that critical habitat.

Cumulative Effects Including the Role of Nonfederal Lands

The Oregon silverspot butterfly naturally occurred on lands now in nonfederal ownership. Management of these lands must be considered in recovery planning for the species, but does not affect the determination for federal lands.

Nelson's Sidalcea

Affected Environment

Nelson's sidalcea (Sidalcea nelsoniana) was listed as threatened in February 1993. A recovery plan is currently being developed for this plant. The species is known from restricted areas of the Willamette Valley and adjacent Coast Range of Oregon. It occurs on the Salem BLM District, specifically on the Walker Flat Area of Critical Environmental Concern, as well as the Finley National Wildlife Refuge, and on private lands.

Mowing, plowing, recreational use, and roadside spraying threaten the remaining populations of this plant in the Willamette Valley. In the Coast Range, plans for the construction of a reservoir recently threatened the largest population of this species.

Environmental Consequences

Effects of Alternatives

Adoption of any of the alternatives is not likely to adversely affect the Nelson's Sidalcea. A significant portion of the Coast Range population occurs within the boundaries of the Walker Flat Area of Critical Environmental Concern on lands administered by the Salem BLM District. This Area of Critical Environmental Concern will be managed similarly under all alternatives, and that management will address the identified threats.

Cumulative Effects Including the Role of Nonfederal Lands

Management of populations of this species that occur on nonfederal lands will not affect the determination that all alternatives will provide equally for this species and that the federal management is not likely to adversely affect the species.

Grizzly Bear

Affected Environment

The grizzly bear is federally listed as threatened. Its current range includes a portion of the planning area, including the National Forests in the Cascade Range in Washington. The Grizzly Bear Recovery Plan (USDI FWS 1990b) is being revised to include the population in Washington.

While grizzly bears are not closely associated with late-successional forests, they inhabit vast, diverse, and remote mountainous areas and avoid human disturbance. They use a variety of vegetation types for foraging and other life functions. These habitats include open areas such as lowland wet meadows and marshes, shrub fields, high elevation sedge or heath meadows, and stream floodplains. Forested areas are used for resting and hiding cover, as well as for foraging.

Environmental Consequences

Effects of Alternatives

The major potential effect of the alternatives on grizzly bears is human disturbance resulting from vehicular traffic. Human access disturbs the bears' normal behavior patterns and may expose them to illegal hunting or accidental shooting. Since the grizzly is not dependent on old-growth forests, the Assessment Team concluded that the effects of forest management activities on the bear were not tied to the amount or distribution of old-growth forests on federal lands. Thus, the grizzly was not addressed by the Assessment Team in detail. Adoption of any of the alternatives is not likely to adversely affect the grizzly bear. Instead, the effects on grizzly bear recovery will depend on local mitigation measures which might be deemed necessary.

Possible Mitigation Measures

Regardless of the alternative selected, future federal projects (such as timber sales) that may affect grizzly bears will be required to enter Section 7 consultation. At that time in project-level planning, the disturbance effects on grizzlies may be identified and mitigated with road closures. The ongoing grizzly bear recovery planning efforts will identify additional conservation measures which could be applied to any of the alternatives considered in this SEIS, and could be addressed in the appropriate federal land planning document.

Cumulative Effects Including the Role of Nonfederal Lands

Nonfederal lands comprise a minor portion of the recovery zones identified for the north Cascades population of grizzlies. Management of these lands will not affect the determination for the federal lands.

Gray Wolf

Affected Environment

In the lower 48 states (except Minnesota) the gray wolf (Canis lupus) is federally listed as endangered. Its current distribution within the range of the northern spotted owl includes the northern Cascade Range in Washington. This population was not included in the initial federal listing of the species in the Intermountain States. Therefore, there is no recovery plan for the species in Washington. The recovery plan for gray wolves is currently being revised by the Fish and Wildlife Service to include the population in Washington.

The gray wolf is not closely associated with late-successional forests. Both forested and open habitats support deer and elk populations which are its major prey. Areas that support small mammal populations are also important at times of the year when large prey are not available. Wolves are documented to avoid human contact and spend a disproportionate amount of time in remote areas, especially when raising young at den sites.

Environmental Consequences

Effects of Alternatives

The Assessment Team did not address gray wolves because of this species' lack of dependence on old-growth forests. As with the grizzly bear, it was the Assessment Team's determination that wolves would do equally well under all alternatives, and the effects of forest management activities on wolf conservation are not tied to the amount or distribution of old-growth forest retained on federal lands. Regardless of the alternative selected, there is not likely to be an adverse affect to gray wolves. Instead, the effects of the alternatives on wolf recovery will depend on implementation actions that create or maintain remote habitat and important prey populations. This conclusion is based on the initial information provided by the wolf recovery efforts and knowledge of wolf ecology.

Roads that are left open to traffic and result in disturbance of this species by humans constitute forest management's major effect on gray wolves. Human access disturbs the wolves' normal behavior patterns and may expose them to illegal hunting or accidental shooting. Based on the initial information provided by the wolf recovery efforts and knowledge of wolf ecology, wolf recovery will depend on implementation actions that create or maintain remote habitat and important prey populations.

Possible Mitigation Measures

Continuing wolf recovery planning efforts will identify additional measures that can be taken to improve wolf conservation under the selected alternative. Individual Forest Plan amendments should address these wolf recovery objectives and actions.

Cumulative Effects Including the Role of Nonfederal Lands

Management of nonfederal lands does not affect the determination for federal lands under any of these alternatives.

Columbian White-Tailed Deer

Affected Environment

The Columbian white-tailed deer (Odocoileus virginianus leucurus) was listed as an endangered species in 1967 (32 FR 48:4001) and its populations and habitat are addressed in a Recovery Plan. This deer prefers oak woodland/ grassland ecotones and riparian habitat in coniferous forests. Almost all habitat for this subspecies is on private lands. The highest densities of Columbian white-tailed deer are found in Douglas County, Oregon, along the south bank of the North Umpqua River within about one kilometer of the river. The Douglas County population was not officially recognized as part of this subspecies until 1977.

Lands administered by the Roseburg BLM District fall within the current range of the Columbian white-tailed deer. The Revised Preferred Alternative of the Roseburg District RMP (USDI BLM unpub.) stated that timber harvest or other vegetation-altering activities on all BLM-managed lands within the distribution of the deer would only occur if they are determined to be beneficial to the subspecies or until such time that definitive information is available describing the use level and value of these lands in the context of meeting recovery plan goals. In addition, acquisition of lands through exchange within the core area for the deer in Douglas County has been achieved. A recently announced land exchange in the Roseburg BLM District would secure 6,585 acres of suitable habitat. A habitat management plan will be prepared for lands administered by the BLM determined to be of significant value to Columbian white-tails or any lands acquired specifically for this species.

The major potential human-caused threat to the Columbia River population is the degradation of riparian habitats resulting from logging and brush removal (USDI FWS 1983). Lesser threats include collisions with automobiles, poaching, entanglement in barbed wire fences, and competition with livestock. Natural threats include flooding, high tides, diseases, parasites, and competition with black-tailed deer and Roosevelt elk. The primary threat to the Roseburg population is the subdivision and residential development of native riparian habitats, particularly along the North Umpqua River. Additional threats come from livestock development activities in the lowland river valleys.

Environmental Consequences

Effects of Alternatives

Adoption of the any of the alternatives is not likely to adversely affect the Columbian white-tailed deer. The BLM currently follows guidance in the Recovery Plan and this direction will continue.

Cumulative Effects Including the Role of Nonfederal Lands

Nonfederal lands continue to play a role in maintenance of this species, but do not affect the determination for federal lands.

Peregrine Falcon

Affected Environment

The American peregrine falcon (Falco peregrinus anatum) is federally listed as endangered. Both breeding and wintering populations occur throughout the planning area. The Pacific States Peregrine Falcon Recovery Plan addresses populations and habitat and includes recommendations for management of the species. While the peregrine falcon is not closely associated with late-successional forests, it often nests on cliffs that are situated among coniferous forests. It forages in and around coniferous forests, and its diverse prey base is often associated with openings around forested areas.

Environmental Consequences

Effects of Alternatives

Potential effects to the peregrine from adoption of any alternative may result from timber harvest activities, road management, recreation development, mineral exploration, grazing allotments, and increased recreation pressure and/or development including off-road vehicle use (USDI FWS 1982a). However, some of these effects will be lessened by the general reduction in timber harvest and associated activities such as road construction. Other potential effects are lessened by agency adherence to a recovery plan. The

Peregrine Falcon Recovery Plan describes protection measures that are followed by both the Forest Service and BLM. Therefore, regardless of the alternative selected, peregrine falcon conservation will continue. Future Forest and District Plans will further address the needs for peregrine recovery. None of the alternatives is likely to adversely affect the peregrine falcon.

Possible Mitigation Measures

With all of the alternatives, the federal agencies' continued compliance with the Peregrine Falcon Recovery Plan will be adequate.

Cumulative Effects Including the Role of Nonfederal Lands

Nonfederal land management does not affect the determination that the alternatives are not likely to adversely affect the species on federal lands.

Sacramento River Winter Chinook Salmon

Affected Environment

This stock of chinook salmon is listed as threatened throughout the Sacramento River system. A recovery plan for this stock of fish is expected to be released in 1994.

The major spawning areas for this species occur outside of coniferous forests. Before the construction of Shasta Dam, this stock of salmon spawned throughout the upper tributaries of the Sacramento River. The Assessment Team stated, "Forest management practices along the tributaries to the west of the mainstream below the reservoir could have an influence on the species." However, few, if any, federal forest lands occur here. The major factors that affect the species are probably the allocation of water flows from Shasta Reservoir, withdrawal of water from the river for irrigation, and harvesting the fish at sea.

Environmental Consequences

Effects of Alternatives

Regardless of the alternative selected, the federal agencies will consult the recovery plan for direction. The alternatives are not likely to adversely affect Sacramento River winter chinook salmon.

Possible Mitigation Measures

At this time it is not known how Forest Service and BLM land management may improve conditions for this species. When completed, the recovery plan should be reviewed to assure that all appropriate actions are taken.

Cumulative Effects Including the Role of Nonfederal Lands

Nonfederal land management and water management do affect this species, but their effects cannot be mitigated or offset by additional measures on federal lands. Therefore, the determination for federal lands would not change.

Snake River Fall Chinook Salmon, Snake River Spring/Summer Chinook Salmon, and Snake River Sockeye Salmon

Affected Environment

These anadromous species migrate in the Columbia River through the range of the northern spotted owl to reach their spawning areas in Idaho.

Effects of Alternatives

Significant threats to all these anadromous species are issues that are unrelated to federal forest management within the range of the northern spotted owl. For this reason, the Assessment Team did not include these three species in their viability panel assessments.

In preparation of the Final Environmental Impact Statement for the Northern Spotted Owl (USDA FS 1992), the Forest Service determined that ". . . the Snake River sockeye and chinook salmon will not be adversely affected by any of the alternatives evaluated in this environmental impact statement. In a letter from the National Marine Fisheries Service dated January 7, 1992, the Service indicated that they concur with this determination" (USDA FS 1992:3&4-154—155). The alternatives considered in this SEIS are also determined not likely to adversely affect Snake River fall chinook, Snake River spring/summer chinook and Snake River sockeye salmon. Appendix G includes a letter of concurrence from the National Marine Fisheries Service.

Cumulative Effects Including the Role of Nonfederal Lands

Nonfederal lands within the range of the northern spotted owl have no effect on these species and would not affect the determination for federal lands in this SEIS. Cumulative effects, such as management of dams on the Columbia River and irrigation developments, overharvest, diseases, and artificial propagation were identified by National Marine Fisheries Service as contributing to the decline of anadromous salmonid populations. However, these impacts are not expected to be cumulative with the effects of the alternatives and would not affect the determination for federal lands in the planning area.

Klamath Short-Nose Sucker and Lost River Sucker

Affected Environment

The Lost River sucker (Deltistes luxatus) and the shortnose sucker (Chasmistes brevirostris) were listed as endangered species in 1988 (50 CFR Part 17, 1988). The Recovery Plan for these species was completed in April 1993. Critical habitat has not been designated for these species, but the Fish and Wildlife Service has been ordered by the court to designate critical habitat by April 1994. Much of the habitat for the suckers is found within the boundaries of the Klamath Falls Resource Area of the Lakeview BLM District, on the Winema and Fremont National Forests in Oregon, and on the Klamath and Modoc National Forests in California. These suckers live in the lakes, rivers, and some streams of the Upper Klamath Basin. Typically, they migrate from lakes into rivers to spawn, but some populations are known to utilize spring sources for spawning and refugial sites.

The primary threats to these species result from management of nonfederal lands, including: habitat loss due to alteration of the rivers in which they spawn, diverting water into canals through unscreened diversions, lowering flows in the rivers in which they spawn, and the lowering and eutrophication of Klamath Lake. The threats from federal land management activities are those that may be associated with degradation of water quality and hyper-eutrophication of Upper Klamath Lake.

Environmental Consequences

Effects of Alternatives Alternative 7 would have a greater potential for adverse effects on these two species due to the narrower Riparian Reserves under this alternative. The remaining alternatives are not likely to adversely affect the species due to their provision of wider Riparian Reserves which would improve aquatic habitats.

Cumulative Effects Including the Role of Nonfederal Lands Cumulative effects issues of diversion of water for irrigation and disruption of natural migration corridors for these species are important management considerations, but they cannot be mitigated by changes in federal land management and therefore would not change the determination for these species.

MacDonald's Rockcress

Affected Environment

The MacDonald's rockcress (Arabis macdonaldiana) is listed federally as endangered. Populations and habitat of the MacDonald's rockcress are addressed in a Recovery Plan. The species has been documented to occur on the Arcata BLM District, and is assumed to occur on the Six Rivers National Forest, though identification of plants collected there is being reviewed. Both the Forest Service and BLM are currently managing the known and suspected sites on federal lands in accordance with the Recovery Plan. MacDonald's rockcress occurs on barren to shrub-covered, rocky, and serpentine soils associated with Jeffrey pine woodlands, which range from 3,500 to 4,000 feet in elevation in Del Norte and Mendocino Counties, California (Matthews et al. 1990). These serpentine soils do not typically produce stands of commercial timber due to low site productivity. However, salvage sales and related activities plus development of rock quarries for roads present potential threats to this species (Foster 1992). Mining of nickel-rich soils has posed the greatest threat to the species and was the primary concern cited in the original listing (USDI FWS 1978).

Environmental Consequences

Effects of Alternatives The Arcata Resource Management Plan identifies the Red Mountain area, where the MacDonald's rockcress is found, as an Area of Critical Environmental Concern. This identification will give the plant additional management protection beyond its listing protection. All of the alternatives are not likely to adversely affect the MacDonald's rockcress due to their incorporation of the Area of Critical Environmental Concern.

Possible Mitigation Measures Under all alternatives, BLM's continued compliance with the MacDonald's Rockcress Recovery Plan and current management of the Red Mountain Area of Critical Environmental Concern will adequately provide for this species.

Cumulative Effects Including the Role of Nonfederal Lands

The Biological Opinion included the following discussion of the cumulative effects for this species (Appendix G). "Adverse effects of private activities on McDonald's rock-cress include potential killing or damage of plants from herbicides applied for forest management purposes, and mining activities. To the best of the Service's knowledge, no mining currently is occurring or imminent on the privately-owned colonies of McDonald's rock-cress. Given the reduced availability of commercially harvestable timber in the future on Federal lands under the proposed action, the likelihood that timber harvest may occur on adjacent private lands cannot be ruled out, nor therefore the possibility that privately-owned colonies of McDonald's rock-cress could be adversely affected by herbicide application, road construction, and erosion associated with this activity. It is unlikely that cumulative effects, together with the adverse impacts of the proposed action, would appreciably reduce the likelihood of the survival and recovery of McDonald's rock-cress."

Three Court-Identified Defects to the Forest Service 1992 FEIS

Introduction

On May 28, 1992, the U.S. District Court for the Western District of Washington found the January 1992 *Final Environmental Impact Statement on Management for the Northern Spotted Owl in National Forests* (FEIS) (USDA FS 1992) defective in three areas (*Seattle Audubon Society, et al.* v. *Moseley et al.*, No. C92-479WD (*SAS* v. *Moseley*)). On July 2, 1992, the court enjoined the Forest Service from auctioning or awarding any additional timber sales that would log suitable habitat for the northern spotted owl, and ordered the preparation of a new or supplemental environmental impact statement, and a new record of decision.

The three defects to be corrected are summarized as follows:

Thirteen Bureau of Land Management Timber Sales

The May 14, 1992, exemption by the Endangered Species Committee of 13 Bureau of Land Management timber sales from the requirements of the Endangered Species Act required reevaluation of the selected alternative, the Interagency Scientific Committee (ISC) Conservation Strategy, with respect to management direction for spotted owl habitat on the National Forests.

Anderson and Burnham Report

The preliminary results of a demographic analysis conducted by Anderson and Burnham raised issues that must be considered in determining if the selected alternative, the ISC Conservation Strategy, would still be adequate to provide habitat to support a viable population of the northern spotted owl.

Other Species

The Forest Service needed to address effects of its proposed spotted owl conservation strategy on other old-growth associated species in light of projections by some biologists that the strategy would only provide for a low to medium-low likelihood of providing for the long-term viability of these other species.

Response to Defects

To address the three defects in the FEIS identified by the court, the Forest Service established the Scientific Analysis Team which included some of the members of the original Interagency Scientific Committee. These experts, in turn, conferred with additional scientists and specialists in preparing a detailed technical analysis of the three defects. The team's report, *Viability Assessments and Management Considerations for Species Associated With Late-Successional and Old-Growth Forests of the Pacific Northwest* (SAT Report), was published in March 1993. It is appended to this SEIS as Appendix H, an uncirculated appendix.

As a result of President Clinton's Forest Conference on April 2, 1993, the Forest Ecosystem Management Assessment Team was established to identify options for management of late-successional and old-growth forests on federal lands within the range of the northern spotted owl. To assure consistency of approach, this Assessment Team was to develop and assess options that would likely result in satisfaction of the Forest Service "viability" standard on lands administered both by the BLM and the Forest Service. The Assessment Team used the SAT Report in its analysis, and incorporated its key elements into many of their options.

The Forest Service and BLM were then directed by the Secretaries of Agriculture and the Interior to supplement the FEIS (and other EIS documents) to assess the effects of the options prepared by the Assessment Team. Thus, the defects found by the court are effectively addressed in the FEMAT Report and this SEIS.

Thirteen BLM Timber Sales

On April 19, 1993, the BLM withdrew the application for exemption from the Endangered Species Act for the 13 timber sales at issue, making the issue moot (Babbitt 1993, Penfold 1993). In addition, this SEIS addresses management impacts to plant and animal communities on lands administered by both the Forest Service and BLM.

Anderson and Burnham Report

The final Anderson and Burnham report of 1992 (Anderson and Burnham 1992) was reviewed by the Scientific Analysis Team (Appendix H) and again by the Assessment Team (Appendix A). Subsequent to those reports, the northern spotted owl demographic data were updated to reflect 2 additional years of data for the five previously-analyzed study areas, and to add material from six new study areas. The formal analysis of these data was conducted during a 12-day session in December 1993 involving 50 scientists and 103 data sets. It is reported in a paper authored by Ken Burnham, David Anderson and Gary White. The paper is included in this SEIS as a portion of Appendix J, and its results are reported and discussed earlier in this chapter.

Briefly, the analysis of updated demographic data strengthens the previous inference that northern spotted owl populations are declining. The rate of decline is estimated to fall within a range of 0.7 to 8.4 percent per year, and the authors interpret the rate to be accelerating. These results are discussed in detail in the Threatened, Endangered and Proposed Species section earlier in this chapter and in the biological assessment (Appendix G).

Other Species

An underlying need for the proposed action examined in this SEIS is to adopt management direction for lands administered by the Forest Service and BLM within the range of the northern spotted owl to assure that late-successional and old-growth habitat is managed to support viable populations of species. The Assessment Team developed a list of species likely to be closely associated with late-successional and old-growth forests. An analysis of the effects of each alternative was conducted for these species or species group. The management activity that would affect late-successional species habitat allowed under most alternatives is not such that it would be likely to result in the extirpation of species from the planning area. This holds for the 32 species which the court found required additional analysis.

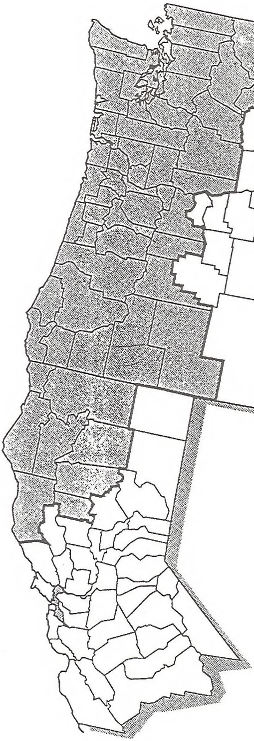
The Economy and Communities

Overview

The social and economic area affected by the alternatives presented in this SEIS generally correspond to the range of the northern spotted owl, including western Washington, western Oregon, and northwestern California (see Figure 3&4-15). The three states have a population that is growing at a higher rate than the national average. The 1990 population in the 57-county area was 7,291,325 people, with an urban population comprising nearly 74 percent of the total population. This reflects a significant change from the end of World War II when the National Forests and BLM Districts were opened for timber resource development. In 1950, the three-state area in the spotted owl's range had a population of 3.5 million people (less than half the current). At that time, urban centers contained 58 percent of the population. Today most of the population resides in the metropolitan areas of western Washington (Seattle/Tacoma), Willamette Valley (from Eugene/Springfield to Portland/Vancouver), southern Oregon (Medford/Ashland), and northern California (Redding/Red Bluff). Transportation links are plentiful including the I-5 interstate corridor connecting Canada and California; north/south U.S. highways 97, 99, and 101; east/west interstates I-90, I-84, I-82, and U.S. highways 2, 12, 20, and 26; and major airports in Seattle/Tacoma and Portland. The Southern Pacific Railroad connects the West Coast; the Union Pacific Railroad connects to points east through Salt Lake City and Boise; and the Burlington Northern Railroad connects with the northern tier states.

Traditionally, jobs and industry in the region have relied on the extraction of natural resource products from the fields, forests, and hills. Many small to medium-sized industries were established near the resource sites, usually in rural areas. In fact, a number of communities were established around these plants to enable workers to be close to their jobs. Investments and profits from these industries have significantly helped the regional economy develop and

Figure 3&4-15. Geographic area encompassed in the impact region



grow. Probably the periods of highest employment and business growth related to natural resource industries was in the 1910-30 period and again in the 1950-60 period. As the industries have become more efficient and productive, many smaller businesses have closed, jobs have been lost or moved, and communities have had to adjust to severe changes. A number of the resource-processing businesses moved away from proximity to the resources to be closer to transportation hubs, subsequently increasing their competitiveness. Impacts from the reorganization of these industries, especially the timber industry, was especially felt during the 1970-90 decades.

As a result of the loss of thousands of jobs in rural communities in recent decades, people in the region have flocked to the major cities where jobs have been generally abundant, even during recessionary periods. The labor force employed in the farming, forestry, fishing, and mining sector in 1990 was 4 percent of total employment, in contrast to 10.8 percent in 1950. Also, employment in the manufacturing sector decreased to 17.9 percent in 1990 from 23.5 percent in 1950. Generally, in the Pacific Northwest during the last few decades, employment in these sectors has gone through hiring, layoffs, and rehiring cycles based on a number of factors including national recessions, housing starts, fluctuating interest rates, changing productivity and efficiency standards, new technology, service-based employment, and retail trade.

Social and economic data for the analysis in this SEIS was based on political boundaries and compiled from states and counties, which report information about their respective areas. There are 25 counties in western and central Washington, 24 counties in western and central Oregon, and 8 counties in northwestern California, all of which comprise the social and economic study area for this SEIS. Thus, the human dimension (socio-economic) analyses presented in this SEIS depend on secondary sources of information (U.S. Census Bureau data, as well as various national, state, and local data), as well as two social workshops (described below). In some instances, and as reported in the following forest resource descriptions, additional social and economic information was gathered and incorporated by the Assessment Team (FEMAT Report, Chapter VI, Economic Evaluation of Options).

This section does not present an analysis of the costs and benefits associated with the various alternatives in this SEIS. As stated in the regulations, "For purposes of complying with the Act [NEPA], the weighing of the merits and drawbacks of the various alternatives need not be displayed in a monetary cost-benefit analysis and should not be when there are important qualitative considerations" (40 CFR 1502.23).

Evaluation of many economic aspects of the alternatives were limited by resources and uses that have no market or transaction costs or benefits. The social analysis relies on qualitative evaluations by experts familiar with the areas or communities. Also not factored into this analysis is reduced federal employment due to implementation of the alternative selected in the Record of Decision for this SEIS, or changes due to market conditions or public preferences.

Timber Harvest

Affected Environment

Each of the proposed alternatives will have a direct effect upon the level of timber harvested from forest lands administered by the BLM and the Forest Service within the planning area. Timber harvest and associated revenue from private or other publicly owned forests in the region will be indirectly affected.

Environmental Consequences

Methodology

The data necessary to do the analysis of sustainable sale quantities were obtained through the construction of Geographic Information System (GIS) data bases. This system provides spatial information about land allocations.

The federal forests of the region are managed under a nondeclining yield mandate which means that scheduled annual harvest levels can be maintained without decline over the long term if the land allocations and associated standards and guidelines and the planned schedule of harvests and regeneration is followed. The decadal harvest levels were estimated using a variety of techniques including linear programming (FORPLAN), simulation (TRIM-PLUS), and data base manipulation. These planning models simulate the acres treated and resource yields given the land allocations and management standards and guidelines. An analysis in support of the Assessment Team used the term "probable sale quantity" (PSQ) to describe these results rather than "allowable sale quantity" (Johnson et al. 1993). The objective is to estimate sale levels likely to be achieved (PSQ) as opposed to estimating ceiling or upper-limit harvest levels (ASQ). The use of PSQ rather than ASQ for this SEIS recognizes the uncertainties in the estimates. Sustainable sale estimates will be revised using more refined data and procedures available when Draft Forest and District plans are completed or current plans are revised.

The PSQ is based only on lands that are considered suitable for the production of programmed, sustainable timber yields. Timber suitable lands are those lands physically and economically suited to timber production that are outside of lands designated for forest uses considered incompatible with programmed, sustained timber harvests. Timber suitable lands are located only in the matrix or in Adaptive Management Areas. Lands designated as Congressionally Reserved Areas, Administratively Withdrawn Areas, Late-Successional Reserves, and Riparian Reserves are considered unsuitable for sustained timber yields. These lands are therefore not included in calculations of PSQ.

The Managed Late-Successional Areas on the Shasta-Trinity and Wenatchee National Forests under Alternative 9 in this Final SEIS are also considered as reserves with no PSQ attributed to them. These areas were designated as Managed Late-Successional Areas in Alternative 9 in the Final SEIS to provide habitat around designated northern spotted owl pair areas in eastern Washington and the California Cascades as described in the *Final Draft Spotted Owl Recovery Plan* (USDI unpub.). In Alternative 9 of the Draft SEIS, these areas were considered as part of the matrix. Neither the FEMAT Report nor the Final Draft Spotted Owl Recovery Plan, from which the standards and guidelines for these late-successional areas are adopted, discuss whether these areas should be considered as part of the base for calculation of PSQ. They have not been included in the calculations of PSQ for Alternative 9 in the Final SEIS. This may change as a result of province, Forest or District-level planning.

Matrix acres include all federal lands outside the four types of withdrawals listed above and outside of Adaptive Management Areas. Matrix lands include productive forest, nonproductive forest and nonforest lands. Timber suitable acres, on the other hand, include only the physically and economically suitable timberland in the matrix or in Adaptive Management Areas. The timber base, or suitable lands, is a subset of the acres located in the matrix and in Adaptive Management Areas (Johnson et al. 1993).

During the analysis for this SEIS, some standards and guidelines for the various alternatives made it difficult to determine actual harvest levels. Some examples: (1) Many alternatives require watershed analysis in Key Watersheds before timber harvest can occur. Estimates were made of probable sale levels using a set of interim rules for those watersheds. (2) Several alternatives would designate "activity centers" for marbled murrelets and other species as they are found. These designations would preclude or restrict timber harvest. However, when PSQ predictions were made, no allowance was made for these findings beyond sites that are already known. (3) Alternative 9 designates Adaptive Management Areas. The Assessment Team assumed that such designation would not reduce the sale level that would otherwise occur under the alternative. However, the actual level of sales that will occur in these areas is somewhat uncertain. (4) The extent of Riparian Reserves associated with intermittent streams is not precisely known. Therefore, sustainable timber sale quantities are subject to change based on additional analysis and inventories.

Probable sale quantities do not include volume that might be obtained under some alternatives from thinning, salvage and other treatments in areas designated as Late-Successional Reserves or Riparian Reserves, Administratively Withdrawn Areas, or Managed Late-Successional Areas. An additional volume of 100 to 170 million board feet per year might be obtained from these activities depending on the alternative.

Effects of Alternatives

Estimates according to the BLM and Forest Service indicate that timber sales planned in federal forests within the range of the northern spotted owl under the No-Action Alternative would be 3 to 4 billion board feet per year, thus generating more that $1 billion annually in economic benefits in the Pacific Northwest. Under sustained yield plans, annual harvest levels from federal forests in the study area for regional and community analysis had averaged 5.6 billion board feet during the period 1980 to 1989. PSQ from federal forests within the range of the northern spotted owl averaged 4.5 billion board feet during the same period. The alternatives considered to protect the habitat of the northern spotted owl and associated late-successional species will restrict timber harvest in these forests, resulting in substantial social and economic costs.

The probable levels of federal timber sales for the first decade for each alternative are summarized in Table 3&4-43 and Figure 3&4-16. The PSQ estimate for Alternative 1 was incorrectly reported in the Draft SEIS and has

Table 3&4-43. Historical federal harvest levels and annual probable sale quantites (PSQ) in the first decade by alternative[1]

Administrative Unit	Average Harvest 1980-89	Average Harvest 1990-92	Alternative 1	2	3	4	5	6	7	8	9	10
	----------	----------	----------	----------	----------	million board feet, Scribner	----------	----------	----------	----------	----------	----------
National Forests - Region 6[2] Owl Forests[3]												
Washington	1,019	528	16	104	112	103	152	129	230	202	120	152
Oregon	2,029	997	40	265	299	340	449	365	765	518	413	412
Total	3,048	1,525	56	369	411	443	601	494	995	720	533	564
National Forests - Region 5[4] Owl Forests[3]												
California	561	291	17	113	125	111	141	150	238	222	224	198
BLM - Owl Forests												
Oregon/California	915	573	41	142	149	158	188	167	412	290	201	196
Total Owl Forests	4,524	2,389	114	624	685	712	930	811	1,645	1,232	958	958

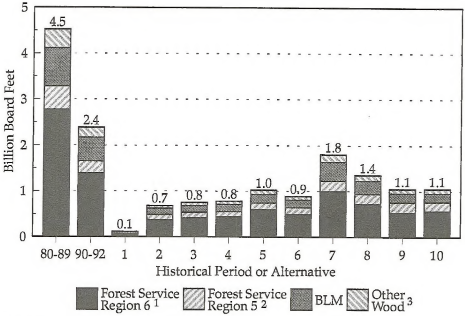
[1] Probable sale quantities do not include "other wood" estimates. To obtain other wood estimates, add 10 percent. Historical numbers are gross volumes and thus include historical levels of other wood. Historical numbers for 1990-92 are estimates.

[2] Region 6 = Pacific Northwest Region, Forest Service

[3] Owl Forests = Those lands administered by the Forest Service and Bureau of Land Management within the range of the northern spotted owl.

[4] Region 5 = Pacific Southwest Region, Forest Service

Figure 3&4-16. First decade probable average annual timber sale levels (PSQ) by historical period and alternative



1 Region 6 = Pacific Northwest Region

2 Region 5 = Pacific Southwest Region

3 Includes cull, submerchantable material, firewood and other products.

been corrected in this Final SEIS. The PSQ figures for Alternative 9 are changed from the Draft SEIS to reflect modifications made to Alternative 9 as a result of public comments and internal review. The modifications, discussed in Chapter 2, earlier in Chapter 3&4, and presented in detail in Appendix B11 of this Final SEIS, are reflected in changes to standards and guidelines and to land allocations, The modifications that affected PSQ estimates include additions to reserves to protect known locations of species associated with late-successional forest conditions, the application of Riparian Reserve Scenario 1 throughout the range of the northern spotted owl, protection of known northern spotted owl nest sites, the designation of Managed Late-Successional Areas in Washington and northern California, additional requirements for coarse woody debris on matrix lands, and the replacement of the 180-year rotation on National Forests in California by the rotations specified in Forest Plans. Other modifications made to Alternative 9 add to the uncertainty of PSQ calculations. These changes include the requirement to survey and manage future sites of some late-successional forest associated species, the requirements for buffers around caves and other structures where bats are found, the requirement to maintain late-successional forest remnants in fifth field watersheds that currently have less that 15 percent of forested areas in late-successional forests, and modifications to site treatments on matrix lands.

The probable sale quantities in the Final SEIS also reflect updated analysis that corrected some minor problems in the estimates reported in the Draft SEIS. The revisions to the Spatial Unified Database (see Chapter 2, Acreage and Data Changes Between Draft and Final) were analyzed correctly in the updated PSQ except for the following: (1) minor adjustments to Key Watershed and Late-Successional Reserve boundaries by the Forests and Districts were completed too late for inclusion in the update, (2) the owl additions identified for inclusion in Late-Successional Reserves for Alternatives 1, 2, 3, 6, 8, and 10 (Johnson et al. 1991) were not modeled in the updated PSQ, and (3) the Modoc and Lassen National Forests are not included in this analysis. The alternatives are expected to have no effect on PSQ on the Lassen National Forest and little (relative to this analysis) effect on the Modoc. However, after an alternative is selected, timber offered for sale from these two Forests within the range of the northern spotted owl will reflect the harvest implications of the standards and guidelines in Chapter 2 of this Final SEIS.

The overall result of the revisions to PSQ for Alternative 9 between the Draft SEIS and the Final SEIS is a reduction of 92 million board feet (MMBF) per year: from 1,050 MMBF to 958 MMBF per year. Administrative unit PSQs are displayed in Table 3&4-44 by alternative for each administrative unit.

Probable sale quantity calculations were made by administrative unit and aggregated into the regional and state totals. Review of administrative unit probable sale quantities will be made before completion of Draft Forest or District Plans or when the plans are revised. Sustainable sale estimates will be made using more refined data and procedures available when Draft Forest and District Plans are completed or current plans are revised.

Probable average annual sale quantities by alternative in Tables 3&4-43 and 3&4-44 are net volumes and do not include "other wood". Other wood is the volume of cull (wood that is decaying or too crooked for processing),

Table 3&4-44. Probable sale quantities (PSQ) in millions of board feet (MMBF) by alternative for each administrative unit

Administrative Unit		Alternative 1	2	3	4	5	6	7	8	9	10
		MMBF									
National Forests - Region 6* - Washington											
Gifford Pinchot		9	58	62	58	94	71	135	97	73	72
Mt. Baker-Snoqualmie		2	10	12	12	15	16	32	24	12	19
Okanogan		1	5	5	5	6	6	8	10	5	9
Olympic		1	8	8	7	9	9	19	15	10	12
Wenatchee		4	23	25	22	28	28	36	57	20	41
NF - Washington Total		16	104	112	103	152	129	230	202	120	152
National Forests - Region 6* - Oregon											
Deschutes		2	13	14	14	15	14	19	18	17	18
Mt. Hood		7	45	50	68	85	59	132	77	67	59
Roque River		1	5	6	11	16	10	29	31	26	25
Siskiyou		3	20	22	27	34	27	118	41	24	27
Siuslaw		3	21	23	19	29	27	119	38	23	27
Umpqua		10	66	75	89	108	92	149	125	83	98
Willamette		10	64	77	88	129	104	152	147	136	120
Winema		5	32	32	23	33	33	47	40	37	39
NF - Oregon Total		40	265	299	340	449	365	765	518	413	412
NF - Region 6 Total		56	369	411	443	601	494	995	720	533	564
National Forests - Region 5** - California											
Klamath		7	39	44	38	50	55	82	102	96	92
Mendocino		0	12	12	11	13	13	23	21	20	19
Six Rivers		6	12	15	19	23	19	43	24	26	21
Shasta/Trinity		4	50	54	43	55	63	90	75	82	67
NF - California Total		17	113	125	111	141	150	238	222	224	198
National Forest Total		72	482	536	554	742	644	1,233	942	757	762
Bureau of Land Management Districts - Oregon											
District	Sustained Yield Unit										
Salem	Columbia	4	9	9	8	10	9	28	14	9	10
	Clackamas	1	5	6	6	9	7	17	11	8	10
	Alsea	1	3	3	3	3	4	22	14	8	6
	Santiam	1	6	7	5	12	8	24	14	11	9
	Salem Total	8	23	25	23	34	29	91	53	36	35
Eugene	Upper Willamette	10	18	20	22	28	24	46	42	25	29
	Siuslaw	6	9	9	9	10	9	21	12	7	10
	Eugene Total	16	27	29	31	38	33	67	54	32	40
Roseburg	South Umpqua	1	5	5	7	9	6	20	12	9	7
	Douglas	3	14	15	18	22	17	54	39	29	22
	Roseburg Total	4	19	20	25	31	23	74	51	38	29
Coos Bay	South Coast	12	41	41	44	44	43	95	66	43	52
	Coos Bay Total	12	41	41	44	44	43	95	66	43	52
Medford/	Josephine	0	14	15	14	16	16	38	30	22	17
Lakeview	Jackson	0	15	16	17	19	19	39	32	26	19
	Klamath	0	3	3	3	6	4	8	4	4	4
	Medford Total	1	32	34	35	42	39	85	66	53	40
BLM Total		41	142	149	158	188	167	412	290	201	196
Total		114	624	685	712	930	811	1,645	1,232	958	958

Note: All PSQ estimates are reported in 32 foot logs. Divide the PSQ by 0.825 to convert to 16 foot logs. PSQ estimates for each administrative unit will be reviewed upon completion or revision of Forest and District Plans. PSQ estimates do not include other wood estimates.

* Region 6 = Pacific Northwest Region, Forest Service

** Region 5 = Pacific Southwest Region, Forest Service submerchantable size material, or other products not considered as merchantable and not normally part of allowable sale quantity calculations. Historically, other wood has accounted for about 10 percent of the total harvest volume from timber suitable federal lands in the planning area. Figure 3&4-16 does include an additional 10 percent of PSQ as other wood. Harvest of other wood in the future is uncertain due to changes in forest management standards and guidelines, such as retention of snags and coarse woody debris.

In future decades, sustainable harvest levels of timber (PSQ) should increase as the effect of management on the timber suitable lands takes effect. Growth per acre will increase and a better balance of age classes (a more equal representation of all age classes) will be achieved.

The average annual value of harvest in the planning area was $650 million in 1990-1992. This represents the market value of the trees prior to harvesting. Log values to the mill in this period were over $1 billion per year and actual product values were substantially higher (logging and transportation costs were approximately $140/MMBF).

In the short term, timber sale quantities may differ from the calculated sustainable level due to required surveys and assessments and due to the time required to develop new timber sales that conform with the selected alternative (FEMAT Report, Chapter VI, Economic Evaluation of Options). Coastal harvests will be restricted until the completion of marbled murrelet surveys, which may take 3 or more years. Harvests in many watersheds will be restricted until comprehensive watershed analyses are conducted, which may take several years. Finally, some sales in the current program may be located in designated areas and therefore, unsuitable for harvest. The importance of short-term sales is magnified because most of the current volume under contract on federal lands will be harvested in 1994. (FEMAT Report, Chapter VI, Economic Evaluation of Options).

In June of 1993, the Forest Service had approximately 1.8 billion board feet of timber under contract and 0.085 billion board feet offered but not awarded throughout the planning area. The BLM had approximately 0.235 billion board feet under contract and 0.232 billion board feet offered but not awarded. The Forest Service and BLM will conduct analysis of each of the "sales under contract" and "sales which have been offered but not awarded" to determine whether harvest of these areas should be allowed under the selected alternative. The analyses include economic as well as conservation criteria. Based on these analyses, the agencies will determine which harvests can proceed as planned, which can proceed with minor modifications, and which should not proceed. At least one-third of the sales under contract are outside any of the designated land allocations, and will probably continue as planned. Additional Endangered Species Act consultation with the Fish and Wildlife Service for the marbled murrelet may be required in some cases. Other sales may have to be reconfigured to meet objectives for specific species, watersheds, and late-successional designated areas.

Estimated sale levels under all alternatives are below program levels of the 1980's, as well as below the harvest levels of 1990-1992 when most new federal timber sales were enjoined. In 1990-1992, harvests consisted of sales under contract from the 1980's. The sale quantities of the alternatives will not permit 1990-1992 levels of timber harvest in the future. In the next 1 to 3 years, the outlook for sale levels is substantially less than the decadal average sales potential.

In addition to reduced harvest quantities in the decade ahead, wood quality is also apt to decrease. In the first decade, thinning and other partial harvests would account for a large portion of the volume harvested under the various alternatives. Secondary wood products manufacturers may see an even greater decline in raw materials than the probable sale quantities would indicate as a result of smaller average tree size.

Sustained Yield Units

The Olympic National Forest has two sustained yield units: the Shelton Cooperative Sustained Yield Unit (Shelton CSYU) and the Grays Harbor Federal Sustained Yield Unit (Grays Harbor FSYU).

The Shelton CSYU was established in 1946 and is managed cooperatively by the OlympicNational Forest and the Simpson Timber Company. The unit comprises approximately 361,000 acres of forest land divided between the Olympic National Forest (111,000 acres) and Simpson Timber Company (250,000 acres). Alternative 9 designates the Olympic National Forest in the unit as Late-Successional Reserves (77,000 acres) and the Olympic Adaptive Management Area (23,000 acres). The other alternatives specify different mixes of land allocations. The standards and guidelines associated with an alternative apply only to the Olympic National Forest in the CSYU and not to Simpson Timber Company lands.

None of the alternatives in the SEIS would change the boundaries of the Shelton CSYU or call for any changes in the Cooperative Agreement. Under Alternative 9, the probable sale quantity for the CSYU would be approximately 178 million board feet (approximately 2 MMBF from the Olympic National Forest and 176 MMBF from Simpson lands). The other alternatives include similar harvest levels and mixes for the Shelton CSYU. The 1990 Olympic Forest Plan estimated a 193 MMBF harvest level for the Shelton CSYU with about 9 MMBF coming from the Olympic National Forest within the unit. Recent (1986-1990) actual harvest levels from the CSYU have averaged 184 MMBF per year. Of this, an annual average of 180 MMBF has come from Simpson Timber Company lands.

The agreement establishing the Shelton CSYU states that the unit is to be managed for "continuous and sustained forest production." The agreement does, however, provide for removal of lands in the Olympic National Forest from the timber harvest base when environmental, recreational, or other considerations make it in the public interest to use the land for other than timber production. Between 1946 and 1985 the National Forest portion of the CSYU was the principal source of harvest from the unit; now the focus of timber harvest has shifted to the Simpson Timber Company lands.

The Grays Harbor FSYU was established in 1949 to help stabilize Grays Harbor County's natural resource-based economy. The unit encompasses approximately 126,000 acres of the Quinault Ranger District of the Olympic National Forest. Under the provisions governing this unit, a minimum of 50 percent of the timber harvested from the Quinault Ranger District must receive primary manufacturing within Grays Harbor County. The primary manufacturing provision includes all timber purchasers and their associated manufacturing facilities within Grays Harbor County. Alternative 9, as well as most of the other alternatives, allocates the majority of the unit's lands to Late-Successional Reserves. Similar to the Shelton CSYU, the standards and guidelines of the selected alterative will apply to the Grays Harbor FSYU.

Role of Nonfederal Lands

The change in availability of federal timber will likely affect regional forest product prices and spur increases in harvest from private and other public lands in the region. Predictions of harvest levels from nonfederal lands were estimated for harvests of 0.5, 1.0, 1.5, and 2.5 billion board feet from federal forests (Table 3&4-45). The effects of changes in federal harvests on regional timber prices and harvests from nonfederal sources were simulated using the Timber Assessment Market Model (TAMM). The results were updated for the Final SEIS to correct errors in private harvest estimates. Some supply responses are indicated from private timber owners. The supply responses predicted from nonfederal forests in the Final SEIS are 4 percent less than those predicted in the Draft SEIS. The level of the supply response is short lived and tempered by the age distribution of the timber on private lands (FEMAT Report, Chapter VI, Outlook for Nonfederal Timber Harvests). Private harvests increase in the mid-1990's and then drop below levels of the 1980's by the year 2000.

Reductions in federal timber sales in the planning area do produce price increases for timber (FEMAT Report, Chapter VI, Outlook for Nonfederal Timber Harvests). All simulations show large price increases from the prevailing levels in the regional market in 1990. These price increases will motivate other public and private landowners to harvest timber in the near term and to invest in timber management in the longer term.

Total public and private timber harvests (Table 3&4-46) give an indication of which regions are most affected by changing federal harvest levels. In the State of Washington, total harvest levels are less affected than those in the other states. Federal harvests represent a much smaller portion of the total harvest. Also, the predicted response of other landowners will tend to maintain harvests in Washington at a level somewhat higher than during 1990-1992. However, this will be 16 to 17 percent less than the level of the 1980's. Almost all of the harvest reduction in Washington is in the western region of the state.

Oregon harvests are predicted to decline under all alternatives compared to harvest levels of the 1980's. All alternatives except Alternative 7 would decrease harvests on the east side of the Cascade Range as well as the west side. Eastern Oregon harvests would be substantially reduced on federal and nonfederal lands. Substantial reductions are also predicted for California under all alternatives due to reductions on both federal and nonfederal lands (Tables 3&4-43 and 3&4-46).

Table 3&4-45. Predicted decadal average timber harvest levels on nonfederal lands by geographic region for various federal harvest levels (statewide for Oregon and Washington)

Region	Average 1980-1989	Average[1] 1990-1992	Harvest Level from Federal Forests in the Owl Region[2] 500	1000	1500	2500
	---million board feet, Scribner---					
Washington						
Western	4,126	3,775	4,061	4,004	3,969	3,827
Eastern	822	752	810	785	773	767
Total	4,948	4,527	4,871	4,789	4,742	4,594
Oregon						
Western	3,023	2,855	3,408	3,360	3,332	3,212
Eastern	604	688	466	444	434	429
Total	3,627	3,543	3,874	3,804	3,766	3,641
California						
Owl Region[2]	1,640	1,783	1,404	1,369	1,328	1,258
3 State Total	10,215	9,853	10,149	9,962	9,836	9,493

[1] Values for California are the average for 1990-1991. Volumes were estimated for Oregon and Washington for 1992.
[2] Owl Region = The range of the northern spotted owl.

Source: TAMM simulations

Table 3&4-46. Historical and predicted first decade average timber harvest from all lands by geographic region for a range of harvest levels from federal forests

Region	Average 1980-1989	Average 1990-1992	Harvest Level from Federal Forests in the Owl Region[1] 500	1000	1500	2500
	--------	million board feet, Scribner	--------			
Washington						
Western	4,940	4,179	4,107	4,103	4,127	4,122
Eastern	1,151	1,014	934	946	965	1,002
Total	6,091	5,193	5,041	5,049	5,092	5,124
Oregon						
Western[2]	5,805	4,320	3,676	3,903	4,166	4,669
Eastern[3]	1,708	1,624	858	896	930	972
Total	7,513	5,944	4,534	4,799	5,096	5,641
California						
Owl Region[1]	2,201	2,074	1,479	1,519	1,553	1,633
3 State Total	15,805	13,211	11,054	11,367	11,741	12,398

[1] Owl Region = The range of the northern spotted owl.
[2] Western Oregon figures include a small amount of harvest from lands administered by the BLM in northern California.
[3] Harvest levels from non-owl forests have not been subjected to rigorous analysis for the various alternatives and appear only for regional price projections. Harvest levels from eastside forests are uncertain at the present time.

Historically, a substantial portion of the nonfederal timber harvest was exported (FEMAT Report, Chapter VI, Outlook for Nonfederal Timber Harvests). Export logs are the second most important forest product in the region in terms of volume and value. While some people view these exports as a drain on the manufacturing industries, others view them as a vital part of the economy of the region.

Reductions in federal timber harvests may result in increased domestic competition for logs currently exported. The combined effects of higher domestic prices, changing wood quality, and increased export of milled products has led many to conclude that there will be substantial reductions in log exports from the region. Log exports from the region did decline from 3.7 to 2.5 billion board feet (a 32 percent reduction) between 1988 and 1992. This level of export is predicted to continue into the decade ahead assuming no change in nonfederal log export policies.

In summary, the effects of federal harvest reductions on nonfederal lands will vary by state. While federal harvest reductions will not be buffered to any great extent by increases in nonfederal harvest levels in Oregon and California, they will be in Washington.

Mills could see some increased supply from a redirecting of log exports to domestic markets. Market forces, however, have already caused a reduction in log exports to a level that is expected to remain stable during the decade ahead.

Mineral Resources

Affected Environment

Minerals are divided into three classes for management purposes: locatable, salable, and leasable minerals. The manner in which each class is managed and the authority of the federal agencies to control the exploration and development of each management class varies.

Locatable minerals are those metallic and nonmetallic minerals for which the Mining Law of 1872 gives United States citizens the statutory right to prospect for, locate, and develop claims on public domain lands. All valuable mineral deposits on lands open to mineral entry are locatable unless excluded because they are leasable or salable. Gold, silver, copper, and zinc are examples of minerals which are generally locatable. Locatable minerals occur throughout the range of the northern spotted owl.

Salable minerals are common varieties of sand, stone, gravel, pumice, pumicite, cinders and clay. In general, these minerals are of widespread occurrence, of relatively low unit value, and are generally used for construction materials or for building roads. Disposal of salable minerals from public lands is at the discretion of the federal agencies.

Leasable minerals include those minerals that can be leased under one of the several mineral leasing acts. In northern California, western Oregon, and western Washington, the leasable mineral commodities include oil and gas, geothermal energy, coal, and metallic minerals on acquired lands.

Federal lands in the planning area are known to include substantial mineral resources. For example, the 1992 analysis of designated critical habitat for the northern spotted owl (FEMAT Report, Chapter VI, Economic Evaluation of Options) provided preliminary assessments of the potential effects of limiting mining activities within the lands designated as being critical habitat for the northern spotted owl.

At least 10 known mineral resource deposits are located within critical habitat units, including 7 in Jackson and Josephine counties in Oregon. These minerals include lime, limestone, silica, copper, zinc, gold, silver, and chrome. Of these 10 known deposits, 1 is currently being mined, 3 others could be profitably mined at 1990 prices, and 4 more could be profitably mined given a doubling of mineral prices. The mineral resources from the currently profitable mines are estimated to have a value of $344 million. It should be noted that this value includes the one active operation and the potential contributions from the other operations.

In addition to known reserves with some current or potential activity, the Geological Survey (USDI) identified three mineral terranes in southwestern Oregon and the "copper porphyry" terrane as having substantial potential for the discovery of new deposits. The copper porphyry terrane corresponds roughly to the Cascade Range in Washington, Oregon, and northern California. This terrane in particular holds great potential for mineral deposits within the boundaries of designated reserves. The copper porphyry terrane potentially could produce hundreds of millions of dollars worth of minerals including silver, gold, molybdenum, and copper.

The entire Cascade Range of Washington and Oregon, as well as the eastern halves of the Klamath and Shasta-Trinity National Forests and 40 percent of the Mendocino National Forest in California, are prospectively valuable for geothermal resources. Geothermal exploration has been localized with little disturbance to a site. Also, the location of drilling sites for exploration has been flexible; therefore, environmentally sensitive sites usually have been avoided.

Areas of federal forests in Oregon and Washington are prospectively valuable for oil and gas resources. There are no prospective oil and gas resources within the boundaries of the four northern California National Forests.

In the long term, it is likely that additional mineral deposit discoveries will lead to further activities in mining and mineral processing in the region. The level of expansion in these industries may be limited under the alternatives.

Environmental Consequences

The effect of the alternatives on mineral and energy resources is directly related to the areas that would be withdrawn from mineral leasing or to the constraints placed on the development of those resources. Withdrawal of areas from leasing may not be necessary because energy exploration and development activities affect very few acres. A more likely effect would be mitigation measures attached to mineral leases and plans for locatable mineral development designed to protect habitat for spotted owls and other late-successional and old-growth related species.

Salable mineral development typically takes the form of small sand and gravel pits, usually on the order of 1 acre in size. Because of the inherent low value of salable minerals, they are usually extracted close to the surface of the ground and near where they will be used. It would be unusual to need to develop such a source within a designated reserve.

The development of mineral resources may be limited by the land allocations and standards and guidelines proposed in the alternatives. However, the more likely effect of designating areas for habitat for the northern spotted owl and other late-successional and old-growth related species would be that additional measures to protect habitat would be required under mineral leases and in plans for locatable mineral development. This would tend to increase the costs of extracting minerals and result in less mining in these areas.

Range/Grazing Resources

Affected Environment

Federal lands of the West are often leased for grazing. Grazing use of federal lands in Oregon, Washington, and northern California is far more prevalent east of the Cascade Range than within the range of the northern spotted owl. Within the range of the northern spotted owl, lands administered by the BLM historically provide about 23,000 animal unit months (AUMs) while National Forests provide about 213,000 AUMs. This contrasts with 510,000 AUMs on the remainder of the National Forests in the Forest Service's Pacific Northwest Region.

Environmental Consequences

Modification of grazing practices would occur under all the alternatives, particularly in the Riparian Reserves. Grazing practices that retard or prevent attainment of reserve objectives will be adjusted or eliminated. The Assessment Team concluded that the consequences to the industry would be small based on the relatively minor amount of range production on federal lands within the planning area. These modifications would likely have consequences, however, for individual permittees.

Special Forest Products

Affected Environment

There is a great deal of interest in the role that nontraditional or "special" forest products might play in the region. Currently, there are five major segments within the industry: (1) floral greens, (2) Christmas ornamentals, (3) wild edible mushrooms, (4) other edibles and medicinals, and (5) Pacific yew (*Taxus brevifolia*). These products appear to have a significant amount of economic value, however their contribution is largely unknown because of below market pricing by public owners and a lack of record keeping.

The major market segments are floral greens, Christmas ornamentals, and edible mushrooms. (The Pacific yew will have less demand in the future in light of the development of synthetic taxol.) In 1989, approximately 27 million bunches of floral greens, 4,000 tons of moss, 15,000 tons of Christmas boughs, 1,000 tons of holly, and 7 million cones were harvested from the forests in the region with a value of over $42 million. In 1992, mushroom harvests totaled 1,200 tons, with a value over $12 million (FEMAT Report, Chapter VI, Economic Evaluation of Options). It must be noted that these are the values of the sales of these products, not the receipts to the government, as these products are rarely marketed by the Federal Government. Instead, permits are issued for nominal fees.

The medium-to-low elevation western hemlock zone of the planning area appears to hold the greatest potential for supporting special forest products activity. Also, the higher elevation mountain hemlock zone is very productive for high-valued beargrass (*Xenophyllum tenax*). These forest types are well represented within the planning area for this SEIS.

Environmental Consequences

Activities will be evaluated, in all cases, for effects on Late-Successional Reserve and Riparian Reserve objectives. Protection of other resource values, special status plants and animals, and resource sustainability must be insured. Where these activities are extensive, it will be appropriate to evaluate whether they have significant effects on late-successional and riparian habitat or species. Restrictions may be appropriate in some cases.

Silvicultural prescriptions can enhance the production of special forest products. Most floral greens thrive in management regimes that maintain the forest in mid-to-late seral stages and maintain semiclosed canopies. Thus, the value of these products can be enhanced through maintenance of stands in this condition. Christmas ornamentals are less sensitive to stand structure, and information is not yet available on management associations of other special products. Use of special forest products could be restricted by alternatives that designate more forest areas to northern spotted owl habitat and other protected areas.

Commercial and Subsistence Fisheries Resources

Affected Environment

While commercial fisheries production and subsistence fishing by American Indians are not a direct output of the forest, they are influenced by the quality of the stream habitat within forested areas. Fisheries-related industries represent a significant portion of the coastal economy of the Pacific Northwest. The principal commercial species categories in the region are salmon, tuna, groundfish, crab, and shrimp. While salmon are the species most directly impacted by forest management activities, it is important to look at all species landed to see how the industry has adapted to changing conditions. Forested watersheds can have considerable impacts on the habitat of these fish species. While not attributable solely to forest conditions, the catch rates and angler days for Pacific Northwest salmon fishing have declined dramatically from the late 1970's.

The volume and value of commercial seafood landed in Pacific Northwest ports fell substantially from 1989 to 1991 (FEMAT Report, Table VI-6, p. VI-28). The most significant decline occurred in salmon catch. A variety of factors contributed to this, including depressed fish prices, unfavorable ocean conditions, and increased competition. These declines have also effected American Indian fisheries and lifestyles.

Short-term changes cannot be extrapolated to determine long-term projections. The seafood catch in the early 1980's, for example, declined greatly with unfavorable economic conditions coupled with El Niño conditions. However, there is evidence of a long-term shift in the Pacific Northwest fishing industry from salmon and tuna production towards groundfish and shrimp. This species substitution has helped sustain the commercial fishing fleet (Radtke and Davis unpub.). Three factors, however, currently pose difficulties for the coastal fishing industry: (1) the recession in world seafood prices, (2) continued reductions in salmon availability, and (3) the loss of a large portion of the groundfish (particularly Pacific whiting) to offshore processors (FEMAT Report, Chapter VI, Economic Evaluation of Options).

Environmental Consequences

None of the alternatives presented in this SEIS are likely to influence the immediate future of commercial or subsistence fisheries operations. However, improved watershed and fisheries management policies could aid in the production of high value salmon in the long term. Generally, it is assumed that the more protection an alternative provides for a stream and its riparian habitat, the more potential benefit there is to fish habitat and fish populations. In the long term, improved watershed protection may aid in the production of commercial and Indian subsistence fisheries.

Recreation Resources

Affected Environment

Federal forests within the range of the northern spotted owl provide significant opportunities for people to enjoy the outdoors. Forest recreation in 1990 totaled 135 million visits (Swanson and Loomis unpub.). Estimates of willingness to pay suggest that forest visitors placed a value of over $1.6 billion upon these visits (over and above their actual expenditures of $2.8 billion) (FEMAT Report, Chapter VII, Social Assessment of Options).

People choose their recreation experience from a variety of settings, activities, and experiences. This broad spectrum of recreation opportunities has been organized based on a system called the Recreation Opportunity Spectrum (ROS). This system classifies the land into broad categories based on recreational potential. The classes include primitive, semiprimitive nonmotorized, semiprimitive motorized, roaded natural, and roaded modified rural recreational opportunities. For recreation supply and demand overall, there is evidence of an excess supply of the more developed, motorized forms of recreation (FEMAT Report, Table VI-9, p. VI-18). Additionally, there is a high and increasing demand for recreation settings with little development, little management activity, and no motorized access. There are about 5.5 million acres in the planning area currently allocated to primitive and semiprimitive, nonmotorized recreation. Demand for use of this recreation classification is forecasted to reach nearly 13.5 million acres by the year 2000 (FEMAT Report, Chapter VI, Economic Evaluation of Options).

The presence or absence of roads is one of the most critical aspects of a landscape that affects people's recreation experience. The majority of developed sites, such as ski areas, campgrounds, and visitor centers occur in roaded setting classifications. Driving for pleasure is the number one recreational use (in terms of numbers) of federal forests and the roaded natural recreation opportunity class has the highest estimated value per acre of the various recreation use classes.

While land classifications can be useful for describing some aspects of recreation value, they are not sufficient for describing hunting and fishing opportunities and values. Pacific Northwest fishing represents one of the highest valued recreation opportunities in the region. Sport fisheries activities are dominated by trout, salmon, and steelhead fishing (77 percent of the fishing days were in pursuit of these species) (FEMAT Report, Chapter VI, Economic Evaluation of Options).

Environmental Consequences

The range of alternatives analyzed indicate little variation in recreation opportunity. Alternatives 1, 3, 4, 5, 8, and 9 could lead to improved primitive and semiprimitive recreational opportunities with the elimination of roads for watershed restoration.

Most recreation activities in unroaded settings disturb very little habitat and would not immediately or directly affect late-successional habitat. The modification of habitat by building roads or developed recreation sites could negatively impact Late-Successional Reserves and Aquatic Conservation Strategy objectives. New development proposals that address public needs or provide significant public benefits will be reviewed on a case-by-case basis by the Regional Ecosystem Office. New proposals may be approved when adverse effects can be minimized and mitigated. Existing developments such as campgrounds, recreation residences, and ski areas should result in few additional adverse impacts to Late-Successional Reserves. Routine maintenance of existing facilities is expected to have less effect on late-successional forest conditions than development of new facilities. Development of additional facilities at existing ski areas will be considered on a case-by-case basis by the Regional Ecosystem Office. Priority for review will be given to expansions identified in approved Ski Area Master Plans. The effects of recreational developments on late-successional and riparian habitat will need to be examined on a case-by-case basis by the Regional Ecosystem Office to ensure that Late-Successional Reserve and Aquatic Conservation Strategy objectives are met.

For recreation values, the alternatives provide additional primitive nonmotorized recreational opportunities and create more "natural" appearing landscapes.

Roadless Areas

Affected Environment

This section is new to the Final SEIS and discusses the affected environment as it relates to roadless areas. The National Forests and Bureau of Land Management Districts have developed extensive road systems to provide access to the lands they administer. Forest roads provide access for forest management, recreation, fuels management, firefighting, mining, insect and disease control, and numerous other activities. However, many areas remain unroaded today for one or more of the following reasons: high road development costs, unstable and landslide-prone soils, low timber values, or resource values best managed without roads (such as backcountry or Wilderness).

"Roadless Areas" are a limited and specialized category of resource and have generated considerable interest among the public and land managers alike. In the early 1970's, as National Forests were being developed to meet renewable resource demands, the Forest Service initiated an inventory of areas that could be considered as candidates for the Wilderness Preservation System. The inventory was called the Roadless Area Review and Evaluation (RARE). Roadless areas were identified as essentially those areas without roads totaling 500 contiguous acres or more in size. Roadless areas are relatively undisturbed tracts of the forest ecosystem which have been neither set aside as Wilderness, nor substantially altered by road building, timber harvesting, or other development. Over a 10-year period, the inventory was developed and updated, (RARE I and RARE II).

Once identified, these areas were subjected to a rigorous evaluation of wilderness attributes through development of an environmental impact statement. As a result of that evaluation, some areas were recommended for Wilderness status and some areas were deferred for additional consideration during individual Forest planning efforts under the National Forest Management Act.

In Oregon and Washington, most areas recommended for Wilderness status have either been designated by Congress as Wilderness, or are being managed to maintain wilderness values pending future legislative action. In California, Congress considered all RARE II recommendations in the 1984 Wilderness Act and specified areas for Wilderness status. The 1984 Wilderness Act states that remaining roadless areas not specified for Wilderness designation are those that ". . . do not possess outstanding wilderness attributes or . . . possess outstanding energy, mineral, timber, grazing, dispersed recreation, and other values and . . . should not now be designated as components of the National Wilderness Preservation System but should be available for nonwilderness multiple uses under the land management planning process . . ." In all three states, subsequent Forest planning efforts have since identified appropriate management prescriptions for those areas not designated by Congress as Wilderness. These prescriptions range from primitive nonmotorized recreation to timber harvest. Some of these areas have subsequently been roaded, but most have not. In either case, these areas are still referred to (including in this SEIS) as "inventoried roadless areas" from RARE II.

Currently there are approximately 3 million acres (Table 3&4-47) of inventoried roadless areas on Forest Service administered lands within the planning area, although a small portion of these have been roaded since the RARE II inventory. Roadless areas provide diverse, undisturbed habitats for fish and wildlife, and can be especially important for species sensitive to human disturbance. For the recreationist, roadless areas offer opportunities not available in more developed settings. Streams in roadless areas are often a source of high quality water for communities. While many roadless areas contain extensive areas of late-successional forest, not all roadless areas consist of late-successional forest.

Environmental Consequences

The effects of the various alternatives on inventoried roadless areas are displayed in Table 3&4-47. Because not all roadless areas consist of late-successional forest, protection of inventoried roadless areas is not, in itself, within the scope of the proposed action subject to analysis in this SEIS. Protection of roadless areas for wilderness, solitude, recreation, and other values has been examined through RARE II and subsequent Forest planning processes. For a detailed site-specific discussion of individual roadless areas refer to Appendix C of each Forest's Plan, Final EIS.

Where they do not contain late-successional or old-growth values, roadless areas may not have been considered in the location of Late-Successional Reserves in the alternatives. Conversely, numerous inventoried roadless areas that contain late-successional and old-growth forest values were considered and are included in Late-Successional Reserves in various alternatives in this SEIS.

Alternatives in this SEIS do not increase the area available for timber harvest above that which is already available for harvest under existing forest plans. Generally, the effects of management activities in each roadless area are proportional to the level of activity authorized over the whole of the planning area under each alternative of this SEIS. All alternatives allow some degree of timber management and road construction in portions of some roadless areas, and leave other roadless areas in an undeveloped condition. The undeveloped character of those areas into which entry would be allowed will be altered as road construction and timber harvesting occurs. Table 3&4-47 shows the amount of inventoried roadless areas that fall into various categories of designated areas and the matrix for the various alternatives. The alternatives have varying amounts of inventoried roadless areas located within reserves, ranging from approximately 94 percent in Alternative 1, to 75 percent in Alternative 7. Not all matrix lands are suitable for timber management.

Approximately 50 percent of the inventoried roadless areas are located within Key Watersheds. To protect high quality aquatic and riparian habitats, in all alternatives except 7 and 8, no new roads will be constructed in inventoried roadless areas within Key Watersheds. Watershed analysis must be conducted in all non-Key Watersheds that contain inventoried roadless areas before any management activities can occur within those areas (Appendix B6, Aquatic Conservation Strategy).

Each time an inventoried roadless area is developed there is a cumulative impact: that development contributes to an overall reduction in roadless acres from either a local, regional, or national perspective. Timber harvest, road construction, and commodity management activities will continue to reduce the roadless area resource gradually through time. The effect of each alternative is directly related to the level and types of management activity allowed. Alternatives 5, 7, and 8 allow the most management activity in inventoried roadless areas and Alternatives 1 and 9 allow the least amount of management activity. Management activities may affect water quality, wildlife

Table 3&4-47. Estimated acreas of federal land in roadless areas by allocation for each alternative by state and physiographic province

		Alternative 1				Alternative 2			
State/ Physiographic Province	Total Roadless Acres	Late-Successional Reserves	Admin. Withdrawn Areas	Riparian Reserves	Matrix	Late-Successional Reserves	Admin. Withdrawn Areas	Riparian Reserves	Matrix
Washington									
Eastern Cascades	785,100	519,300	192,800	25,100	47,900	475,800	219,100	26,100	64,100
Western Cascades	566,200	403,700	119,900	17,300	25,300	341,200	164,500	21,100	39,400
Western Lowlands	0	0	0	0	0	0	0	0	0
Olympic Peninsula	91,700	83,700	700	3,700	3,600	82,700	900	3,600	4,500
Total:	1,443,000	1,006,700	313,400	46,100	76,800	899,700	384,500	50,800	108,000
Oregon									
Klamath	310,900	262,300	30,500	7,100	11,000	252,000	32,700	8,200	18,100
Eastern Cascades	146,100	126,700	10,500	2,400	6,500	123,100	12,600	2,100	8,200
Western Cascades	356,000	294,400	36,900	10,300	14,900	259,900	54,800	13,500	28,200
Coast Range	26,500	24,700	200	800	800	24,100	300	900	1,300
Willamette Valley	0	0	0	0	0	0	0	0	0
Total:	839,500	708,100	78,100	20,600	33,200	659,100	100,400	24,700	55,800
California									
Coast Range	13,000	7,700	2,900	900	1,600	5,100	3,000	1,300	3,700
Klamath	599,400	428,600	88,400	36,700	45,800	276,500	157,600	59,000	106,400
Cascades	118,900	58,600	23,600	15,500	21,200	43,000	27,800	14,700	33,500
Total:	731,300	494,900	114,900	53,100	68,600	324,600	188,400	75,000	143,600
3 State Total:	3,013,800	2,209,700	506,400	119,800	178,600	1,883,400	673,300	150,500	307,400

Table 3&4-47. (Continued)

State/ Physiographic Province	Total Roadless Acres	Alternative 3: Late-Successional Reserves	Alternative 3: Managed Late-Successional Areas	Alternative 3: Admin. Withdrawn Areas	Alternative 3: Riparian Reserves	Alternative 3: Matrix	Alternative 4: Late-Successional Reserves	Alternative 4: Managed Late-Successional Areas	Alternative 4: Admin. Withdrawn Areas	Alternative 4: Riparian Reserves	Alternative 4: Matrix
Washington											
Eastern Cascades	785,100	335,100	147,200	218,400	24,200	60,300	442,600	10,600	227,800	34,600	69,500
Western Cascades	566,200	326,200	15,000	164,500	21,100	39,400	312,500	26,000	160,000	29,000	38,700
Western Lowlands	0	0	0	0	0	0	0	0	0	0	0
Olympic Peninsula	91,700	82,700	0	900	3,600	4,500	84,300	0	400	3,600	3,500
Total:	1,443,000	744,000	162,200	383,800	48,900	104,200	839,400	36,600	388,200	67,200	111,700
Oregon											
Klamath	310,900	243,300	8,700	32,700	8,200	18,100	235,200	0	41,800	12,700	21,200
Eastern Cascades	146,100	56,700	66,600	12,600	2,100	8,100	71,900	100	51,700	6,000	16,400
Western Cascades	356,000	233,100	26,900	54,800	13,500	28,200	231,200	0	64,700	24,500	36,100
Coast Range	26,500	24,100	0	300	900	1,300	24,200	0	300	1,000	1,100
Willamette Valley	0	0	0	0	0	0	0	0	0	0	0
Total:	839,500	557,200	102,200	100,400	24,700	55,700	562,500	100	158,500	44,200	74,800
California											
Coast Range	13,000	5,100	0	3,000	1,300	3,700	3,100	0	3,600	2,300	4,000
Klamath	599,400	261,800	14,700	157,600	59,000	106,400	250,500	3,800	171,100	77,800	96,300
Cascades	118,900	33,600	9,400	27,800	14,700	33,500	40,700	0	30,800	20,300	27,100
Total:	731,300	300,500	24,100	188,400	75,000	143,600	294,300	3,800	205,500	100,400	127,400
3 State Total:	3,013,800	1,601,700	288,500	672,600	148,600	303,500	1,696,200	40,500	752,200	211,800	313,900

Table 3&4-47. (Continued)

State/ Physiographic Province	Total Roadless Acres	Alternative 5					Alternative 6 & 10			
		Late-Successional Reserves	Managed Late-Successional Areas	Admin. Withdrawn Areas	Riparian Reserves	Matrix	Late-Successional Reserves	Admin. Withdrawn Areas	Riparian Reserves	Matrix
Washington										
Eastern Cascades	785,100	266,800	20,600	348,100	42,100	107,900	405,900	251,000	37,100	91,000
Western Cascades	566,200	259,900	37,200	181,700	32,600	54,700	300,000	190,700	27,100	48,400
Western Lowlands	0	0	0	0	0	0	0	0	0	0
Olympic Peninsula	91,700	84,300	0	400	3,100	4,000	82,700	900	3,600	4,500
Total:	1,443,000	611,000	57,800	530,200	77,800	166,600	788,600	442,600	67,800	143,900
Oregon										
Klamath	310,900	225,000	1,400	45,900	12,200	26,500	233,900	42,200	10,700	24,300
Eastern Cascades	146,100	43,900	1,400	71,400	6,100	23,300	65,100	56,100	5,200	19,800
Western Cascades	356,000	159,900	0	83,400	36,400	76,800	211,100	76,800	21,900	46,700
Coast Range	26,500	24,200	0	300	800	1,300	24,100	300	900	1,300
Willamette Valley	0	0	0	0	0	0	0	0	0	0
Total:	839,500	453,000	2,800	201,000	55,500	127,900	534,200	175,400	38,700	92,100
California										
Coast Range	13,000	3,100	0	3,600	1,600	4,700	4,800	3,200	1,300	3,700
Klamath	599,400	204,300	4,000	188,000	72,300	131,000	242,000	177,400	64,300	115,800
Cascades	118,900	39,400	0	31,300	14,600	33,600	35,500	31,500	15,800	36,100
Total:	731,300	246,800	4,000	222,900	88,500	169,300	282,300	212,100	81,400	155,600
3 State Total:	3,013,800	1,310,800	64,600	954,100	221,800	463,800	1,605,100	830,100	187,900	391,600

Table 3&4-47. Continued

State/ Physiographic Province	Total Roadless Acres	Alternative 7					Alternative 8			
		Late-Successional Reserves	Managed Late-Successional Areas	Admin. Withdrawn Areas	Riparian Reserves	Matrix	Late-Successional Reserves	Admin. Withdrawn Areas	Riparian Reserves	Matrix
Washington										
Eastern Cascades	785,100	266,800	20,600	348,100	9,600	140,000	405,900	251,000	20,800	107,300
Western Cascades	566,200	222,300	37,200	207,900	7,900	90,800	300,000	190,700	16,800	58,700
Western Lowlands	0	0	0	0	0	0	0	0	0	0
Olympic Peninsula	91,700	79,500	0	2,300	800	9,200	82,700	900	2,700	5,400
Total:	1,443,000	568,600	57,800	558,300	18,300	240,000	788,600	442,600	40,300	171,400
Oregon										
Klamath	310,900	78,400	1,400	109,200	8,000	114,000	233,900	42,200	6,400	28,600
Eastern Cascades	146,100	43,900	1,400	71,400	1,300	28,100	65,100	56,100	2,900	22,100
Western Cascades	356,000	159,900	0	83,400	7,600	105,600	211,100	76,800	12,500	56,100
Coast Range	26,500	18,400	0	900	600	6,600	24,100	300	600	1,600
Willamette Valley	0	0	0	0	0	0	0	0	0	0
Total:	839,500	300,600	2,800	264,900	17,500	254,300	534,200	175,400	22,400	108,400
California										
Coast Range	13,000	2,800	0	3,700	400	6,100	4,800	3,200	800	4,200
Klamath	599,400	158,700	4,000	201,900	17,400	217,500	242,000	177,400	37,600	142,500
Cascades	118,900	39,400	0	31,300	3,500	44,700	35,500	31,500	10,600	41,300
Total:	731,300	200,900	4,000	236,900	21,300	268,300	282,300	212,100	49,000	188,000
3 State Total:	3,013,800	1,070,100	64,600	1,060,100	57,100	762,600	1,605,100	830,100	111,700	467,800

Table 3&4-47. (Continued)

State/ Physiographic Province	Total Roadless Acres	Alternative 9: Late-Successional Reserves	Adaptive Management Areas	Managed Late-Successional Areas	Admin. Withdrawn Areas	Riparian Reserves	Matrix
Washington							
Eastern Cascades	785,100	476,900	42,600	11,400	168,500	25,500	60,300
Western Cascades	566,200	359,500	59,900	0	99,800	17,200	29,700
Western Lowlands	0	0	0	0	0	0	0
Olympic Peninsula	91,700	82,100	9,400	0	100	100	100
Total:	1,443,000	918,500	111,900	11,400	268,400	42,800	90,100
Oregon							
Klamath	310,900	230,100	30,200	0	29,000	7,000	14,700
Eastern Cascades	146,100	59,900	0	0	56,900	6,300	23,000
Western Cascades	356,000	211,100	4,500	0	74,700	20,100	46,000
Coast Range	26,500	24,300	2,300	0	0	0	0
Willamette Valley	0	0	0	0	0	0	0
Total:	839,500	525,400	37,000	0	160,600	33,400	83,700
California							
Coast Range	13,000	4,300	0	0	2,700	1,500	4,500
Klamath	599,400	257,200	93,400	0	135,000	41,900	72,000
Cascades	118,900	49,100	1,300	0	25,500	12,700	30,400
Total:	731,300	310,600	94,700	0	163,200	56,100	106,900
3 State Total:	3,013,800	1,754,500	243,600	11,400	592,200	132,300	280,700

habitat, scenic quality, and soil resources as described in sections addressing those resources elsewhere in this chapter. Management activity in roadless areas will also decrease the acres available for dispersed and more primitive recreation opportunities. The timber in roadless areas has a commodity value and has the potential to contribute to both the economic and social network of local communities.

Scenic Quality

Affected Environment

Contributions from the forests in the planning area extend beyond commodities. The noncommodity outputs of the forest are based on human values and can provide a basis for regional development, both through tourism-related activities and quality of life considerations. Many contend that economic growth in the Pacific Northwest has been fueled by the quality of life in the region, and that environmental quality is a component of this quality of life.

Landscapes managed for visual resources include those kept in a natural state (preservation visual quality), those managed to appear natural or slightly altered (retention and partial retention visual quality), and those moderately to heavily altered by human activity (modification and maximum modification visual quality). Preservation visual quality objectives allow only ecological changes in the landscape; retention objectives require that management activities not be visually evident.

Environmental Consequences

All alternatives would maintain the visual quality objectives identified in current plans and draft plan preferred alternatives. In Alternative 1, over half the area managed for retention and preservation visual quality objectives would be located in the matrix with 88 percent of the federal forest lands in more restrictive reserves or withdrawals. While the percentage of the matrix lands managed for retention and preservation visual quality objectives is highest for Alternative 7, particularly in California, there is not much difference among the three states within the range of the northern spotted owl (FEMAT Report, Chapter VII, Social Assessment of Options).

Research on preferred visual landscapes in forest settings indicates a public preference for more "natural" appearing landscapes. Driving for pleasure is the recreational activity of greatest demand on federally administered lands. Landscapes within designated areas would likely be more appealing for sightseeing than lands in the matrix, especially over time as the selected alternative is implemented. Additionally, they generally would constitute a more desirable backdrop for other recreational activities such as camping and hiking than those areas subject to timber harvesting. The alternatives with greater acreage in reserves and withdrawals present opportunities to create landscapes that appear more natural and therefore have higher scenic values.

Pacific Northwest forest ecosystems are not static. Change by growth, succession, and agents of disturbance (e.g., fire, wind, insects and disease) is an inherent part of these ecosystems. In general, those alternatives that provide for greater amounts of designated areas will lead to ecosystems with fewer signs of modification by humans.

Regional Employment

AFFECTED ENVIRONMENT

Employment in each of the natural resource sectors discussed below focuses primarily on direct employment, as opposed to indirect or induced effects caused by changes in industrial purchases and household expenditures within a region. This section of the Final SEIS does, however, project additional job displacements from induced and indirect effects. Under all of the alternatives, direct employment in timber harvesting and processing will decline as a result of reduced harvest levels.

Timber-Based Employment

Timber-based employment in 1991 consisted of approximately 120,000 wage and salary employees (FEMAT Report, Chapter VI, Outlook for Regional Employment). An additional 12,000 employees (10 percent) were self employed. The wage and salary employees are divided among the following sectors: 17,000 in logging; 32,000 in milling; 13,000 in veneer and plywood manufacturing; 25,000 in secondary wood products; 6,000 in miscellaneous solid wood products; and 27,000 in pulp and paper processing. Total wage and salary employment in the timber industry is down from the post-1980's recession high of 152,000 employees. It is estimated that employment dropped to 144,900 employees in 1990 and to 125,400 employees by 1992. Direct employment levels in the timber industry are predicted to vary between 110,000 and 121,000 for the next decade, depending in part on which alternative is selected.

The role of timber in the regional economy has changed over the last 25 years. During the period 1985 to 1989, timber-based employment represented approximately 5.1 percent of regional employment (Table 3&4-48). This was down from 9.5 percent in the early 1970's due largely to diversification within the region's economy. Growth in the nonmanufacturing sectors account for most of the change. Subregional differences were, however, substantial. The Pacific Northwest is still heavily timber dependent outside the influence of the Portland and Seattle metropolitan areas, although less so than 20 years ago.

Employment in Recreation and Tourism

Considering recreation and tourism-based employment in the 14 coastal counties within the planning area, it is estimated that tourism directly supported wages totaling $348 million in 1990. Assuming an average annual wage of $15,000 to $20,000 per full-time worker, 17,000 to 23,000 full-time workers were directly supported by the tourism industry in these coastal counties. The actual number of people employed in the industry is likely much higher because recreation and tourism-based jobs tend to be seasonal and part time. These jobs constitute a considerable part of the coastal economy. In the short term, none of the alternatives presented in this SEIS will have an appreciable effect on the nature of coastal tourism. In future decades, however, restoration of salmon and trout runs could have marked improved effects on coastal recreation activities.

Table 3&4-48. Timber industry and total employment by subregion in the study area[1]

State/Region	1970-1974 Average			1985-1989 Average		
	Employment			Employment		
	Total	Timber	Timber as % of Total	Total	Timber	Timber as % of Total
	--thousands--		- percent-	--thousands--		-percent-
Washington -						
Olympia Peninsula	83.7	16.6	19.84	127.9	13.2	10.32
Puget Sound	702.7	23.4	3.33	1205.3	21.6	1.79
Lower Columbia	65.0	16.0	24.58	101.0	13.0	12.88
Central	72.2	3.4	4.75	118.7	3.7	3.10
Total	923.6	59.4	6.43	1552.9	51.5	3.31
Oregon -						
Northwest	411.8	16.9	4.12	690.9	19.9	2.88
West-Central	103.2	24.6	23.87	176.3	19.7	11.18
Southwest	76.8	23.7	30.83	121.9	21.3	13.31
Central	33.8	7.1	21.14	59.5	8.5	14.22
Total	625.6	72.4	11.57	1048.3	69.4	6.62
California -						
Total	67.4	21.0	31.23	106.5	16.3	15.26
3 State Total	1616.6	152.8	9.45	2707.7	137.2	5.07

[1] Does not include self-employed individuals. Add approximately 10 percent to estimate total employment in timber industries. Timber industries include solid wood products (inclusive of mobile home manufacturing) and pulp and paper processing (Standard Industrial Classification (SIC) 26, inclusive of paper converting). The study area includes the counties that fall, wholly or partially, within the range of the northern spotted owl.

Source: Greber (1992)

Thousands of people are supported by the inland recreation industry. The BLM estimates that 900 recreation and tourism jobs were directly attributable to management of the lands they administer. Based on expenditure data (FEMAT Report, Chapter VI, Outlook for Noncommodity Production) and an estimated income of 41 cents for every dollar spent on recreation or tourism, 50,000 to 80,000 full-time jobs may be directly attributable to forest-based recreation on lands administered by the Forest Service and BLM. Of these jobs, it is estimated that 4,000 to 5,000 are jobs created by fishing opportunities. The land allocations of the alternatives may provide more of the recreation opportunities that are currently limited by supply (FEMAT Report, Chapter VI, Outlook for Noncommodity Production). Thus, there should be some gains to recreation and tourism-based employment in the inland communities. The extent of these gains, however, is uncertain.

Commercial and Subsistence Fisheries Employment

Based on figures for 1991 for Washington, Oregon, California, and Alaska, 0.037 full-time equivalent jobs were supported per thousand pounds of fish landed. In 1992 an estimated 15,108 jobs in Oregon were supported by $141.5 million worth of fish landed. Income from fish harvesting and processing represents 38 percent of the total income and approximately one half of the full-time equivalent jobs (direct, indirect, and induced) from this level of fish harvest (FEMAT Report, Chapter VI, Outlook for Regional Employment). Based on these estimates, the fish landed in 1991 in Washington, Oregon, and northern California would have supported approximately 5,000 full-time equivalent workers in the fishing industry.

Of these 5,000 jobs, less than 10 percent would have been directly related to the commercial salmon industry. This low percentage reflects a combination of growth in the importance of other species and the current low levels of salmon catch.

American Indian commercial fisheries are difficult to fully document. Tribal commercial fishing operators generally do not obtain state licenses, but are licensed by the respective tribes. Subsistence fishing, which often benefits one or more families and is usually less than full-time employment, is also difficult to document.

Other Natural Resources-Based Employment

Statewide in Washington in the late 1980's, there were approximately 12,000 people employed in mining and mineral processing; in Oregon, this number was 6,700 (note many of these jobs are in the eastern reaches of the state, outside the planning area, and some are on private lands). Northern California statistics are not available. A considerable amount of the minerals processed in the region came from federal lands.

The 1992 assessment of northern spotted owl critical habitat designation estimated that 4 of the 10 mineral deposits in Critical Habitat Units could be profitably mined at prevailing mineral prices; approximately 300 jobs would be associated with this mining and mineral processing activity. This employment level includes the one active mining operation and the potential contributions from the other operations (see the sections on The Economy and Communities, and Mineral Resources earlier in this chapter). The vast mineral terranes in the region hold the potential for thousands of additional jobs as new deposits are discovered. The copper porphyry terrane, in particular, appears to hold great potential for revealing mineral deposits that might be within the habitat of the northern spotted owl and other late-successional and old-growth forest related species. This terrane contains silver, gold, molybdenum, and copper, and holds the potential for production of hundreds of millions of dollars worth of minerals, and several thousand mining and mineral processing jobs.

Jobs directly attributable to range and grazing activities are quite low. Estimates for the number of jobs directly involved in cattle production per 1,000 animal unit months vary from 0.3 to 1.0. Based on these ratios, 69 to 236 livestock jobs would be attributable to the 236,000 animal unit months currently utilized on federal lands in the planning area.

The floral greens, Christmas ornamentals, and mushroom segments of the special forest products markets produced over $70 million in harvests in 1992 and provided employment opportunities for an estimated 28,000 to 30,000 individuals in the region. As many as half of these employees are involved with the harvesting or processing of two or more special products due to the sequential and seasonal nature of the work (Christmas ornamentals in late fall and early winter, edible mushrooms in spring, and floral greens in all but the spring seasons). Most of the harvesting and processing jobs are not full time, but are seasonal, low paying, and without benefits. Thus, these numbers cannot be compared directly with other employment statistics. There does, however, appear to be economic potential in the processing and marketing of these special forest products. The extent of such possible developments is unknown.

Service Employment in Forestry

Employment effects within the timber-based employment section (above) focus only on logging and wood processing jobs. There are an estimated 6,000 additional jobs in the forestry services sector. Primarily, these jobs are in reforestation and timber stand improvement. Two factors will influence future employment in the forestry services sector: (1) fewer acres of harvest will reduce the need for reforestation, fertilization, precommercial thinning, and other timber stand improvement work, and (2) investments made for assessments, surveys, and inventories as proposed under the alternatives will provide job opportunities. These activities, as well as recommendations for watershed restoration and forest stand improvement, would offset some of the employment declines in the forestry services sector.

The Bureau of Land Management's Draft Resource Management Plans (USDI BLM 1992a-f) assumed that the effect on the forestry services employment sector ranged from 0.3 to 0.6 jobs per million board feet of timber harvested. Thus, a two billion board foot reduction in timber harvests in the region would result in the displacement of approximately 600 to 1,200 forestry services workers.

Additional investments on lands that allow for programmed timber harvest (the matrix) would help to offset job losses in the forestry services sector. An aggressive timber stand improvement and pruning program could add 800 or more jobs per year over the next decade and promote the yield of higher quality, higher valued wood in future decades in Washington and Oregon. Reforestation activities would support an additional 500 jobs on lands administered by the Forest Service over 3 years, and an estimated 200 jobs on lands administered by the BLM for 1 year (FEMAT Report, p. VI-32).

Northern spotted owl inventory and monitoring are estimated to cost $6.1 million per year. Most of this cost is for labor. Assuming a total cost of $30,000 per job, this translates into 200 jobs per year. Marbled murrelet surveys are estimated to require approximately 200 employees for 5 months per year for the next 2 to 3 years (weather depending) (FEMAT Report, p. VI-32).

Watershed restoration activities are receiving increasing attention in the region. Forest Service estimates of stream and watershed restoration activities indicate the potential for 2,500 jobs in Oregon and Washington over the next 3 years. Additional jobs may be possible on lands administered by the BLM. The Forest Service has identified approximately 3,800 jobs in Oregon and Washington that are related to other ecosystem restoration activities (FEMAT Report, p. VI-32).

In summary, silvicultural activities, surveys, assessments, and restoration work on federal forests within the range of the northern spotted owl could provide 7,000 jobs per year over the next 3 years. Program costs, however, would be substantial: estimated budget requirements exceed $250 million per year (FEMAT Report, p. VI-32).

Environmental Consequences

Methodology

Using Forest Service economic data and the input-output model IMPLAN, it was estimated that each million board feet of change in timber harvest levels affects approximately 7.8 jobs in the solid wood products industry (Table 3&4-49). In addition, historic wood utilization indicated 1.29 pulp and paper industry jobs for each million board feet of timber harvested. These job estimates are based on 1989-1990 average timber harvests and 1990 employment levels. The harvests are distributed to subregions by percentages according to 1988 mill survey statistics. To discuss subregional differences, the survey units used by the Forest Service for conducting periodic surveys of forest product industries have been adopted. While the IMPLAN coefficients are useful for showing a snapshot of the current economy, they do not capture the dynamics in the economy and thus do not distinguish between actual job losses and lost opportunities in the economy. For example, industries affected by the indirect effects may reposition themselves to serve other markets and, while current workers may not be displaced, future growth in the sector may be curtailed.

To demonstrate the dynamics in the economy, the state economist in Oregon and the Economic and Revenue Forecast Council in Washington developed forecasts using their respective state economic and revenue forecasting models. While these models predict that lower harvest levels curb expansion, there is

Table 3&4-49. Average timber industry employment affected per million board feet of timber processed by subregion in the study area (inclusive of self-employed individuals)[1]

State/Region	Solid Wood Products[2]	Pulp and Paper[3]	Total
	---jobs per million board feet, Scribner---		
Washington -			
Olympic Peninsula	4.37	1.01	5.38
Puget Sound	9.67	1.74	11.41
Lower Columbia	5.94	5.58	11.52
Central	10.28	0.00	10.28
Oregon -			
Northwest	9.16	2.19	11.35
West-Central	9.11	0.66	9.77
Southwest	9.07	0.37	9.44
Central	16.38	0.00	16.38
California -	5.77	0.63	6.40
3 State Average	7.79	1.29	9.08
3 States - by Sector			
Logging	1.62		
Sawmilling	3.08		
Veneer and Plywood	1.33		
Millwork	0.82		
Other Wood Products	0.95		
Pulp		0.17	
Paper Processing		1.11	

[1] The study area includes the counties that fall, wholly or partially, within the range of the northern spotted owl.
[2] Solid wood products is defined as Standard Industrial Classification (SIC) 24, except that mobile homes and prefabricated wood buildings are omitted from the statistics.
[3] Paper converting is not included in the statistics.

still growth in the regional economies (FEMAT Report, Chapter VI, Outlook for Regional Employment). These statewide forecasts, however, mask the subregional differences where the rural economies are shrinking while metropolitan economies are expanding. The new job holders in the region do not necessarily correspond to the job losers elsewhere in the region. There will be dislocations from rural communities (FEMAT Report, Chapter VI, Outlook for Regional Employment).

The harvest levels assumed by region and by alternative are displayed in Table 3&4-50. These are based on the harvest levels summarized in Table 3&4-43 and interpolation of the data appearing in Table 3&4-44. Within half-state regions, the harvests are distributed by percentages according to 1988 mill survey statistics. The resulting projected employment in timber industries is displayed in Table 3&4-51 (employment is based on harvests multiplied by IMPLAN based jobs/MMBF). Table 3&4-51 compares the projected employment levels to employment in 1990 and estimated employment in 1992. These projected employment levels are less than those presented in the Draft SEIS, primarily due to reductions in nonfederal timber harvest response and a reduction in PSQ from federal forests for Alternative 9. The differences in nonfederal timber harvest response results in an increased displacement of approximately 3,000 direct jobs.

Projections of job ratios (jobs per MMBF of harvest) and employment have not been adjusted for future changes in technology. Technology can increase jobs per unit of input when the focus is on saving raw materials and product-improving technology changes. Since raw material is apt to be the limiting resource, technology in the decade ahead will likely focus on saving raw material as opposed to saving labor (FEMAT Report, Chapter VI, Outlook for Regional Employment).

The job ratios in Table 3&4-49 vary significantly by subregion. This variation is based on the tree species processed, the types of mills in the subregions, the amount of secondary manufacturing, and the level of log exports from the region. For example, the jobs per million board feet are much higher than the overall regional average in central Oregon where there is a substantial amount of secondary wood products manufacturing which is tied to the species processed in the subregion. The Olympic Peninsula, on the other hand, shows lower jobs per million board feet due to the amount of logs shipped into the region and then exported, and to the lack of secondary wood products manufacturing.

Effects of Alternatives

In the Draft SEIS, the projections for the pulp and paper industry indicated no change in total employment. This is not to suggest that there will be no effects in the pulp and paper employment sector, but rather suggests that the industry will respond to supply-induced changes in ways different from the solid wood products sector. Of the 28,000 employees in the pulp and paper sector in 1990, less than 3,000 worked in the pulp sector, while 16,000 worked in paper processing and 9,000 were employed in paper converting. The Economics section of Appendix F (Response to Public Comments) of this Final SEIS displays the potential employment effects in the primary pulp and paper processing industries.

The paper converting sector uses paper from the national and global market. There is a weak, direct relationship between harvest levels and this portion of the pulp and paper market. The paper market has already begun to respond to changing market conditions by installing increased paper recycling capacity to buffer effects of changes within the pulp processing sector. In addition, a vast supply of pulp is available in the global market.

While the pulp sector is apt to be the most affected of the pulp and paper sectors by changes in forestry activity arising from the proposed action, utilization of alternative species and improved pulp recovery processes can allow these industries to continue to supply existing plant capacities. Capital investment, however, is apt to be required to achieve this scenario and the current market for pulp is plagued by weak prices. There is also a large quantity of chips exported from the region; a portion will likely be redirected to domestic pulp mills.

Mobile home construction (typically included with the timber industry employment statistics) is assumed to maintain historic employment levels. Employment in this sector is included in the projections in Table 3&4-51 at its 1990 level.

In summary, these projections imply a range of job displacement arising from the proposed action from 4,600 to 15,900 jobs, relative to 1992. Compared to 1990, the potential displacement is 24,100 to 35,400 jobs. The relative differences to the time period of 1985 to 1989 have been added in this Final SEIS and are 16,400 to 27,700 jobs. The Final SEIS job displacement estimates are higher than the estimates displayed in the Draft SEIS. The differences result from corrections in predicting nonfederal harvest levels and, for Alternative 9, the reduction in PSQ from federal forests resulting from changes in standards and guidelines, and land allocations between the Draft and Final SEIS. The majority of the affected jobs are in Oregon and are concentrated in southwestern Oregon.

The alternatives presented in this SEIS would have the greatest effect on the timber industry sector of the regional employment base. In addition to displaced workers, there would be indirect effects caused by fluctuating business expenditures in the region and induced effects caused by changes in personal expenditures in the region. These ripple effects tend to increase the ramifications of job gains or losses in communities or regions. There is roughly one job affected outside the timber industry for every job affected within the timber industry. The addition of potential indirect and induced employment effects to the direct job displacement estimates implies a total job opportunity loss as a result of the proposed plan from 11,000 to 38,000 relative to 1992, and ranging from 57,000 to 84,000 jobs relative to 1990.

Timber-based employment would decline under all alternatives as a result of reduced harvests. Subregions characterized as heavily timber dependent are apt to experience the most severe impacts. While service employment in forestry also appears to be faced with job declines, these declines could be offset at least in part through investments in reforestation, timber stand improvement, monitoring, inventory, and restoration activities.

Table 3&4-50. Historical and projected volume processed per year in the next decade from all owners, by subregion of the study area and alternative[1]

State/Region	Average Harvest 1980-89	1990-92	Alternative 1	2	3	4	5	6	7	8	9	10
			----------million board feet, Scribner--------------									
Washington -												
Olympic Peninsula		1914	1876	1892	1890	1887	1892	1888	1884	1886	1882	1882
Puget Sound		1320	1348	1360	1360	1358	1355	1360	1355	1369	1348	1364
Lower Columbia		982	849	872	873	873	886	876	893	883	876	874
Central		353	293	316	316	312	314	317	321	344	305	333
Total	5661	4569	4366	4440	4439	4430	4447	4441	4453	4482	4411	4453
Oregon -												
Northwest		1442	1327	1386	1392	1403	1429	1403	1529	1441	1411	1408
West-Central		1519	1121	1195	1209	1217	1263	1236	1370	1303	1258	1255
Southwest		1515	1042	1225	1241	1264	1312	1275	1590	1425	1317	1321
Central		875	434	474	474	470	476	473	494	481	478	478
Total	6972	5351	3924	4280	4316	4354	4480	4387	4983	4650	4464	4462
California -												
Total	2216	2261	1419	1492	1498	1485	1496	1512	1524	1542	1568	1543
3 State Total	1484	1218	9709	10212	10253	10269	10423	10340	10960	10674	10443	10458

[1] The study area includes the counties that fall, wholly or partially, within the range of the northern spotted owl.

Some employment gains reasonably may be made in recreation and tourism, as well as in special forest products. It may, however, be difficult to absorb displaced loggers and mill workers into these fields due to skill considerations and geographic locations. It should also be noted that recreation, tourism, and special forest products employment opportunities have wage rates significantly less than those of logging and wood products manufacturing jobs.

In the long run, management in accordance with any of the alternatives presented in this SEIS may provide an increased supply to commercial fisheries. Yet, in light of the current issues and the potential over-capacity of the industry, these gains may not be substantial. Restoration of salmon and trout runs could have positive effects on coastal recreation.

Mineral activities have potential long-term benefits of great significance to the region and to the Nation. The effect of the alternatives on mineral and energy resources is directly related to the areas in which mineral leasing no longer would be allowed or to the constraints placed on the development of those resources. These constraints would tend to increase the costs of extracting minerals and result in less mining in these areas.

Table 3&4-51. Historical and projected employment in the timber industry in the next decade, by subregion and alternative[1]

	Actual	Estimated	Alternative									
State/Owl Region[2]	1990	1992	1	2	3	4	5	6	7	8	9	10
			----------thousand jobs---------------									
Washington												
Olympic Peninsula	13.9		11.6	11.7	11.6	11.7	11.7	11.7	11.6	11.2	11.6	11.6
Puget Sound	25.7		20.3	20.4	20.4	20.4	20.3	20.4	20.3	20.5	20.3	20.4
Lower Columbia	14.1		12.4	12.6	12.6	12.6	12.7	12.6	12.7	12.6	12.6	12.6
Central	4.2		3.8	4.0	4.1	4.0	4.0	4.1	4.1	4.3	3.9	4.2
Total	57.9	51.3	48.1	48.7	48.7	48.7	48.7	48.8	48.7	49.0	48.4	48.8
Oregon												
Northwest	21.9		19.8	20.3	20.3	20.4	20.7	20.0	21.6	20.8	20.5	20.5
West-Central	20.9		13.7	14.4	14.5	14.6	15.0	14.3	16.0	15.4	15.0	14.9
Southwest	21.4		10.3	12.0	12.1	12.4	12.8	12.1	15.3	13.8	12.8	12.9
Central	8.9		7.4	8.0	8.0	8.0	8.1	8.0	8.4	8.2	8.1	8.1
Total	73.1	62.8	51.2	54.7	54.9	55.4	56.6	54.4	61.3	58.2	56.4	56.4
California												
Total	13.9	11.3	10.2	10.6	10.7	10.6	10.7	10.8	10.8	10.9	11.1	10.9
3 State Total	144.9	125.4	109.5	114.0	114.3	114.7	116.0	114.0	120.8	118.1	115.9	116.1

[1] Includes self-employed individuals in all solid wood products and pulp and paper sectors. Wage and salary employment is approximately 7.5 percent less than total employment.
[2] Owl Region = The range of the northern spotted owl.

While the net impact of implementation of any of the alternatives is apt to be displacement of natural resources-based jobs, the economy of the region as a whole is predicted to continue to grow. Rural communities will bear the brunt of the adverse economic effects resulting from the proposed action while the more developed areas are projected to continue to expand.

Government Revenues

Affected Environment

Throughout the range of the northern spotted owl, federal timber harvest has been an important source of revenue in terms of returns to local governments. Studies from western Oregon show that county governments derived on average 23 percent of their funds from timber receipts in 1988, while schools derived 2 percent of their funds from timber receipts. Because schools represent the vast majority of local government expenditures in Oregon, the sum total of local government tax base reliance on such receipts was 7 percent. Southwestern Oregon counties are even more highly timber dependent: 55 percent of county funds, 4 percent of school funds, and 20 percent of aggregate local funds were derived from federal timber harvest receipts in 1988. Currently, the Federal Government shares 25 percent of the gross receipts from National Forest timber sales and 50 percent of the gross receipts from O&C lands (BLM and Forest Service).

Environmental Consequences

Under current policies, declines in federal timber harvest will reduce federal receipts to counties. While timber prices will increase, they will not fully offset the declines in revenues to the federal and local governments (Table 3&4-52). The federal receipts noted in Table 3&4-52 are not indicative of returns to the Federal Treasury; they do not reflect administrative costs of approximately 30 percent of gross sales value. Both the Federal Treasury and the local governments will see reduced revenues from implementation of any of the alternatives.

Due to the location of the greatest harvest reductions, and the nature of the revenue-sharing distribution formulas, southwestern Oregon is the most substantially affected subregion (FEMAT Report, Chapter VI, Outlook for Government Revenues). It should be noted that a congressional safety net has been safeguarding the communities from large scale reductions on a year-to-year basis. In 1993, the safety net payment for O&C lands guaranteed 85 percent of the average annual payment made from 1986 through 1990. Any reduction in these federal receipts shared with the counties arising from the proposed action will correspondingly impact their school and road funds due to the nature of the distribution formula even under continued provision of such a safety net.

Rural Communities

Affected Environment

The study area for regional and community analysis for this SEIS includes 57 counties that fall, wholly or partially, within the range of the northern spotted owl. This includes 25 counties in Washington, 24 in Oregon, and 8 in California (see Figure 3&4-15). These counties contain 347 communities (both incorporated and unincorporated areas) in Washington, 320 in Oregon, and 68 in California. Not all of these counties or communities were included in the analysis - the larger metropolitan counties (such as King, Pierce, and Multnomah) and cities (Seattle and Portland) were excluded because of their concentration of residents and general lack of direct forest resource dependence, although many of these urban residents rely on the federal forests within the planning area for recreation. The social analysis focused on those rural counties and communities that are more timber and natural-resources dependent. The analysis examined effects on 219 communities: 30 communities in northern California, 81 in Oregon, and 108 in Washington.

The community analysis entailed five efforts. First, a survey was sent to state extension agents to solicit background information and an overall rating of the communities' general adaptability in response to change. Second, a report was prepared based on census data that summarized various demographic changes

Table 3&4-52. Historical average and projected annual federal timber receipts by subregion and alternative[1]

State/Owl Region[2]	Average 1990-1992	Alternative 1	2	3	4	5	6	7	8	9	10
		million dollars									
Washington											
Gross Receipts	n/a	7.3	47.4	50.4	46.2	66.5	56.0	86.6	86.4	43.5	70.0
Local Gov't Share	34.1	1.8	11.9	12.6	11.6	16.6	14.0	21.7	21.6	10.9	17.5
Federal Share	n/a	5.5	35.6	37.8	34.7	49.9	42.0	65.0	64.8	32.6	52.5
Oregon - Forest Service											
Gross Receipts	n/a	15.8	103.6	115.2	130.0	174.7	138.5	263.0	187.7	156.0	154.5
Local Gov't Share	107.7	4.0	25.9	28.8	32.5	43.7	34.6	65.8	46.9	39.0	38.6
Federal Share	n/a	11.9	77.7	86.4	97.5	131.0	103.9	197.3	140.8	117.0	115.9
Oregon - Bureau of Land Management											
Gross Receipts	n/a	15.5	52.8	55.6	58.1	71.3	61.1	139.2	102.0	71.5	70.6
Local Gov't Share	131.1	7.7	26.3	27.7	28.9	35.5	30.4	69.4	50.8	35.6	35.2
Federal Share	n/a	7.8	26.5	27.9	29.2	35.8	30.6	69.9	51.2	35.9	35.4
California											
Gross Receipts	n/a	5.7	23.7	26.2	23.4	30.0	31.2	48.0	45.6	54.6	41.1
Local Gov't Share	21.4	1.4	5.9	6.6	5.9	7.5	7.8	12.0	11.4	13.7	10.3
Federal Share	n/a	4.3	17.8	19.7	17.6	22.5	23.4	36.0	34.2	41.0	30.8
3 State Total											
Gross Receipts	n/a	44.3	227.5	247.4	257.7	342.5	286.8	536.8	421.7	325.6	336.2
Local Gov't Share	294.3	14.9	70.0	75.7	78.8	103.3	86.8	168.8	130.7	99.1	101.6
Federal Share	n/a	29.4	157.5	171.8	178.9	239.2	199.9	368.1	291.0	226.5	234.6

[1] Using current distribution formula without legislative safety net.
[2] Owl Region = The range of the northern spotted owl.

in the counties within the range of the northern spotted owl. Third, two workshops involving nearly 100 participants from a variety of state and local agencies and offices, as well as American Indian reservations, prepared detailed analyses of the relative ability of the communities to deal with changes likely to result from the alternatives on a state-by-state basis. Fourth, a review of the American Indian tribal lands, rights, and uses was undertaken. Fifth, specialized papers were commissioned to provide detailed expert opinion and analysis in key areas.

The effects of the alternatives presented in this SEIS on rural communities are primarily those which flow directly and indirectly from changes in the regional and local economies. The preceding section on the economic effects of the alternatives addresses: (1) the context of the changes, especially those relating to timber harvest levels, already occurring in rural communities, and (2) the changes expected to occur as a result of implementing one of the alternatives. Effects on rural communities are estimated specifically for Alternatives 1, 3, and 7, and a scenario based on the 1985-87 timber harvest level, with interpolations for the remaining alternatives.

The Assessment Team chose not to label specific, identifiable communities during the assessment process. Some labels, such as "risk" or "being at risk" have the potential to mobilize individuals and community leadership into action. For example, wood products workers may start a small business in anticipation of layoffs and their children may show increased motivation for education; groups may respond with economic development efforts or participate more actively in influencing forest management policy decisions. However, labeling can also paralyze and demoralize community members, increase social disruption, and create indirect and unintended impacts on communities (such as the "red-lining" of communities by banks). As a result, the Assessment Team did not identify communities by name or location, but did show results by subregion in Appendix VII-C of the FEMAT Report. For a presentation of the special difficulties faced by rural communities in western Washington, western Oregon, and northern California see the FEMAT Report, Social Assessment of Options in Chapter VII.

Consequences

Washington, Oregon, and California differ in the pattern, severity, and regional distribution of the projected effects of a reduced timber harvest. The results of the analyses are discussed in terms of each of the affected community's capacity to cope (which sheds light on the anticipated severity and direction of the consequences) and the resulting risk to the communities.

The three states differ in the portion of their respective economies attributable to the timber industry; the structure and distribution of tax receipts to county and local governments; and the distribution of federal, state, and private timberlands. This variability is reflected in the consequences associated with the alternatives presented in this Final SEIS.

Community Capacity

Community capacity involves the ability of residents, community institutions, organizations, and leadership — formal and informal — to meet local needs and expectations. Community capacity involves a wide variety of factors that can be divided into three broad areas: (1) physical and financial infrastructure, (2) human capital, and (3) civic responsiveness.

The Assessment Team described strikingly similar patterns of consequences occurring in communities with similar types of capacity and intervening variables. Although subregional variations can affect consequences, the main processes that determine how a community is affected by changes in federal forest policies are similar throughout the region. There is considerable variation in community capacity and consequences among communities.

Communities with moderately high or high capacity to adapt to changes tend to be larger communities. Although examples exist of small communities with relatively high capacity, smaller communities tend to have limited infrastructure, lower levels of economic diversity, less active leadership, more dependence on nearby communities, and weaker links to centers of political and economic influence. These communities also are likely to have less control over resources and capital. As a result, small communities generally are more vulnerable to external change such as shifts in forest management policies and their secondary effects.

Some regional patterns emerge directly from the data. The ratings define a region of lower capacity/negative consequences in the isolated interior Coast Range of Oregon and along the west slope of the Cascade Range. Two other groupings of low capacity/negative consequences occur in the central Olympic Peninsula and along the north Cascade Range.

Washington communities with lower capacity are likely to be smaller, highly dependent on the timber industry, and, as in Oregon, beyond primary transportation corridors. Preliminary analysis of the community ratings in all three states indicates that only about 20 percent of low capacity communities lie within 10 miles of interstate highways, compared to nearly 60 percent of high capacity communities.

Coastal communities in all three states tend to have higher capacities and more positive consequences, due in large part to better developed tourism and more diversified economies. The two workshop panels indicated that communities surrounded by federal lands (typically smaller and located in isolated mountainous areas) are likely to have low capacity and more negative consequences regardless of the alternative. Preliminary analysis of communities in all three states indicates a negative correlation between capacity and the closeness and density of surrounding federal forest land. Both workshop panels considered many of the same attributes as being the most important in rating community capacity. The factor most commonly mentioned was economic diversity, including the degree of timber dependence based on the percentage of all workers employed in the timber industry and the local and regional availability of private timber. Local leadership and location were also cited as critical components of capacity. Other factors include a history of community-based improvement efforts, community cohesion and conflict, civic involvement, local control of resources, community attitude, cultural identity, population size, income levels, poverty, and unemployment.

The workshop panels also emphasized both similar and different factors when assessing consequences. Specific consequences estimated under Alternatives 1, 3, and 7 generally depended on the participants' understanding of age-class distribution of forests across matrix lands, assumptions regarding the distances that timber sale bidders are willing to haul logs in a rapidly changing market, and assumptions about availability of timber on state and private lands as well as federal lands outside the region.

Panels for each of the states differed in their interpretations of the consequences to communities under the alternatives. California and Oregon panelists considered present conditions to be similar to Alternative 7. In Oregon, Alternatives 1 and 3 were considered to improve fisheries and thus provide positive consequences in coastal and fishing communities. Washington panelists, however, felt that fisheries would take longer to recover, and therefore Alternatives 1 and 3 would not quickly yield positive effects for coastal and fishing communities.

For about 25 percent of the California communities, panelists saw positive consequences associated with Alternative 7 compared to Alternative 3, which they projected would not maintain an adequate supply of logs to local mills. They also were not as optimistic as were Oregon and Washington panelists about the 1985-87 harvest levels because they considered such levels to be unsustainable.

Panelists in Washington elected to apply a "no effect" rating for a number of communities (about 20 percent) that they felt would not experience any effects from changes in federal forest management. The California and Oregon groups did not use this label; they felt all communities would be affected in some manner and tended to give "even" ratings to communities lacking direct dependency on timber. The panelists who rated northern California communities considered a larger set of complex interactions affecting communities as a result of federal forest management than did panelists in the other two states.

The Assessment Team conducted a detailed analysis of Alternatives 1, 3, and 7. It found relatively few differences among the effects of these alternatives in terms of community capacity and consequences. Impacts associated with Alternative 9 ranked between those presented for Alternatives 3 and 7 largely because the expected harvest level in the alternatives is higher than for Alternative 3 and lower than for Alternative 7. As shown in Table 3&4-53, communities generally cluster in ranges reflecting either low capacity and negative consequences, or high capacity and moderately positive consequences for each alternative. These are called consequence ratings. Considering Alternative 7 and the 1985-87 scenario, and specifically as probable harvest levels from federal lands increase under the alternatives, a greater number of communities were assigned more positive consequence ratings.

By examining the variation in consequence ratings for individual communities among the alternatives, the relative sensitivity of communities to shifts in federal timber availability becomes clearer. For example, some insensitivity to the alternatives is apparent even in the aggregate state ratings. For California, as compared to the other two states, the difference between average

Table 3&4-53. Relationship between community capacity and consequences

Alternative 1	Consequences to Communities (%)				
Capacity	Negative	Moderately Negative	Even	Moderately Positive	Positive
Low	12	3	0	1	0
Medium Low	13	5	3	2	1
Medium	8	8	7	1	0
Medium High	7	4	4	3	0
High	2	4	9	4	0
Alternative 3					
Low	7	5	1	1	0
Medium Low	9	6	6	2	0
Medium	4	10	10	1	0
Medium High	6	3	9	1	0
High	1	3	12	3	0
Alternative 7					
Low	4	6	3	1	0
Medium Low	6	6	10	1	0
Medium	2	6	15	2	0
Medium High	1	5	11	1	0
High	1	2	16	1	0
1985-87 Scenario					
Low	0	2	6	4	4
Medium Low	0	1	12	9	2
Medium	0	0	8	10	6
Medium High	0	1	4	10	3
High	0	2	4	11	2

consequence ratings for Alternatives 1 and 7 is nearly twice as high, and for Alternatives 1 and 3, it is over three times as high. Although these state-level differences may be caused by a variety of factors, they do indicate an underlying variation in responsiveness to management changes and, specifically, to federal harvest changes (Table 3&4-53).

In some heavily timber-dependent communities, consequence ratings increase several points (i.e., become more positive) moving from Alternative 1 to the 1985-87 scenario. Ratings for other communities are unchanged across the alternatives, indicating either a balance of positive and negative effects, or communities less affected by federal forest policy. Still other communities have ratings that are negatively related to increases in timber harvest levels. As seen in Figure 3&4-17, changes in consequence ratings range from negative to positive when moving from Alternative 1 to 3 to 7, and finally to the 1985-87 scenario.

Table 3&4-54. Community capacity and consequence impacts combined by percentages for Washington, Oregon and northern California, by three alternatives and the historical 1985-1987 timber base

	Negative	Medium Negative	Medium	Medium Positive	Positive
Alternative 1	42	24	23	11	1
Alternative 3	27	27	38	8	0
Alternative 7	14	25	55	6	0
1985-1987	0	6	34	44	17

As reported in the Timber Harvest section earlier in this chapter, major reductions have already occurred in timber harvest levels in the planning area, from a peak of about 4.5 billion board feet per year between 1980 and 1989, to only 2.4 billion board feet per year from 1990 to 1992 (a period of injunction against offer or award of new old-growth timber sales in spotted owl habitat on National Forests). The probable sale quantities in all alternatives are below recent averages as compared to previous peak or baseline conditions.

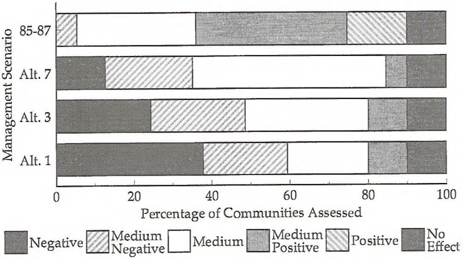
For northern California, these data suggest that some of the adverse effects associated with declining harvest levels from federal lands have already occurred. However, the effects on communities in western Oregon and Washington are just now beginning. The current timber harvest levels there are relatively high due to sales under contract from the late 1980's. The full effects on employment will be felt by late 1994 as the available timber from federal forest lands is reduced. The variation in the harvest levels across the alternatives does not appear to create in some general respects a significant difference in social effects for the future, given those that have already occurred in the last decade, and the extent to which some communities have already adapted to corporate restructuring, reduced harvest, closed mills, and lost jobs.

Rural Communities at Risk

For the purposes of this assessment, risk is a function of the relationship between community capacity and the consequences associated with the alternatives. Communities with combinations of low capacity and negative consequences are regarded as "most at risk"; versus those with high capacity and positive consequences which are ranked "least at risk." Alternatives 1, 3, and 7 would result in about one-third of the 167 surveyed communities falling in the "most at risk" category. In all three alternatives, however, the changes are great compared to those for the 1985-87 harvest level scenario in which only 3 percent of the communities were ranked as "most at risk."

Not surprisingly, the majority of the communities "most at risk" in Alternatives 1, 3, and 7 appear to be those highly dependent on the timber industry and on federal forest lands as the source for much of their timber supply. Workshop panelists predicted that Alternatives 1, 3, and 7 would likely lead to additional mill closures and reduced forest related employment, and that the economic and social infrastructure would suffer.

Figure 3&4-17. Predicted consequences of four federal land management scenarios on communities in western Washington, western Oregon and northern California



Note: The 10% "No Effect" percentages reflect the approximate percentage of communities that will not be impacted by any of the alternatives.

The "most at risk" communities differ from others in significant ways. These communities are smaller (average population 3,000, with most under 6,500), and are located in counties with low population density and higher poverty. Workshop panelists judged that isolated communities were more likely to experience negative consequences with Alternatives 1, 3, and to a lesser extent 7, because there are few employment opportunities available locally or in nearby communities, and there is limited access to capital, transportation links, and other resources. In many "at risk" communities, a somewhat higher portion of income comes from federal and state public assistance programs. This was particularly the case in California where 5 percent of income was so derived, compared to an average of 2.5 percent in other "at risk" communities and 1.9 percent in all subregions.

Communities that lack economic diversity and have low leadership capacity are more likely to be "at risk." These communities may find it difficult to mobilize and respond to changing conditions which may affect a variety of groups. These communities are likely to experience increased unemployment, poverty, and social disruption in the absence of assistance.

People Coping With Change

Affected Environment

Changes in the management of the federal forests in the spotted owl region administered by the Forest Service and BLM have effects (impacts) on people and the families, groups, and communities to which they belong. While predicting the nature and extent of these effects cannot be done with precision, such effects are important.

Social impacts are those which change communities, institutions, and social and cultural conditions. The social, community, and cultural changes resulting from implementation of any of these alternatives will be felt almost exclusively in western and central Washington and Oregon and northwest California, and will be disproportionately intense in rural and timber-dependent areas.

The social impacts expected from implementing any of the SEIS alternatives are primarily those which flow directly and indirectly from economic changes in the wood products and forestry economic sector. Changes in employment, wages, and the viability of firms has immediate and long-term effects on individuals, families, and communities.

There is substantial literature about the social effects of economic changes in rural communities. These studies, which deal in part with natural resource-based communities, do not provide a precise data base from which to draw conclusions. Such studies do, however, allow an assessment that is useful in comparing the types and relative amounts of social effects that are likely to occur.

Drawing from sociological studies of timber-dependent communities, interviews with knowledgeable people, and the research literature on job loss and adaptability, Robert G. Lee of the University of Washington has written about the social and community effects of implementing the ISC Conservation Strategy (Thomas et al. 1990) for Oregon and Washington (Lee 1990). The following discussion of social impacts (and later, the impacts of implementing the alternatives) draws principally from his work dealing with affected people in the spotted owl region.

Lee (1990) notes three important components in timber-dependent communities: Loggers, mill managers and workers, and rural business and service people. Each has adapted to past fluctuations in the timber industry, and each will be affected somewhat differently by the changes resulting from implementation of any of these alternatives:

> "'Loggers are distinguished by an unusual commitment to individualism, hard work, inventiveness, and entrepreneurial spirit.' Matt Carroll characterizes loggers as an 'occupational community' more so than a residential community, and notes the central place of their occupation in their sense of self. Loggers are more geographically mobile than others in timber-dependent communities.
>
> "Mill managers and workers are in a highly cyclical industry and have developed a variety of ways of adapting to or "riding out" hard times on the assurance that the typical national cycles of demand for wood products will, eventually, swing back to full employment. Long-term workers usually have built strong ties with one mill and one town. Home ownership and family tie them to communities and [mill managers and workers] are typically less mobile than the woods loggers.
>
> "Local business and service owners provide the core of timber-dependent communities, providing much of the community's leadership. They are rooted in the town, with shared values and behavior patterns, tied to

> communities by the ownership and investment in homes and businesses. In addition, they share a commitment to hard work, individualism, and self-reliance. While these values are often regarded as the foundation of American culture, they may inhibit the development of cohesiveness and adaptability needed to make the changes in careers and economic structure to respond to a permanent decline in timber harvests."

Lee (1990) notes four factors of social and cultural disruption in the dispute about federal old-growth management: (1) a shift from decentralized, participatory forest land management that is oriented toward communities and workers to a centralized command and control for forests both public and private, (2) the perception that the federal government has reneged on its commitment to maintain a nondeclining, even flow of timber from federal forests, (3) a social structure that is less likely to adapt to a permanent loss of employment, and (4) the potential for conflict among different people in which the timber industry and workers, as well as other interest groups, are negatively stereotyped and stigmatized. Each of these factors can impose a significant emotional impact, and all can undermine individual and community efforts to successfully adapt to changes.

Loss of Jobs

The effects of job loss in any industry are significant. The following excerpt from Lee et al. (1991) lists many of the consequences of job losses in the wood products industry (in-text references removed):

> "Stress resulting from job losses alone can be experienced as a life-threatening event that can have severe consequences for the individual and the community. Depression and other mental illnesses are the most frequently observed consequences of unemployment. Individuals with a prior history of mental illness are most susceptible to economic instability, and will be among the first in need of assistance. In fact, lower educational levels are associated with higher use of mental health services indicating that low levels of education limit both options and capacity to be successfully reemployed during periods of economic instability.

> "Other manifestations of mental illness, i.e. spouse or child abuse, alcohol and drug abuse, and social conflict also increase in response to rising unemployment. Increased demands for medical services also accompany economic downturns and unemployment. The reported incidences of heart trouble, hypertension, bone and joint ailments, and chronic headaches all increase during periods of economic instability. People experiencing high levels of stress often suffer from impairment of the cognitive functioning required for retraining or making other changes in their lives. Extreme work-related stresses can produce symptoms resembling the "delayed stress syndrome" from which so many Vietnam veterans suffered. When coupled with stress originating from the blaming of loggers and other wood products workers, loss of way of life, and betrayal by government, many individuals are likely to suffer from both a loss of self-esteem and an impaired capacity to recover. Their capacity to make rational decisions about retraining, moving, or shifting occupations can be substantially reduced by such an accumulation of stress" (Lee et al.

1991:20-21).

Learned ways of coping with the instability in wood products employment may no longer be adequate. Robert Lee observes (in-text references removed):

> "Loss of a job is by itself often experienced as a life-threatening event, and can be followed by personal trauma and a permanent psychological harm. Instability in the wood products industry has been so prevalent that people have learned how to cope with losing and regaining jobs. Job security is sought by developing a personal reputation as a good sawmill employee or logger. A sound reputation helps people cope with a cyclical industry, but it leaves people especially helpless when there is massive permanent occupational displacement. As a result, substantial individual and collective trauma can be expected if people are displaced by sudden departures from anticipated harvest schedules, such as is represented by implementation of the ISC strategy.
>
> "Effects on entrepreneurs will be even more severe. People who have invested all their savings and hard work in building a business experience a tremendous loss of self when they are forced to close. Loss of personal business is experienced as a life-threatening event, and can be expected to result in substantial, long-term stress" (Lee et al. 1991:19-20).

Also, as noted by Brian Greber:

> "In many instances, rural communities exist almost solely because of their link to the processing of the forest resource. The value of homes and businesses are thus vulnerable to changes in resource processing. In that the bulk of many families' net wealth lies in their homes, there is a concern that large changes in harvesting can have greater consequences on families than would be indicated by job displacement alone" (Greber 1991:A4).

People Affected

The social effects of the alternatives stem most directly from changes in the timber harvest levels of the alternatives. This is not meant to indicate that timber harvest is the only meaningful link between the Forest Service, BLM and people, but it is the most crucial variable among these alternatives. The impacts will be very noticeable in some communities, and not visible in others. As noted above, the consequences on any particular town will depend in large measure on a variety of factors outside the control of the Forest Service or BLM and outside the ability to predict.

Changes in timber harvest level also stand as a surrogate for other measures of economic development in the National Forests and BLM Districts (such as mining, developed recreation, and energy development), and as a measure of the level of other forest management activities (such as road construction, tree planting, and vegetation management). There are no major economic activities (e.g., higher paying timber jobs) in the federal forests which will increase when timber harvests decline. However, there is expected to be a number of ecosystem restoration activities on the federal forests. Similarly, none of the social impacts linked to the economic activity of people or communities will be minimized because of declining timber harvests. Beliefs in the widespread sustenance of currently timber-based communities solely through nonconsumptive forest activities and recreation are not well founded.

The first decade's annual timber harvest (PSQ) levels of the alternatives are estimated in the Timber Harvest section earlier in this chapter and summarized below from Table 3&4-43. Comparisons were not made from the historical high timber harvests of 1980-89 (4,524 MMBF) or 1990-92 (2,389 MMBF) which would not meet the purpose and need for this SEIS; rather, the alternatives were compared to Alternative 7, the 1992 high timber harvest which incorporates previous Forest and District Plans and the ISC Report:

Alternative 1 =	113	MMBF or 93.1% reduction
Alternative 2 =	624	MMBF or 62.0% reduction
Alternative 3 =	686	MMBF or 58.2% reduction
Alternative 4 =	712	MMBF or 56.7% reduction
Alternative 5 =	931	MMBF or 43.3% reduction
Alternative 6 =	811	MMBF or 50.6% reduction
Alternative 7 =	1,643	MMBF or 0% reduction
Alternative 8 =	1,232	MMBF or 25.0% reduction
Alternative 9 =	958	MMBF or 41.7% reduction
Alternative 10 =	958	MMBF or 41.7% reduction

Under all alternatives, as compared to historical levels, the decline in Forest Service and BLM harvest levels will lead to an increase in stumpage prices, at least in the short term. These higher stumpage prices may in turn lead to higher harvests in the short term from nonfederal timber lands. In the long term, however, these landowners who harvest now to take advantage of higher prices will have lower harvests as a consequence of reduced inventories on their lands (see the section on Cumulative Impacts at the beginning of this chapter). The combination of these market effects will impact communities in different ways.

County Governments Affected

Federal agencies control large portions of many counties within the range of the northern spotted owl. In lieu of the property taxes which local governments would collect if the land were privately owned, the U.S. Treasury returns 25 percent (50 percent on O&C lands) of gross timber sale (and other) receipts to counties to support roads and schools. These funds are a sizable component of the operating budgets for these mostly rural counties. These payments will drop where reductions in timber sale receipts are projected for the alternatives (see the Government Revenues section earlier in this chapter).

These reductions in payments, associated with all the alternatives, will occur at a time when county governments—a principal source of social services in rural areas and small towns—are pressed to provide help for a citizenry stressed by downturns in employment. As noted above, a number of counties and communities have already faced employment problems during the 1980's and early 1990's due, not primarily to federal log shortages, but to mill modernization and consolidation of the industry (Kusel and Fortmann 1991).

Some aspects of this decreased ability to provide county services, thus compounding the need for them, is discussed in a report to the Association of O and C Counties by Robert Lee. The report observes (in-text references removed):

> "Any reduction in social services is likely to have adverse impacts on individuals, families and local communities. This diminished capacity to provide social services is occurring at a time when new demands upon social services will very likely result from sharp increases in the number of people unemployed and dislocated by a decline in the wood products economy. Moreover, these same local social services have been seen as vital for helping communities make a transition from heavy reliance on timber to a more diversified base.
>
> "These cutbacks in community services tend to erode essential community institutions and the esprit de corps of a community, and can result in a weakened sense of pride and identity. Communities suffering from such weaknesses in central institutions (e.g. community colleges, fairs, and museums) are less capable of mobilizing their citizens to voluntarily address common problems resulting from decline in the wood products economy and county revenues. Moreover, individuals and families having difficulty coping with stress are less likely to receive support from neighbors or voluntary associations when the sense of community declines.
>
> "Some indication of the magnitude of the social costs associated with economic dislocation can be gained from a recent study of social costs associated with timber industry job losses in Washington State. An analysis predicted that total additional social costs in unemployment insurance, welfare, social security, training, wages lost, and taxes lost would total $165.6 million within the first year for the dislocation of 7,560 timber industry workers. This estimate did not include the increased costs of psychological counseling, law enforcement, education, or loss of asset value in homes, businesses, and equipment. It also did not consider the social costs of indirect job losses, or many of the other less easily measured costs" (Lee et al. 1991:15-16).

Consequences

The social effects for this SEIS focus on the implications of community-wide job loss, and impacts on people and county governments due to changes in the management of the National Forests and BLM Districts. While it is not possible to quantify the degree of effects to the hundreds of communities, and thousands of families, and individuals, it is assumed that social impacts generally will increase to an extent comparable to the reduction in timber harvest. These effects will "ripple" through the communities due to reduced need for wood workers, mill closures, and a reduction of secondary employment and income. However, a number of communities have faced similar consequences and survived over the last several decades due, in part, to modernization of mills, industry consolidation for efficiency and productivity gains, reductions in work shifts, reduced union wages, and limited local reinvestment. For some communities and employees, the social effects will be intense and debilitating, while for others the effects will be viewed as challenging and an opportunity for change. The following consequences are based, in part, on the assumption that the federal forests in the next few years will have some timber available. If lawsuits or other legal procedures restrict the implementation of the alternative selected in the Record of Decision for this SEIS, then the impacts discussed below would be overly optimistic.

Timber-dependent communities and the wood products industry have experienced many changes. The changes resulting from business cycles, automation, and planned reductions in timber harvest have been met and adapted to with some success. There is a difference in the permanence of the changes. A market downturn in 1981 and 1982 forced reductions in timber harvest from National Forests in Washington, Oregon, and California to levels roughly similar to those of Alternative 7. Those changes were seen as, and were, temporary. Most communities, individuals, and families were able to cope successfully. The changes in timber harvest from Alternatives 1 through 6, 9 and 10 would last longer than any firm or worker's ability to "wait it out." The changes in timber harvest likely under Alternative 8 would have less impact than under Alternatives 1 through 6, 9 and 10, but may still result in a downturn from Alternative 7.

There is a difference in the amount of change. All alternatives will force timber harvest levels lower than experienced in Washington, Oregon, and California in the last two decades. Alternatives 1, 2, 3, 4 and 6 would reduce the timber harvest levels most, Alternatives 5, 9, and 10 would have smaller reductions, and Alternatives 7 and 8 would continue relatively high timber harvests (see Table 3&4-44). However, this high level is lower than the historical averages in the 1980's and early 1990's.

There is a difference in the source of the change. People in the wood products industry have a strong commitment to the workings of the marketplace—the source of previous changes. Current changes have come through the application of laws and opinions from courts that seem to them insensitive to the economic values foregone and the social disruption that results.

There is a difference in the attitude of the rest of the society. There is a perception that there is little support for the plight of people in the industry and in timber-dependent communities. Lee identifies this antagonism as a case of "blaming the victim" (Lee 1990).

An additional impact on some rural communities will be caused by reductions in Forest Service employment and forest management activity. Under Alternatives 1, 2, 3, 4 and 6, an estimated 2,000 to 3,000 Forest Service jobs would be lost (USDA FS 1991:36). Lesser reductions are likely under Alternatives 5, 7, 8, 9, and 10.

For these reasons, the changes that would occur to timber-dependent communities and their people from all alternatives are different from previous changes they have experienced and weathered. These communities—loggers, mill owners and workers, and small businesses—and their families would experience significant, long-lasting impacts that would be difficult to overcome.

Effects on People of Alternatives 1, 2, 3, 4, and 6

The social effects of Alternatives 1, 2, 3, 4, and 6, based on reductions in the timber harvest levels, reflect the need for fewer wood product jobs to process the trees into marketable products. These job reductions would likely cause many wood products workers to relocate to find work, others to seek retraining, and a few to rely on human services to cope with the situation. Counties and cities would have difficulty funding the rising social needs for rural residents, especially those in need of welfare and other human service programs. Tax revenues, already reduced by property tax limitation measures in California and Oregon, would be reduced further by reduced receipts from the Forest Service and BLM due to the low harvest levels in these alternatives. These lower revenues could be offset to some degree, however, if prices continue to rise for federal timber.

The reduction of timber harvest activities would, over time, also contribute to the loss of business and activity in rural towns, as well as reduced tax bases to support local services. The loss of business vitality in rural towns from reductions in timber harvest and other forest development activities compounds the difficulty in providing services, skilled work force, and the quality of life and appearance that will attract new industries and recreational visitors. Generally speaking, the number of jobs lost would be high (with the highest in Alternative 1 and lowest in Alternative 6), need for extra social services would be high, and county revenues from federal timber sources would be low. The potential for retaining fishing related activities and jobs, as well as recreation and scenery, would be high for these alternatives, with the most under Alternative 1 and lesser amounts under Alternative 6.

Effects on People of Alternative 7

The social effects of Alternative 7 on timber-dependent communities would continue current patterns in most communities. Collectively, these communities will need to adapt to a foreseeable decline in timber harvest from all forest ownerships. Some towns will likely be successful; others will experience closed mills and a scarcity of logging activity. However, since the timber harvest is lower than historical highs, and log reserves from previous federal timber purchases are almost gone, the job losses and reduction of county revenues have not been fully documented. In comparison to the other alternatives (but not to historical averages), few jobs would be lost, need for extra social services would be relatively low, and county revenues would stay relatively high.

Effects on People of Alternative 8

Collectively, the social effects of Alternative 8 are between those of Alternatives 1, 2, 3, 4, 5, 6, 9 and 10, and those of Alternative 7. The timber harvest levels of Alternative 8 are about 75 percent of Alternative 7 (the highest PSQ). By simple interpolation, the effects would on average, be about half-way between those of Alternative 7 and Alternatives 9 and 10. In comparison to Alternative 7, jobs would be lost, the need for extra social services would be relatively moderate, and county revenues would remain moderate.

Effects on People of Alternatives 5, 9, and 10

Collectively, the social effects on people and counties for Alternatives 5, 9, and 10 are about 75 percent of those effects for Alternative 8. The timber harvest levels of Alternative 5 are slightly lower than Alternatives 9 and 10, which are almost equal. The probable future timber harvest level for Alternative 5 is 43 percent less than that for Alternative 7. Jobs would be lost, but not as many as under Alternatives 1, 2, 3, 4 and 6. In comparison to the other alternatives, the need for extra social services would be relatively low and county revenues would stay relatively high.

Economic and Community Assistance Program (Proposed)

The Clinton administration proposed in the spring of 1993 an integrated program to improve economic conditions in timber-dependent communities that may be affected by the implementation of the selected alternative for this SEIS. The proposal to Congress by the Labor and Community Assistance Working Group led by Peter Yu was designed to address both immediate and intermediate needs of workers, communities, and businesses. This comprehensive proposal has five components (Yu 1993):

1. Workers and Families — This component is comprised of, for the short term, restoration jobs on the federal forests, an improved timber supply, expediting timber in the "pipeline," timber salvage, and using other lands such as those administered by the Bureau of Indian Affairs to increase timber supply. Intermediate to long-term assistance would be in the form of an expanded, innovative retraining program for workers. There would also be increased availability of funds from the discretionary national reserve account under Title III of the Job Training Partnership Act (JTPA) for job search assistance, retraining, and relocation. The program also calls for a coordinated effort to expand conservation corps activities for young people in the rural Pacific Northwest. Overall, this component calls for an increase of 110 percent in funding from $20.2 million to $42 million.

2. Businesses and Industries — This component is comprised of, for the short-term, a stabilized and enhanced timber supply and an improved business climate. The intermediate goals include increased funding for access to capital through the Rural Development Administration (RDA), and old-growth diversification and community assistance funds available through the Forest Service. Also included are: expanded technical assistance through the Economic Development Administration (EDA) and the states and improving access to markets through procurement preferences and U.S.-Japan wood products agreements. The program also calls for increasing the supply of timber to the secondary wood products processing sector of the Pacific Northwest timber industry and eliminating tax incentives for log exports. Funding is proposed to increase by 47 percent from $163 million to $239.7 million.

3. Communities and Infrastructure — This component is comprised of, for the short term, county assistance for a 10-year timeframe and efforts to diversify communities, as well as planning and capacity-building grants through the EDA. Intermediate efforts are proposed to emphasize infrastructure improvements with programs administered by the Rural Development Administration and Housing and Urban Development (Community Development Block Grant loan guarantee program - Section 108). The federal agencies are expected to work closely with county and local governments to help shape the program. Funding is proposed to increase by 25 percent from $298.6 million to $373.6 million.

4. Ecological Investments — Short-term ecological investments are expected to focus on existing or proposed "off-the-shelf" restoration projects that can be quickly implemented. Intermediate efforts will focus on watershed restoration by the BLM, Forest Service, Fish and Wildlife Service, and the Environmental Protection Agency to provide family wage jobs with local hiring preferences. Included in this effort will be expansion of the Forest Service's stewardship projects and coordination with the Oregon resource trust. Restoration through watershed maintenance, ecosystem restoration and research, environmental monitoring, and forest stewardship will improve the condition of the region's ecosystems, create jobs in timber-dependent areas, improve water quality, and increase salmon stocks to avoid salmon listings and improve commercial fishing. Funding will increase by 19 percent from $438.2 million to $519.8 million.

5. Northwest Economic Adjustment Fund - As requested by the three states, funds are expected to be provided to help communities with emergency social services, training or educational supplements, and financing projects.

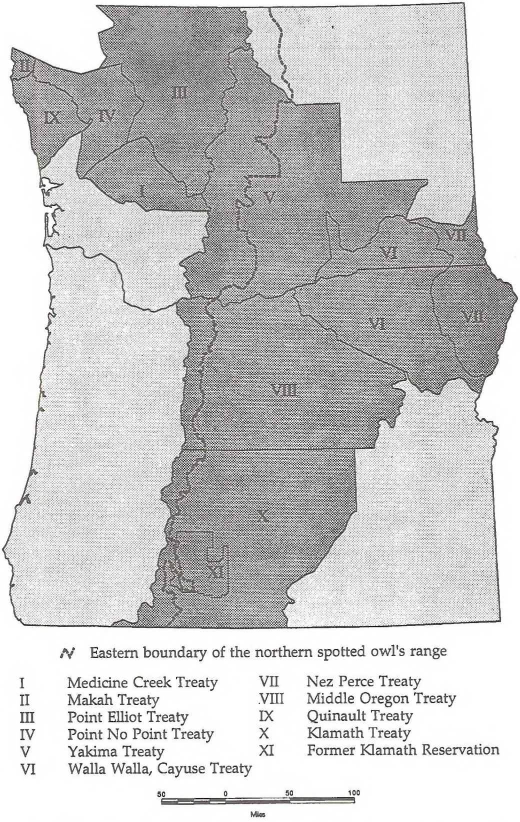
The Clinton administration requested that Congress provide a total of $1.2 billion ($333 million of which is new [i.e., not previously earmarked] money) in fiscal year 1994 for several programs in the Departments of Commerce, Agriculture, Labor, Interior, and the Environmental Protection Agency and the Small Business Administration to assist communities in coping with change under the selected alternative for this SEIS.

American Indian People and Cultures

Affected Environment

American Indians have occupied the Pacific Northwest region for at least 12,000 years and perhaps as long as 35,000 years. There are 25 federally recognized tribes in California and 36 in Oregon and Washington. These tribes exercise sovereign governmental authority over both persons and territory on their respective reservations within the range of the northern spotted owl. Of these federally recognized tribes, 25 have treaties with the United States and 10 have Executive orders (see Figure 3&4-18). In the treaties, tribes have ceded lands to the United States which, in part, comprise National Forests, National Parks and lands administered by the BLM within the range of the northern spotted owl. The various treaties specify reserved rights for water, gathering berries and roots, hunting, grazing, fishing (including the right to erect stations and temporary housing for curing fish), and to conduct other activities which accompany the preservation and use of those natural and cultural resources. As

Figure 3&4-18. Treaty boundaries for Washington and Oregon



I	Medicine Creek Treaty	VII	Nez Perce Treaty
II	Makah Treaty	VIII	Middle Oregon Treaty
III	Point Elliot Treaty	IX	Quinault Treaty
IV	Point No Point Treaty	X	Klamath Treaty
V	Yakima Treaty	XI	Former Klamath Reservation
VI	Walla Walla, Cayuse Treaty		

a result of the Treaties and Executive orders and the sovereign status of tribes, the United States and all of its Departments have a trust responsibility maintained through a government-to-government relationship between the parties.

The duty to protect the treaty reserved rights of American Indian tribes is an obligation for all federal agencies. The adjudication of treaty rights has been the subject of several U.S. Supreme Court cases that reaffirm the duty of federal agencies as trustee to protect the tribes' reserved rights in their actions on National Forests and public lands. Those Indian tribes whose official recognition was "terminated" in previous decades, but which has been subsequently restored and recognized by the United States, may also enjoy certain rights which have been restored by congressional statute.

The natural resources within the range of the northern spotted owl are discussed thoroughly earlier in this chapter, including many resources secured by treaty and others of interest and importance to Indian tribes. Habitat, and therefore the environment, is critical to the protection of those rights, and tribes need to be consulted regarding proposed management activities that may affect levels of plant and animal populations. A number of tribes retain off-reservation rights reserved by treaty when the tribes ceded traditional lands to the United States. These lands have cultural, subsistence and economic importance to tribes. In addition, the tribes in the region have jointly formed technical assistance staff such as the Columbia River Inter-Tribal Fish Commission (CRITFC), the Northwest Indian Fisheries Commission (NWIFC), the Point No Point Treaty Council (PNPTC), and the Skagit System Cooperative (SSC), to assist them in co-managing important trust resources with state and federal resource agencies. A recent 1993 draft agreement, known as PACFish, was executed between several of the tribes and organizations, land management agencies, and the Bonneville Power Administration concerning protection of stream habitat and stream flows to increase natural runs of salmonid species.

In addition to the treaties and rights reserved by various tribes, the federal agencies must comply with other statutes that concern American Indians. The American Indian Religious Freedom Act of 1978 (AIRFA) supports the Indian right to practice religious beliefs. In addition, many federal court cases have adjudicated treaty rights for fishing and other resource uses and generally established rules for how decisions regarding resource conservation should be made.

In general, these principles ensure that state conservation measures will not impair or restrict rights reserved by Indian tribes and their members pursuant to provisions set forth by Treaties or Executive orders unless: (1) the conservation measures are reasonable and necessary for preservation of the species at issue, (2) the conservation purpose of the measures cannot be achieved solely by regulation of non-Indian activities, (3) the conservation measures are the least restrictive available to achieve the required conservation purpose, (4) the conservation measures do not discriminate against Indian activities either as stated or as applied, and (5) voluntary tribal conservation measures are not adequate to achieve the necessary conservation purpose. Although these court decisions are concerned only with the exercise of state authority, it is reasonable to expect that the same principles would apply to the exercise of federal authority, absent explicit statutory language.

When dealing with the many archaeological materials found on federal lands, especially related to ground-disturbing activities such as road construction and timber sales, the agencies follow provisions of the Antiquities Act of 1906, the National Historic Preservation Act of 1966 (NHPA) Section 106 (which works in conjunction with the State Historic Preservation Offices), the Archaeological Resources Protection Act of 1979 (ARPA), the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA), and others. In addition, the Forest Service and the Bureau of Land Management have heritage and cultural resource manuals and handbooks for regional, Forest, state, and District direction to guide implementation of the laws.

Many Northwest American Indian tribes have beliefs that they were created at or near their present locations at the beginning of time. They used fire and otherwise managed the forest land to create and maintain specific landscapes (Williams 1994). Harvest strategies and techniques were governed by a complex system of social, political, and cosmological mechanisms that served to regulate and distribute resources in a manner which ensured perpetuation of, and access to, culturally important plants and animals. Tribes actively managed the land until it was ceded to the United States through treaties or Executive orders. The many strategies and techniques used by various tribes to manage the many forest resources still have implications for management today. For example, recent research indicates that certain plants may need to be managed by using prescribed fire to maintain their vigor and distribution within the landscape (Blackburn and Anderson 1993). Also see Appendix D for a description of northern spotted owl inventory efforts on tribal and Indian owned lands.

The economic and community assistance program (see previous section) for consideration by Congress (Yu 1993) is not restricted to rural, timber-dependent communities. Many of the reservations and communities on the reservations are expected to have problems in adjusting to reduced timber supplies similar to those expected in nonreservation counties and communities.

Consequences

Given both traditional and contemporary links between American Indian tribes and forests, it is clear that tribal members depend on public lands and resources for employment, subsistence, and cultural identity. Indian tribes have an interest in certain federal forest resources protected by treaties. The proposed action will not alter or affect these rights and interests nor will it impose any extra conservation burden on the tribes or Indian reservations. Many tribes have completed habitat conservation plans which comply with Federal law and policy and achieve significantly higher levels of protection for all species than on adjacent federal forest lands. Tribes and the Bureau of Indian Affairs also consult with the listing agency on actions which may affect listed species under the Endangered Species Act. Timber harvest and management on tribal and Indian owned lands are not controlled or modified by the proposed action. This SEIS provides alternatives to manage the resources on federal lands in ways that are responsive to tribal concerns.

This SEIS has examined the potential of the alternatives to impair or restrict the rights of various tribes and finds that none fall into that category. There are great variations in the uses of natural resources and sites on federal forest land by the various tribes. The proposed action would have no effect on the exercise of Indian religious freedom on federal forest lands. The federal agencies will consult with federally recognized tribes during the implementation of the selected alternative. There will be many opportunities for involving all tribes or groups in future land management decisions resulting from this proposed action.

Implementation of standards and guidelines could potentially affect American Indian practices and activities. For example, standards and guidelines that prohibit or discourage the collection of certain plant material or trees in Late-Successional Reserves could conflict with tribal rights and affect cultural subsistence practices. However, continuation of tribal uses when impacts are slight is recognized typically as an obligation under treaties and agreements. The Regional Ecosystem Office (REO) will consider these obligations when reviewing such exceptions to the standards and guidelines. Habitat protection measures, such as controls on the use of fire, could also have effects if these controls occur within traditional gathering areas (such as those for grasses and huckleberries) that need to be burned. However, the programmatic direction in this SEIS has no discernible impact on Indian trust resources.

A number of Indian communities and reservations were considered in the social analysis. Although the communities are not specifically identified in this SEIS, it is expected that the Indian communities and reservations will be impacted in ways similar to other rural communities affected by changes in federal timber harvest levels from forest lands administered by the Forest Service and BLM terms of reduced employment and ability to cope with change. See the discussion in the Rural Communities section above.

Many areas on the National Forests and BLM Districts have special meaning to American Indian tribes, bands, families, and individuals. Every alternative would allow for some continued amount of logging and road construction on federal forest lands which are potentially disturbing to the land, fisheries, and cultural sites. Yet the amounts of disturbance are well below historical levels. It appears there would be little difference in consequences to American Indians associated with the low levels of land disturbance among Alternatives 1, 2, 3, and 4. The degree of disturbance to vegetation, land, and cultural sites under Alternatives 5, 6, 8, 9, and 10 would be slightly higher, but lower than Alternative 7, which would have the highest ground disturbance. On the other hand, since a large number of archaeological and historical places are discovered while conducting ground searches prior to ground-disturbing activity, there may be fewer total archaeological and culturally important sites discovered under the alternatives that impose greater restrictions on timber harvest and road construction activities.

The assessment of aquatic species discussed earlier in this chapter establishes that all alternatives except possibly Alternatives 7 and 8 are expected to reverse the trend of aquatic and riparian habitat degradation and begin recovery of these habitats. Application of the Aquatic Conservation Strategy within the range of the northern spotted owl would improve habitat conditions for stocks of fish important to American Indians. For anadromous fish, there is very limited data available to establish direct relationships between land management actions and population response, due, in part, to other impacts such as predation and artificial propagation and the difficulty of translating these impacts into population numbers. Further, other effects such as commercial and sport fishing and ocean conditions such as El Niño compound the uncertainty in determining effects of improving habitat conditions of American Indian fisheries. Thus, the effects of the improved habitat conditions of American Indian fisheries are not quantifiable. Generally, the expectation is that fish production off federal land would increase with the improvements in aquatic habitat on federal lands and would, thus, benefit tribal fisheries. The rate of improvement depends on the many factors affecting fish production discussed earlier in this chapter. Regardless of which alternative is selected in the Record of Decision, fishing should improve with more streamside protection, although attendant increasing and higher sustainable fish numbers may take years. Efforts to comprehensively improve the fisheries will involve both the Forest Service and BLM, as well as other federal agencies, state agencies, and Indian tribes.

Other Environmental Consequences

Many of the environmental impact statements which are supplemented by this SEIS disclosed consequences to a number of environmental components, resources, and human uses at a more specific scale than is appropriate or necessary for the rangewide, regional, scope of this SEIS. These include special areas (such as Research Natural Areas and Areas of Critical Environmental Concern) and the urban/wildland interface. In addition, the environmental impacts to site-specific resources, such as historical and pre-historical cultural resources, will be addressed and mitigated in subsequent site-specific environmental analyses.

However, an essential characteristic of all 10 action alternatives in this SEIS is that they would permit significantly fewer ground-disturbing activities than the preferred or selected alternatives in those earlier EISs. Thus, those elements which benefit from little human interference generally will have environmental consequences less severe than disclosed in the supplemented EISs. Those elements which are themselves management activities, which benefit from management or from early seral stages, or reflect timber-dependent or overall employment, generally will experience more detrimental impacts than disclosed for the preferred and selected alternatives in those earlier EISs.

Conflicts With Other Plans

The Council on Environmental Quality Regulations at 40 CFR 1502.16(c) require a discussion of "possible conflicts between the proposed action and the objectives of Federal, regional, State, and local (and in the case of a reservation, Indian tribe) land use plans, policies and controls for the areas concerned." Appendix D of this SEIS, Related Direction and Activities, describes those plans as they pertain to the proposed action.

The interagency cooperation that is at the foundation of this effort, and the direction that the proposed action meet the requirements of the applicable laws and regulations, have provided the assurance that there are minimal conflicts between different federal laws and policies. The implementation of this decision through interagency structures (see Appendix E) will facilitate the early resolution of any future conflicts.

The management direction in this SEIS applies only to federal lands where state and local land use plans, policies and controls have little application. Similarly, this proposed action and the alternatives do not apply to tribal and Indian owned lands. Thus, the proposed action and the alternatives have minimal basis for conflict with other plans, policies and controls. However, the implementation process, and specifically the Regional Interagency Executive Committee and Regional Ecosystem Office, actively encourage state and tribal participation to assure coordination and a minimizing of conflicts over land use questions.

Adverse and Long-Term Consequences

The Council on Environmental Quality regulations require that this discussion include "... any adverse environmental effects which cannot be avoided should the proposal be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented" (40 CFR 1502.16). The proposal is the preferred alternative, Alternative 9.

Adverse Consequences

The adverse consequences which could not be avoided if the preferred alternative were implemented have been presented earlier in this chapter. The principal action of the preferred alternative is the addition of late-successional and old-growth reserves and Riparian Reserves to existing management direction and the addition or revision of environmental analysis and monitoring mechanisms to existing management. The principal adverse consequences of the preferred alternative include the loss of jobs and income, and the threat to the economic vitality of many timber-dependent communities. The implementation of projects consistent with the preferred alternative would result in reduction in habitat for late-successional and old-growth related species in the 22 percent of the planning area that comprises the matrix and Adaptive Management Areas. However, the amount of late-successional forest will increase over time within the 78 percent of the planning area that comprises withdrawn and reserved areas (FEMAT Report, p. IV-55 and Figure IV-2, p. 70). There is further protection to habitat for late-successional and old-growth related species in that projects can proceed only if watershed analysis and site-specific environmental analysis and consultation find management activities consistent with this and other management direction. The consistency of these actions with the specific prescriptions and long-term objectives of this proposal will be either affirmed by monitoring and research, or will be adapted to conform with the long-term objectives.

The short and long-term reduction in timber harvest from these federal forests will have an adverse impact on the county governments, firms, communities, and families who have depended on that harvest in the past. While this impact can be partly mitigated by various programs and efforts beyond this SEIS, these changes are disruptive to all, and devastating to some. Those most affected will see their standard of living reduced, their ties with others strained or broken, and their community institutions weakened.

Short-Term Uses and Long-Term Productivity

The use or protection of natural resources for long-term sustained yield is at the legislated basis of management and direction for the Forest Service and the Bureau of Land Management. The short-term uses of resources in accordance with the standards and guidelines of the preferred alternative shall result in minimum long-term loss in productivity of forest soils and other components necessary for a healthy forest environment.

Irreversible or Irretrievable Commitments

Implementation of projects in accordance with the preferred alternative would result in some, if not all, loss of utility of habitat for late-successional and old-growth related species for the period of time needed for that habitat to grow again—a commitment of over a century. Some old-growth forest stands would be harvested under the preferred alternative. Although certain economic and social values will be saved at the point of harvest, these areas will then not contain as full an array of ecological and human values associated with old-growth forests as stands not harvested. Depending on the physiographic province and site, it would be several centuries or more before the full array of those characteristics return.

If the preferred alternative is selected, lands committed primarily to maintenance of a functional interconnected late-successional and old-growth forest ecosystem would not provide timber growth at the rate they would were stands harvested and regenerated; this loss of growth is not retrievable.

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The following is a list of contributors to this supplemental environmental impact statement. Numerous others contributed to the completion of this document through their assistance in support functions and/ or by assuming duties of coworkers who were heavily involved in this effort. Their help is greatly appreciated.

This SEIS is based on the work of the Forest Ecosystem Management Assessment Team and their report *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment*, which comprises Appendix A of this document. Literally, hundreds of people contributed to the Assessment Team's task. A complete list of the members of the Forest Ecosystem Management Assessment Team, as well as significant contributors to that task, is included in Appendix A.

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Alaska Region
Angeles NF
  Arroyo Seco RD
Ashley NF
  Supervisor Office
Beaverhead NF
Big Horn NF
  Supervisor Office
Bitterroot NF
  Supervisor Office
Black Hills NF
  Supervisor Office
Boise NF
  Supervisor Office
Caribbean NF
  Supervisor Office
Chequamegon NF
Chugach NF
Cibola NF
  Public Affairs Department
Clearwater NF
  Supervisor Office
Columbia River NSA
Colville NF
  Colville RD
  Curlew Job Corps CCC
  Kettle Falls RD
  Newport RD
  Republic RD
  Spokane Info Office
  Sullivan Lake RD
  Supervisor Office
Deschutes NF
  Bend RD
  Crescent RD
  Fort Rock RD
  Lava Lands Visitor Center
  Sisters RD
  Supervisor Office
Dixie NF
  Supervisor Office
Eastern Region
Flathead NF
  Supervisor Office
Fremont NF
  Bly RD
  Lakeview RD
  Paisley RD
  Silver Lake RD
  Supervisor Office
Gifford Pinchot NF
  Mount St. Helens Ntnl. Vol. Mnt
  Mt. Adams RD
  North Zone Eng
  Packwood RD
  Randle RD
  South Zone Eng
  Supervisor Office
  Visitor Info. Center
  Wind River RD
  Zone I Eng
  Zone III Eng
Helena NF
  Helena RD
Idaho Panhandle NF
  Supervisor Office
Intermountain Regional Office

Inyo NF
Klamath NF
- Goosenest RD
- Happy Camp RD
- Oak Knoll RD
- Salmon River RD
- Scott River RD
- Supervisor Office
- Ukonom RD

Kootenai NF
Lake Tahoe Basin
- Management Unit

Lassen NF
Lincoln NF
- Cloudcroft RD

Lolo NF
- Superior RD

Los Padre NF
- Santa Lucia RD

Malheur NF
- Bear Valley RD
- Burns RD
- Long Creek RD
- Prairie City RD
- Supervisor Office

Manti-Lasal NF
- Monticello RD

Medicine Bow NF
Mendocino NF
- Corning RD
- Covelo RD
- Stonyford RD
- Supervisor Office
- Upper Lake RD

Modoc NF
- Supervisor Office

Mt Baker-Snoqualmie NF
- Darrington RD
- Mt. Baker RD
- North Bend RD
- S Eng Zone
- Skykomish RD
- Supervisor Office
- White River RD

Mt. Hood NF
- Barlow RD
- Bear Springs RD
- Clackamas RD (Ripplebrook)
- Columbia Gorge RD
- Estacada RD
- Hood River RD
- Mt. Hood Vistor Center
- Supervisor Office
- Timber Lake CCC
- Zigzag RD

Nez Perce NF
- Supervisor Office

Nicolet NF
- Supervisor Office

Northeastern Area - S&PF
Northern Region Office
- Public Affairs
- Wildlife and Fisheries

Ochoco NF
- Big Summit RD
- Crooked River Natl Grassland
- Paulina RD
- Prineville RD
- Snow Mountain RD
- Supervisor Office

Okanagon NF
- Supervisor Office
- Tonasket RD
- Twisp RD
- Winthrop RD

Olympia NF
- Hood Canal RD
- Quilcene RD
- Quinault RD
- Soleduck RD
- Supervisor Office

Pacific NW Regional Office
Pacific NW Research Station
Pacific SW Regional Office
Pacific SW Station
- Redwood Science Lab
- Silviculture Laboratory

Payette NF
- Supervisor Office

Plumas NF
- Supervisor Office

Rocky Mt Region
Rogue River NF
- Applegate RD (Star RS)
- Ashland RD
- Butte Falls RD
- Prospect RD
- Supervisor Office

Routt NF
Salmon NF
- Cobalt Ranger District

Sequoia NF
- Supervisor Office

Shasta-Trinity NF
- Big Bar RD
- Hayfork RD
- McCloud RD
- Mt Shasta RD
- Shasta Lake RD
- Supervisor Office
- Weaverville RD
- Yolla Bolla

Sierra NF
- Supervisor Office

Siskiyou NF
- Chetco RD
- E Eng. Zone
- Galice RD
- Gold Beach RD
- Illinois Valley RD
- Powers RD
- Rand Info Center
- Supervisor Office
- W Eng. Zone

Siuslaw NF
- Alsea RD
- Angell Job Corps Center
- Cape Perpetua Visitor Center
- Hebo RD
- Mapleton RD
- Oregon Dunes Natl Rec Area
- Supervisor Office
- Waldport RD

Six Rivers NF
- Lower Trinity RD
- Mad River RD
- Orleans RD
- Smith River RD
- Supervisor Office

Southern Region

Southern Station
  Law & Ecology Research
Southwestern Region Office
Stanislaus NF
  Groveland RD
  Supervisor Office
Tahoe NF
  Supervisor Office
Targhee NF
  Supervisor Office
Toiyabe NF
  Carson RD
Tongass NF
  Ketchikan Area
  Ketchikan RD
  Stikine Area
Umatilla NF
  Heppner RD
  North Fork John Day RD
  Pomeroy RD
  Supervisor Office
  Walla Walla RD
Umpqua NF
  Cottage Grove RD
  Diamond Lake RD (Toketee RS)
  North Umpqua RD
  Supervisor Office
  Tiller RD
  Wolf Creek CCC Job Corps
Washington Office
  FW Staff
  IS&T Staff
  International Forestry
  Office of Environ. Coordination
  Office of the Chief
  Public Affairs Department
Wallowa Whitman NF
  Baker RD
  Burnt Powder Eng Zone
  Eagle Cap RD
  Hells Canyon NRA (Clark)
  Hells Canyon NRA (Riggns)
  Hells Canyon Natl Rec Area
  LaGrande RD
  Pine RD
  Supervisor Office
  Unity RD
  Wallowa Valley RD
Wasatch-Cache NF
  Supervisor Office
Wenatchee NF
  Chelan RD
  Cle Elum RD
  Entiat RD
  Lake Wenatchee RD
  Leavenworth RD
  Naches RD
  North Tech. Center
  Supervisor Office
White River NF
  Supervisor Office
Willamette NF
  Blue River RD
  Detroit RD
  Lowell RD
  McKenzie RD
  Oakridge RD
  Rigdon RD
  Supervisor Office
  Sweet Home RD
Winema NF
  Chemult RD
  Chiloquin RD
  Klamath RD
  Supervisor Office
USDA National Agricultural Library
  Acquisitions and Serials Branch
USDA OPA Publication Stockroom
USDA Office of Equal Opportunity
USDA Office of General Counsel
USDA Office of Inspector General
USDA Soil Conservation Service
  Ecological Sciences Division
USDC - Office of General Counsel
USDC NOAA
  Ecology and Conservation Division
USDC NOAA/NMFS
  Office of Habitat Protection
USDC NOAA/NOS/OCRM/SLR
USDE
USDE Bonneville Power Administration
  AJP
  EFBG
  MMLL
USDI
USDI - National Park Service Air
USDI - Office of American Indian Trust
USDI - Office of Environmental Affairs
USDI - Office of Regional Solicitor
  Asst Regional Solicitor- Indian Affairs
USDI - Office of the Regional Solicitor
USDI - Office of the Secretary
USDI - Office of the Solicitor
USDI Bureau of Indian Affairs
  Burns District
  Department of Forestry
  Office of Trust Responsibilities
  Umatilla Agency
  Warm Springs Agency
  Branch of Forestry
USDI Bureau of Land Management
  Alturas Resource Area
  Arcata Resource Area
  Baker Resource Area
  Burns District
  CPD
  Caliente Resource Area
  California State Office
  Coeur D'Alene Dist.
  Colorado State Office
  Coos Bay District
  Denver Service Center
  Dillon Resource Area
  Division of Recreation and Wildlife
  Eastern States
  Eugene District
  Klamath Falls Resource Area
  Lakeview District
  Lakeview Multiple Use Advisory
  Lands & Renewable Resources
  Medford District
  Montana State Office
  Office of the Director
  Oregon State Office
  Phoenix Resource Area
  Phoenix Training Center
  Prineville District Office
  Public Affairs
  Redding Resource Area

Roseburg District Office
Roswell District
Salem District
Santiam Resource Area
Spokane District
Tillamook Resource Area
Training Center
Ukiah District
Utah State Office
Vale District
Walker Resource Area
Wenatchee Resource Area
USDI Bureau of Mines
USDI Bureau of Reclamation
USDI Fish and Wildlife Service
Ecological Services BFA
Portland Field Office
Society of Wetland Scientists
USDI Geological Survey
USDI National Marine Fisheries Service
Bin C15700 Building
Bin C15700, Building 1
F/CM1
Habitat Conservation Division
Recovery Team
USDI National Park Service
Crater Lake National Park
Mount Rainier National Park
North Cascades National Park
Olympic National Park
RESEARCH AND RESOURCES MANAGEMENT
Redwood National Park
USDI National Park Service - DSC- TEA
USDI Oregon Caves National Monument
USDT Federal Highway Administration
Watershed Management Team
White Mountain Research Station

State, Provinces, County and City Governments

Alaska Department of Fish And Game
Anderson City Counsel
Anderson City Mayor's Office
Arizona Game & Fish Dept.
Ashland Mayor's Office
Association of O&C Counties
Association of Oregon Counties
Benton County Development Dept.
California Board of Forestry
California Coastal Commission
California Department of Fish and Game
California Department of Forestry & Fire Protection
California Department of Parks and Recreation
California Department of Transportation
California Divison of Mines/Geology
California Farm Bureau
California Farm Bureau Federal
California Farm Bureau Federation
California Regional WQ Control BD
California Research Bureau
California Resources Agency
California Spotted Owl Team
California State Lands Commission
Caltrans
Cave Junction Mayor's Office
City of Albany
City of Bay City
City of Corvallis
City of Dalles
City of Detroit
City of Grants Pass
City of Klamath Falls
City of Malin
City of Myrtle Creek
City of Myrtle Point
City of Pateros
City of Port Townsend
City of Portland
City of Salem
City of Seattle
City of Sheridan
City of Tacoma
City of Toledo
City of Willamina
Clackamas County
Clallam County
Clallam County Commissioners' Office
Clark County Department of Community Services
Coos County
Coos County Board of Commissioners
Council of Goverments
County Forester
County Supervisor
County of Klamath
Curry County Board of Commissioners
Dept. of Parks & Recreation
Development Services Dept
Dirkson Senate Office Bldg.
Douglas County
Douglas County Board of Commissioners
Eastside Ecosystems Mgt State Project
Feather River Recreation & Park District
Glenn Co. Board of Supervisors
Grays Harbor Board of Commissioners
Greater Victoria Water District
Hood River County
Humboldt Bay Harbor Dist.
Humboldt County
Humboldt County Board of Commissioners
Humboldt County Board of Supervisors
Illinois Valley Soil & Water Conservation District
Imperial Irrigation District
Interagency Comm Outdoor Rec.
Jackson County
Jackson County Board of Commissioners
Josephine County
King County Environmental Division
Klamath County
Klickitat County Commissioners
Lake County
Lake County Board of Supervisors
Lakeside City Planning Commission
Lane County Board of Commissioners
Lane Regional Air Pollution Authority
Lassen County Board of Supervisors
Legislative Committee on Trade
Linn County
Lower Columbia Economic Dev. Council
Marion County
Mayor of Sebastopol
Medford Water Commission
Mendicino County Board of Supervisors
Mid-Columbia Economic Development Dist.
Mid-Willamette Council of Governments
Minnesota Department of Natural Resources
NCRBP
OCZMA
OSU Extension Service
Ohio Attorney General's Office
Okanogan County Commissioners

Oregon Cooperative Wildlife Research Unit
Oregon Department of Agriculture
Oregon Department of Environmental Quality
Oregon Department of Environmental Section
Oregon Department of Fish & Wildlife
Oregon Department of Fish and Wildlife
Oregon Department of Forestry
Oregon Department of Geology & Mineral Industries
Oregon Department of Geology & Mineral Industry
Oregon Department of Human Resources
Oregon Department of Justice
Oregon Department of Land Conservation and Development
Oregon Department of Transportation
Oregon Division of State Lands
Oregon Economic Development Department
Oregon Employment Division
Oregon Executive Department
Oregon Extension Office
Oregon Governor's Office
Oregon International Port of Coos Bay
Oregon Office of the Governor
Oregon Policy and Planning Section
Oregon Salmon Commission
Pacific State Marine Fisheries Comm.
Parks and Recreation Department
Plumas County Board of Supervisors
Polk County
Polk County Board of Commissioners
Polk Soil & Water Conservation Districts
Port Townsend Mayor's Office
Port of Port Angeles
Portland Mayor's Office
Portland Regional Water Supply Plan
Puget Sound District Council
Regional Water Quality Control Board
Research & Statistics Employment Division
Rogue Valley Council of Governments
Seattle Water Department
Shasta County Board of Supervisors
Shasta County Planning Division
Shasta Lake Mayor's Office
Siskiyou County
Siskiyou County Board of Supervisors
Siskiyou County Farm Bureau
Siskiyou County Supervisor
Siuslaw SWCD
Skamania County
State Marine Board
Stevens County Commissioners
Tehama County Board of Supervisors
Thurston County Planning Department
Tillamook County
Trinity County Board of Supervisors
Trinity County Ca
Trinity County Dept. of Transportation
Trinity County Planning Dept.
Turner Planning Commission
US House of Representatives
US Senate Committee On Environment
Ukiah District Advisory Council
WSEO
Wallowa County Court
Washington County Dept./Land Use & T
Washington Department of Agriculture
Washington Department of Ecology
Washington Department of Fish and Wildlife
Washington Department of Fisheries
Washington Department of Natural Resources
Washington Department of Revenue
Washington Department of Transportation
Washington Department of Wildlife
Washington Employment Security Dept.
Washington Energy Office
Washington Environmental Council
Washington Forest Protection
Washington Governor's Office
Washington Labor Council
Washington National Heritage Program
Washington Office of the Governor
Water Resources Department
Weaverville-Douglas City Rec. Dist.
Willamalane Park & Recreation Dist.
Wisconsin Department of Natural Resources
Wyoming Game and Fish Dept
Yakima Wildlife Resource Management
Yamhill Soil & Water Conservation Dist.

Businesses

1st Interstate Bank of Washington
1st Security Bank of Idaho
ABC Six Rivers Realty
Acme Glass Co. Inc.
Ag Crook Co.
Ahrns Chiropractic
Alaska Power & Telephone Company
Allan C Wirkkala, Sr. - Contracting
Allen And Gibbons Logging And Douglas Timber Operators
Almanor Forest Products
Alpental Snoqualmie Ski Acres
Alrt Corporation
American Soil Products, Inc
Ancient Forest Adventures
Arcangeli Trucking
Arco Oil And Gas
Arneson & Wales
Arrowhead Timber Co.
Arthur Farm
Atta Crystal Resort
Avison Lumber Co.
B & B Logging
BNA Publications
BNRR
BPOE
BR Strong Consulting Engineers
Bald Knob
Bambi Hair
Barnes Forestry Consultants
Bat Country Horseman of California
Beak Consultants Inc.
Bear Creek Tree Farms
Beginnings Inc.
Ben Levine Timber
Benton Bowmen
Berry Botanic Garden
Beyers Lumber Company
Bio-West Consultants
Bio/West Inc.
Biological Consulting Services
Biosphere Communications
Biosurveys
Biosystems Analysis Inc.
Black Diamond Millworks, Inc.
Blackfoot Mining Co.
Bloch Lumber Co.
Blue Oak Millworks
Boardman Suhr Curry & Field
Bogle & Gates
Bohemia Inc.
Boise Cascade Corp.
Burrill Lumber Company
Buse Timber & Sales

Byandaro
Byron Bros Inc.
C & D Lumber Company
CCD Business Development
CE Exploration
CFI
CH2M Hill
CHFC
CJM & Associates DBA Thinking Inc.
California Energy Company
Campbell Group
Carbon River Ranch
Cardinal Employment Services
Carolina Truss And Manufacturing Co., Inc.
Cascade Handle Co. Inc
Cascade Logging Inc.
Cascade Planning Associates
Cascade River Runners
Cascade Timber Consulting Inc.
Caster Forestry Consultants
Cato Institute
Cedar Springs
Cell Tech
Chambers Associates Inc.
Champion International Corp.
Charles Skinner Trucking
Charter Investment Group
Chelsea Lumber Company
Chemeketans
Chino Lumber & Hardware
Clover Logging Inc.
Coastal Forest Lands Ltd.
Coastal Structures Inc.
Cogan Owens Cogan
Coldwell-Banker & Holman Realty Inc.
Collins Pine Co.
Columbia Forest Products, Columbia Plywood
Columbia Helicopters Inc.
Columbia Plywood
Community By Design
Community Medication Consultants
Computer Support Services
Consulting Forestry Services
Cooksley Geophysics Inc.
Corporation For Enterprise Development
Cors & Bassett
Cortex Consultants
Cotchett Illston & Pitre
Criss & Co. Consultants
Crone Lumber Co, Inc
Crowell & Moring
Crown Pacific Ltd.
Crystal Mountain Resort
Custom Properties
D Thureson Inc.
DCLA
Dahlgren Logging Inc.
Dahlstrom Lumber Co.
Dames & Moore
Daniels & Associates, Inc.
Darnoc Consulting
David Evans & Associates
Daw Forest Products Co.
Decision Research
Deerlick Springs Resort
Deixis Consultants
Deja Inc.
Diamond Wood Products Inc.
Dick Murray Real Estate
Dills Creek Inc.
Doe Engineering Services
Dole Coalwell Clark & White Pc
Douglas Electric Co-Op
Douglas Timber Operators, Inc.
Dr Johnson Lumber Co
Dynamac Corporation
EA Bestland & Associates
EA Engineering
EIP Associates
ELGO Engineering
ENSR
ERA Nicholson & Associates
ESSI
Eades Forestry
Eagle Rock Timber Co.
East Fork Lumber Co.
Eastlick Trucking
Ebasco Environmental
Ebel & Assn. Inc.
Eco Northwest
Economics Resource Group
Ecopro
Ecotours of Oregon
Embasco Environmental
Encap, Inc
Enoch Skirum & Sons Inc.
Environmental Inventory Data
Epic
Epic/Map Rap
Erosion Control Inc.
Erv Meeks Logging, Inc.
Evans Environmental Consultants
Evergreen Products Inc.
Farm Credit
Feller & Associates
Fencl Farm & Forest Products
Fennimore Cutting Inc.
Filler King Co.
Fir Springs Tree Farm
Fishman Environmental Service
Fitzgerald Ranch
Fodge Cedar Prod. Inc.
Forest Engineers Inc.
Forest Management Inc.
Forest Products Finance Group
Fort Vancouver Plywood
Foruria
Foss Whitty Littlefield & McDaniel
Fox Bennett & Turner
Fox Hollow Corp.
Foxx, Neilsen & Assoc.
Frank Lumber Co. Inc.
Freres Lumber Co., Inc.
Friesen Lumber Co.
Fruit Growers Supply Co.
Furman Lumber Inc.
GMW Logging Inc.
Garden Valley Realty
Gary Gregg Trucking Inc.
Gene Whitaker Inc.
Genetic Resource Consultants
Geo-Marine, Inc
Georgia Pacific Corp.
Gillen Logging Inc.
Gimre's of Roseburg Inc.
Giustina Resources
Glacier Energy Company
Gold Bar Et. Al Mining Co.
Golden Reforestation Inc.
Goodyear Nelson Hardwood Lumber Co.
Grabill Quality Cabinetry
Grant Logging Co. Inc.
Green Tree Plantation Inc. & Sora
Greenwood Engineering
Greiner Incorporated
Greyback Forestry
Greystone Consultants
Grove Crushing Co.

Guy Bennett Lumber Co.
H2O Powr
HDR Engineering
Habitat Creations
Haglund & Kirtley
Hale & Dorr
Hampton Tree Farms Inc
Hanel Lumber Co. Inc.
Harza Northwest Inc.
Haylund & Kirthey
Heath Logging Inc.
Heritage Resources
Hermann Brothers Log & Construction Inc.
Herrin Realty
Hi-Ridge Lumber Company
Hoh River Timber, Inc
Homestake Mining Company
Horizon Herbs
Huffman & Wright
Hulbert Auto Park
Hull-Oakes Lumber Co.
Hunt Pole & Log
IF Rodger & Sons
ITT Rayonier Inc.
Idaho Timber Corp. of Oregon
Illahee Tree Farm Inc.
Imt Agencies Inc.
Infotech Development Inc
Intergraph Corp
International Knife & Saw Inc.
International Multi-Shelter, Inc.
International Paper Co.
International Resources
Ita & Wit Orville Boone Trucking
J & K Logging Inc.
J & S Trucking
JSM Technology
James River Corporation
Jeld-Nen
Jensen Securities Co.
Jim Hardin Trucking
Jiustina Resources
John J Kaib MD PC
John L. Moore Forest Products
Johnson & Kloos
Jon L Golly Inc.
Jones & Stokes Associates
KLE Enterprises Inc.
Karnopp Petersen Noteboom, Et. Al
Kaufman & Stewart
Keck, Mahin & Cate
Ken J Collins Co.
Ketchikan Pulp Co.
Kevin Q Davis Attorney At Law
Key Log Ltd.
Kidder Peabody & Company
Kinchelor & Son'S Inc.
Knapp Lumber Sales Inc.
Knudson Logging Inc.
Knutson Towboat Co.
L D Trucking
LSA Association
Labat Anderson Inc.
Lake Plywood
Lance Forest Products
Land Letter
Lane Electric Co-Op
Langell Valley Irrigation
Law Office of Daniel Stotter
Law Office of Frank Frisk
Law Offices of John Shaffer, Jr.
Law Offices/Richard D Siegel
Leo & Lathrop Jr.
Lightning Creek Ranch
Lily Glen Horse Trials
Litco International Inc.
Log House Plants
Lone Rock Timber Co.
Longivew Fibre Company
Louis Berger & Associates, Inc.
Louisiana Pacific Corporation
Lower Springs Acres
Lowery Realty
Lucidyne Technologies
Lumber & Hardward Co
M Miles & Associates Limited
MB & G
MacMillin Forestry & Logging
Madrone Consultants Ltd
Makal Fisheries Management
ManTech Environmental Technology
Manke Lumber Co. Inc.
Mantech Environmental Technology
Marinaccio Resources Inc.
Martin Marietta Energy Systems Inc.
Mason Bruce & Girard Inc.
Matthews Associates Inc.
Maurer Enterprises, Inc.
Mayr Brothers Log Co., Inc.
McCloud Railway Company
McMinnville Water & Light
Meadow Lake Incorporated
Medford Corp.
Mellon Financial Center
Menasha Corp.
Mendocino 4 X 4
Metamorphosis
Meyer Inc.
Miller Shingle Co., Inc.
Miller-Nash-Wiener-Hager-Carlsen Law Firm
Miners Supply Co.
Modoc Lumber Co.
Monett Logging Inc.
More Logging
Morrison & Foerster
Moss Adams
Mt. Baker Ski Area
Mt. Family Calendar
Mt. Hood Meadows Ski Area
Mt. Pacific Construction
Mukumoto Associates
Murray Pacific Corp.
Musselman & Associates, Inc.
NW Marine Trade Association
Nading Plumbing & Heating
National Resource Consulting Inc.
Native Landscapes
Natural Resources Management Corp.
Natural Selection Forestry
Neilsen Brothers Inc.
Neimi Forestry
Nelson Contracting Inc.
Nelson Lumber And Hardware Co.
Noble & Bittner Plug Co.
Norcal Electric Supply
Norman Barnes & Co., Inc.
Northern Land And Lumber Company
Noyes Valley Cattle Co.
Nute Engineering
O'Neal Forest Products
Ochoco Lumber Co.
Off-Road Advertiser
Oji Paper Co., Ltd.
Olympic Cascade Timber Inc.
Oregon Birds
Oregon Raptor Center
Orem & Son Inc.
Owen Durand Logging, Inc.

P & M Cedar
PFE & Associates
PGE
PIC Tech Inc
PNM Cedar
PO Pack
Pacific Bell
Pacific Fibre Products Inc.
Pacific Fisheries Enhancement
Pacific GIS
Pacific Gas & Electric Co.
Pacific Gas Transmission Co
Pacific Lumber Company
Pacific Meridian Resources
Pacific Power & Light Co.
Pacific Wood Fuels Co.
Pacificorp
Pan Ocean Shipping Co.
Paragon
Parametrix
Park Place Real Estate
Pat & Mike Trucking
Pelton Wood Products
Peninsula Gateway
Perkins & Company PC
Petersen & Evans Enterprises
Peterson Pacific Corp.
Petervin Information
Pic Technologies Inc.
Pirtle Morisset Schlosser & Ayre
Planning Consultants Research
Planning Information Corporation
Plum Creek Management Co.
Plum Creek Timber Co.
Pope & Talbot, Inc.
Portac Saw Mill
Portland General Electric
Powell Goss & Herrmann
Prairie Wood Products
Preston Thergrimson Shidler Gates & Ellis
Prudential Securties
Public Works Director
Pulp & Paper Workers Resources Group
R-Z Publishing Inc.
R2 Resources Consultants
RD Merrill Company
RD Productions
RF Mattei & Assoc. Inc.
RL&L Evironmental Services Limited
RS Hinton & Associates
RW Jacks Logging & Road Bldg. Co.
Raedeke Associates
Raftec
Ramsay Tree Farms
Ran-San Enterprises
Random Lengths
Rasmussen Millwork, Inc.
Reading's Creek Tree Farm
Recon
Red Feather, Inc
Reeves Kahn & Eder
Regional Financial Advisors
Reinhart & Assn.
Reservation Ranch
Resort At The Mountain
Resources Northwest Inc.
Rice Logging Co.
Rincon Valley Chiropractic
Robert E Thomas Attorney
Rocking Ac Ranch
Rocway Logging
Rodenbough Logging
Rogers Construction Inc.
Rosboro Lumber Co.
Rose Logging
Roseburg Forest Products
Roseburg Resources Co.
Ross-Simmons Hardwood Lumber
Rough & Ready Lumber Company
Roy F Weston Inc
Rural Human Services, Inc
SDS Lumber Co.
SPO Partners & Co.
Salem Electric Coop.
Sandy Bar Ranch
Sapp Brothers Logging Inc.
Schmidbauer Lumber Inc.
Schwabe, Williamson & Wyatt
Science And Policy Associates
Scientific Certification Systems
Scotia Pacific Holding Co
Scott Land & Timber Co
Scott Paper Company
Sealaska Corp
Sec Inc.
Second Growth Inc.
Seneca Sawmill Co.
Shapiro & Assoc Inc.
Shasta Cascade Wonderlands
Sheets Wholesale Inc.
Shiloh Forest Ent Inc.
Shindler-Mcnair Guide Service
Shingletown Logging
Siegmund Logging Co. Inc.
Sierra Pacific Industries
Sierra Timber Products
Silva Ecosystem Consultants
Silva Tree Management
Silver Butte Timber Co.
Simonarson Law Firm
Simplex Mfg. Co.
Simpson Timber Company
Siskiyou Forestry
Siskiyou General Hospital
Six Pak Construction
Ski Ashland
Ski Bluewood
Ski Lifts, Inc.
So Healer
Soda Mountain Wilderness Council
Sorenson Law Office
South Coast Lumber Co.
Southwest Tyre
Spalding & Son, Inc
Specialty Fiber Products
Springfield Forest Products
Starfire Lumber Co.
Starker Forests Inc.
Starlite Kieko Mining Co.
State Industries Inc.
Stebbins & Coffey
Stephens & Associates
Stevens Pass Inc.
Stimson Lumber Company
Stoel Rieves Boley Jones & Grey
Stokes Construction Co. Inc.
Stoll Rieves
Stone & Webster Environ Tech Services
Stone Container Corporation
Stone Forest Industries
Stu Jones Lumber
Stuntzner Engineering & Forestry
Sun Studs Inc.
Sundance Lumber Co.
Superior Lumber Co.
Superior Veneer
Swanco Timber Inc.
Swanson Bros Lumber Co.

TW Resources
Tacoma Public Utilities
Tartan Tours & Travel
Taylor Lumber & Treating Inc.
Tennessee Valley Authority
Terra Verde Forestry Service
Tetra Tech Incorporated
The Box D Ranch
The Caddis Fly Angling Shop
The Campbell Group Inc.
The Consultants Group
The Drain Enterprise
The Economics Resource Group
The Fence Doctor
The Hearst Corp.
The Irland Group
The Kerr Mercantile Co., Inc.
The Seamless Web
The Umbrella
The Watershed Company
Thomas Creek Lumber & Log Co.
Three Brothers Logging
Tierra Madre Consultants
Tiller Market
Tilton Truss Manufacturing, Inc.
Timber & Wood Products Division
Timber Data Co.
Timber Products Co.
Timberco Inc.
Timberline
Timeless Enterprises
Total Tree Logging Inc.
Towne Center Re
Trans Coast Financial Inc.
Treaty Council
Tremaine
Triangle Veneer Inc.
Tricon Timber, Inc.
Trinite Mining Company
US Bancorp
Universal Forest Products
Vaagen Brothers Lumber Inc.
Vanport Manufacturing Inc.
Versair Inc
Vittz
Vp C8QM Hill
W & H Pacific
WKO Inc
WTD Industries Inc
Wards Home Ranch Herefords
Weaverville Realty Inc.
Western Area Power Administration
Western Core Company
Western Timber Services Inc.
Wetsel-Oviatt Lumber Co.
Weyerhaeuser Co.
Wheelabrator Shasta
Wheelabrator Shasta Energy Co.
White Pass Co., Inc.
Wide Network Environmental
Wilkins, Kaiser & Olsen, Inc
Willamette Industries Inc.
William C Stiles & Associates
William F Delaney And Associates
William M Kier Associates
Willow Lake Resort
Winthrop Associates
Wm. Beaty & Assoc. Inc.
Wood Fiber Industries
Wood Fibre Northwest
Wood Resources International
Woodchip Inc.
Woods Products Industries
Woodward Clyde Consultants
Woolley Enterprises Inc.
Yomiuri Shimbun
Zip-O Log Mills, Inc
Zuber & Son Logging Inc.

Interest Groups

ABT Association
ADWPPW
  Local 5
  Local 68
AFCEE/CCR-S
AFFSEE
AWPPW #5
Alaska Forest Association, Inc
Alliance For A Paving Moratorium
  FOSSIL FUELS POLICY
Alliance For American Yellow Ribbon
Alliance For Survival
Alpine Lakes Protection Society
Alsea Valley Alliance
Alta California Alliance
American Fisheries Society
  CALIFORNIA-NEVADA CHAPTER
  OREGON CHAPTER
  WESTERN DIVISION
American Forest & Paper Association
American Forests
  Pacific Office
American Indian Cultural Center
American Loggers Solidarity
American Motorcyclist Association
  GOVERNMENT RELATIONS DEPARTMENT
American Plywood Assn.
American Rivers
American Society of Landscape Architecture
American Wildlands
Ancient Forest International
Ancient Forest Taskforce
Applegate Roughriders M/C
Applegate Watershed Conservancy
Arizona Trappers Assn.
Ashland League of Women Voters
Aspen Wilderness Workshop
Assn. of NW Steelheaders
  Beaverton Chapter
Assn. of Western Pulp and Paper Workers
Assoc. Reforestation Contractors Org.
Associated California Loggers
Association of Northwest Steelheaders
Association of O & C Counties
Association of Oregon Archeologists
  Dept. Anthropology WOSC
Association of Oregon Counties
Association of Oregon Loggers
Audubon Society
  Admirality
  Aldo Leopold
  Black Hills
  Central New Mexico
  Coeur D'Alene
  Columbia Gorge
  Corvallis
  Greeley
  Kalmiopsis
  Lake Region
  Lane
  Lane City
  Lane County
  Louisiana Council
  Marble Mountain

Midland Empire
Mt. Diablo
Mt. Shasta Area
N.E. Connecticut
Napa-Solano
National
Nebraska
North Central Washington
Pilchuck
Portland
Prairie Woods
Rainier
Redwood Region
Rogue Valley
Royal Palm
Sacramento
Seattle
Siskiyou
Siskiyou Regional Education Project
South Adirondac
Tacoma
Travis
Umpqua Valley
Washington State
Whidbey
Wisconsin Council
Yakima Valley
Yosemite Area
Bandon Fishermens Assn.
Bay Area Action
Bidwell Wildlife Rehabilitation
Big Foot Alliance
Biodiversity Legal Foundation
Blue Heron Environmental Center
Blue Mountain Native Forest Alliance
Blue Mountains Biodiversity Project
Blue Ribbon Coalition Inc
Brookings-Harbor Lions Club
Brownsville Pioneer Saddle Club
Bull Run Coalition
Bureau of Information Network
Butte County Citizens For Fair Govt.
Butte Creek Trail Council
Butte Environmental Council
CGO
Calif. Licence Board Assoc.
California Ancient Forest Alliance
California Enduro Riders Assn.
California Farm Bureau Federation
California Forest Landowners
California Forestry Association
California lu River Sport Fishing
California Licensed Foresters Association
FEDERAL ISSUES COMMITTEE
California Native Plant Society
California Nevada Snowmobile Assn.
California Outdoors
California Public Interest Research Group
California Research Bureau
California Sportsmens Task Force
California Trout Inc
California Women In Timber
Californians For Alternatives To Toxics
Campaign For The Environment
Carpenters Unions 1707 & 1036
Cascade Geographic Society
Cascade Geographic Society & Native Americana
For Enola
Cattlemen & Cattlewomen
Cavenham Forest Industries
Center For International Environmental Law
Center for Study of the Environment
Central Oregon Forest Issues Committee
Central Sierra Environmental Resource Center
Chamber of Commerce
Bay Area
California
Dallas
Darrington
Eureka
Florence Area
Gold Beach
Klamath County
Lake County
Redding
Roseburg Area
Scott Valley
Chehallis Basin Task Force
Chemeketans Hiking Club
Chesapeake Cardiovascular Assn.
Christian Cable Ministries
Citizen Advisory Committee
Citizen Task Force
Citizens For American Forests
Citizens For Better Forestry
Citizens Interested In Bull Run
Citizens of McCully Mtn.
Clackamas Road Forest Group
Clallam County Economic Development Council
Clatsop Conservation Council
Coast Range Association
Columbia River Girl Scout Council
Columbiana
Comac
Committee On Resources & Environment
Communities For A Great Oregon
Community Outreach
Community Relations Assn.
Community Trail Volunteers
Concerned Citizens
Concerned Friends of The Winema
Conservation Chairman
Conservation Chr Native Plnt Soc Of*
Conservation Environment & Historic Preservation
Coos Bay-North Bend Water Board
Coos Forest Protective Assn.
Cow Creek PAC
Dakubetede Environmental Education Programs
Deer Creek Valley Natural Res. Conservation Assn.
Defenders of Wildlife
Don'T Waste Arizona Inc.
Douglas Timber Operators
ECO Forestry Institute Society
EDAW
East Side Task Force 7545
Eastern Oregon Chapter of PTA
Eastern Oregon Mining Association
Ebasco Environmental
Eco Action C/O Nyac
Ecological Society of America
Ecology Center of Southern California
Economic Development Assn. of Skagit County
Ecosystem Protection Alliance
Eel River Salmon Restoration Project
Eel Russian River Commission
Emergency Action Committee Chair
Environmental Advocates/Clic
Environmental Defense Fund
Environmental News Network
Environmental Protection Information Center
Environmental Protection Task Force
Epic Center
Environmental Protective Information
Federation of Fly Fishermen
Flora of North America Project
Missouri Botanical Garden
Ford Foundation
Forest Advocates

Forest Conservation Assn.
Forest Conservation Council
Forest Guardians
Forest Landowners of California
Forest Preservation Society - Southern California
Karin James Research Committee
Forest Project
Forest Resource Activities
Forest Resources Council
Forest Watch
Carson
Illinois Valley
Mendocino
Methow Valley
Friends Aware of Wildlife Needs
Friends of Elk River
Friends of Mt. Hood
Friends of Tehachapi
Friends of Wy'East
Friends of the Breitenbush Cascades
Friends of the Coquille River
Friends of the Earth
Friends of the Greensprings
Friends of the Metolius
Friends of the Trees Society
Friends of the Wolf, B.C.
Fund For Public Research
GYC
Gaia Vision, Coast Range Guardinas, Canaries Who Sing
Gifford Pinchot Task Force
Glen Canyon Environmental Studies
Golden West Women Fly Fishers
Government Camp Recreation Association
Greater Ecosystem Alliance
Green Corps
Green Corps of Sacramento
Guardians of Larch Mountain
Hayfork Community Church
Headwaters Inc.
Helltown Historical Association
Honey Run Covered Bridge Assn.
Horsetown Clear Creek Preserve
Humaine Society of the US
Humanity Rising
Humboldt Buggy Association
Humboldt Rain
IMBA
IWA - Canada
IWA Local 3-261/3-140
Idahoans For Food & Fiber
Illinois Valley Mushroom Club
OREGON MICROLOGICAL SOCIETY CONSERVATION
Independent Logging
Inland Empire Society
Institute For Sustainable Forestry
Int Longshoremen & Warehousemens Union
International Marine Mammal Association
International Woodworkers of America - CIO
Izaak Walton League of America
Japan Wood Products Info. Center
Jay-K Independent Lumber Co.
Keller Environmental Assn.
Kettle Range Conservation Group
King County Democrats
King Mountain Advocates
Kiwanis Club of Coquille
Klamath Basin Water Resources Commission
Klamath Basin Waterfowl Assn.
Klamath Basin Women For Agriculture
Klamath Fast Trekkers
Klamath Forest Alliance
LPIW 2835
LPIW Local 2784
Laborers Local 791
Lakeview Multiple Use Advisory Council
League of Women Voters
Curry County
Lane County
Marion-Polk County
Umpqua County
Leopold Club
Lighthawk
Lincoln County Mycological Society
Local Residents For Old Growth
Los Angeles Earth First
Lumber & Sawmill Workers
Lumber & Sawmill Workers #2633
Lumber & Sawmill Workers Union
MacKenzie Watershed Council
Mary's Peak Alliance
Maryland Wildlands Committee
Mattole Restoration Council
Mazamas
McKenzie Flyfishers
McKenzie Guardians
Medford District Advisory Council
Mendocino Environmental Center
Minerals Exploration Coalition
Miners Alliance
Minnesota Center For Environmental Advocacy
Molalla Saddle Club Oet
Motorcycle Industry Council
Motorcycle Riders Assn.
Mount Shasta Bioregional Ecology Center
Mountain Lion Foundation
Mouse Mountain Forest Council
Mt. Hood Planning Organization
Mt. Rainier National Park Associates
Mt. Shasta Bioregional Ecology Center
Mt. Shasta Horseman'S Club
Mtn. Anthropological Research
Multiple Use Coalition For Trails
N Olympic Timber Act Committe
NAWPA
NCASI
NATIONAL WILDLIFE
NFC
Nahkeeta Northwest
National Assn. of House Builders
National Association of Conservation Districts
National Association of State Foresters
National Forest Foundation
National Research Council
National Resource Issues
National Wildlife Federation
National Wildlife Health Resources
Native Forest Council
Native Forest Network
Native Plant Society of Oregon
EMERALD CHAPTER
Native Yew Conservation Council
Natl Fish & Wildlife Foundation
Natural HWS Division
Dept of Conservation
Natural Resource Defense Council
Natural Selection Forestry
Nature Conservancy
C/O Eugene Public Works Engineering
Nature of Oregon Information Center
Nestucca Santuary
New Age Mission Inc.
New England Natural Resources Ctr.
New Growth Forestry
North Bend Garden Club
North Cascades Conservation Council
North Cascades Institute

North Coast ATV Club
North Coast Environmental Center
Northcoast Environmental Center
Northern CA Environmental Coalition
Northern Coast Range Biodiversity Project
Northwest Citizens Watch
Northwest Eco. Association
Northwest Environmental Center
Northwest Forest Resource Council
Northwest Forestry Association
Northwest Independent Forest Manufacturers
Northwest Mining Association
Northwest Petroleum Assoc.
Northwest Power Planning Council
Northwest Public Affairs Network
Northwest Pulp & Paper Association
Northwest Reforestation Contractors Assn.
Northwest Rivers Council
Northwest Steelheaders
Northwest Timberworkers Resource Council
OFIC
Obsidians, Inc.
Olympia Food & Fiber Foundation
Olympic Environmental Council
Olympic Labor Council
Olympic Natural Resource Center
University of Washington
Olympic Park Associates
Olympic Pennisula Foundation
Opal Creek Educucational Preserve
Oregon Coast Coalition
Oregon Equestrian Trails
Oregon Forest Industries Council
Oregon Forest Transportation Association
Oregon Guides & Packers
Oregon Hunter's Association
Emerald Valley Chapter
Oregon Lands Coalition
Oregon Mycological Society
Oregon National Wild Turkey Federation
Oregon Natural Desert Assn.
Oregon Natural Resources Council
Oregon Public Lands Advisory Committee
Oregon Research Institute
Oregon Resources NW
Oregon Shores Conservation Coalition
Oregon Small Woodlands Assn.
Oregon Society of American Foresters
Oregon South Coast Fishermen Inc.
Oregon State Grange
Oregon Trout/Water Watch of Oregon
Oregon United Sporting Dogs
Oregon Waterfowl & Wetlands Assn.
Oregon Wildlife Federaton
SOUTHERN OREGON COMMITTEE
Oregon Women In Timber
Oregonians For Food & Shelter
Organization of Walton Landowners
Ozark River Keepers Network
Pacific Coast Federation of Fisherman's Association
Pacific Forest Trust
Pacific Lumber & Shipping Company
Pacific Northwest Biodiversity Insitute
Pacific Northwest Ski Areas Association
Pacific Northwest Waterways Assn
Pacific Rim Enviromental Inc.
Pacific Rim Trade Association
Pacific Rivers Council
Pacific Seabird Group
Pacific Watershed Associates
People For Animal Rights
People For Puget Sound
Pine Creek Mtn. Estates
Polar Bear Sno-Mobile Club
Port of Port Angeles
Portage Friends of Wetlands
Portland Greenpeace Office
Prescott National Forest Friends
Public Forestry Foundation
Public Lands Council
Public Lands Foundation
Public TV Organizing Committee
Puget Sound Cooperative
River Basin Study Team 1
Pulp & Paper Workers Regional Council
Pulp & Paper Workers Resource Council
Quail Call Farm
Quilcene Ancient Forest Coalition
R & E Plant Project
Rainforest Relief
Randall Davey Audubon Center
Red Mountain Assn.
Redwood Gun Club
Resources For The Future
River Defense Alliance
Rivers Council of Washington
Rocky Mountain Ecosystem Coalition
Rockydale Neighborhood Assn.
Rogue River Guides Assn.
Sacramento River Preservation Trust
Sacred Earth Coalition
Sacred Earth Foundation
Safe
Salem Community Environmental Council
Salmon Trollers Marketing Assoc
Santa Cruz Mountains Murrelet Group
Santiam Wilderness Committee
Save Americas Forests
Save Chelan Alliance
Save Our Klamath River
Save Our Sawmills
Save Our Wild Salmon
Save The Klamath River
Save The West, Inc
Science Writer'S Group
Selma Citizens Advocating Responsible Forestry
Senior Native Oregonians
Shasta Alliance For Resources And Environment
Shasta County Assn. of Rec. Land Users
Shasta County Peace Officers Association
Shasta Gem & Mineral Society
Shasta Land Management
Shasta Miners & Prospecters
Shasta-Tehama Bioregional Group
Shasta-Trinity Regional Occupational Program
Shoreline Education For Awareness
Sierra Biodiversity Institute
Sierra Cascade Logging Conference
Sierra Club
Angeles Chapter
Cascade Chapter
Headwaters
Legal Defense Fund
Many Rivers Group
N. California/Nevada/Hawaii Office
North Carolina Chapter
Northern Ca/Hi/Nv Chapter
Northwest Regional Director
Oklahoma Chapter
Oregon Chapter
Ozark Chapter
Redwood Chapter
Rocky Mountain Chapter
Rogue Group
SF Bay Chapter
San Francisco
San Francisco Bay Chapter
West Virginia Chapter

Yahi Biodiversity Task Force
Yahi Group
Sierra Pacific
Sierra Pacific Industries
Sierra Pacific Timber Dept
Sisk County Advisor Grazing Commission
Siskiyou Action Project
Siskiyou Bio-Regional Group
KLAMATH ALLIANCE RESOURCE ENVIRONMENT &
Siskiyou Co Sportsmens Assoc
Siskiyou County Cattlemens Assn.
Siskiyou County Farm Bureau
Siskiyou County Historical Society
Siskiyou Project
Siskiyou Regional Education Project
Siskiyou Trail Riders & Mra
Sislayai Resource Conservation District
Sisters Forest Planning Commission
Siuslaw Timber Operations Association
Skagit System Cooperative
Society For Conservation Biology
Society Of American Foresters
COOS CHAPTER
WYNTOON CHAPTER-NORTHERN CALIFORNIA
Soda Mountain Wilderness Council
Sonoma Watershed Council
South Fork Trinity Up-River Friends
Southeast Alaska Conservation Council
Southern Oregon Alliance Flr. Res.*
Southern Oregon Log Scaling & Grading Bureau
Southern Oregon Resource Alliance
Southern Oregon Timber Industries Association
Southern Willamette Earth First
Southfork Trinity Watershed
Speak Up For Wildlife Foundation
Sport Fishing Institute
Sportsmen'S Council Of N. California
St. Andrews Hiking Society
Steamboaters
Stevedoring Services Of America
Student Action For The Environment
Student Alliance For Wildlife Protection
Sustainable Ecosystems Institute
Swan View Coalition
Sweet Home Rock Club
Syskiyou Regional Education Project
T & H Co Cattlemens Association
T.R.E.E.S.
T.R.I.P.S.
Takilma Community Association
Talent Watershed Intercomm Group
Tax Payers For The Environment And It'S Management
Tenmile Creek Association
Teton Science School
Texas Committee On Natural Resources
FOREST TASK FORCE
The Althouse Basin Taskforce
The Campbell Group Inc.
The Colorado Public Interest Research Group
ANCIENT FORESTS
The Ecological Society Of America
The Fund For Animals
The Garden Club Of America
Ntl Affirs & Legialation
The Humane Society Of The Us
The Mcconnell Foundation
The Mountaineers
The Nature Conservancy
WASHINGTON STATE OFFICE
The Northcoast Environmental Center
The Pacific Forest Trust
The Research Group
The Survival Center Activist Network
The Umbrella Group
The Valley Womens'S Club
ENVIRONMENTAL COMMITTEE
The Wilderness Society
WASHINGTON STATE REGION
The Wildlands Project
The Wildlife Society
OREGON CHAPTER
The Williamson River Club
Threatened And Endangered: Little Applegate Valley
Tillamook Forest Council
Timber Counties School Coalition
Timber Family Advocate
Timber Impact Resource Office
Tom Long Watershed Assn.
Tree
Trees
Triangle Grange # 533
Trinity Bioregion Group
Trinity County Miners Alliance
Trout Unlimited
Tulelake Growers Association
Twin Rocks Inholders Association
Umpqua Fisherman'S Association
Umpqua Watersheds
Umqua Corridor Association
United Brotherhood Of Carpenters & Joiners
LUCKY NEW RIVER WOODRIVER KING UNION
United Four Wheel Drive Associations
United Paperworkers
United Stand
Unlimited Pheasants
Upper Ridge Council
Usaka Environmental
Valleyville Hang Gliding Assn.
Virginians For Wilderness
Vulnorable Ecologies Protection Society
WCIW Local 2805
WWPA
Washington Ancient Forest Campaign
Washington Citizens For World Trade
Washington Commercial Forest Action Committee
Washington Contract Loggers Assn.
Washington Contract Loggers Assoc.
Washington County Stock Growers/Oregon Cattlemens
Washington Environmental Council/Audubon Society - Seattle
Washington Forest Protection Assn.
N Dir. Forest Mgmt.
Washington Lands Coalition
Washington Native Plant Society
Washington Public Interest Research Group
Washington State Labor Council
Washington State Trappers Assn.
Washington Trout
Washington Wilderness Coalition
Washington Women In Timber
West Ancient Forest Camp
West Coast Botanicals, Inc.
West Oregon Timber Supporters
Western Ancient Forest Alliance
Western Ancient Forest Campaign
Western Building Material Dealers Assoc.
Western Council Of Industrial Workers
LOCAL 39
LOCAL UNION 3074
Western Forest Industries Assn.
Western Forest Industries Association

Western Legislative Forestry Task Force
Western Mining Council Inc.
Western Network
Western North Carolina Alliance
Western Resources Wrap-Up
Western Wildlife
Wheelabrator Shasta Energy
Whidbey Environmental Action Network
Wide Network Environmental
Wilderness Society
Wildlands Project
Wildlife Management Institute
Wildlife Society
Wildlife Society - Washington Chapter
Wildlife Society C/O Willamette National Forest
Willamette Industries Inc.
Willamette Timbermen Assn., Inc.
Williams Greybach Brushriders
Williams Watershed Protection Assn.
Willits Environmental Center
Women & Mothers Of The Earth
Woodnet
Woodworkers 3-38
World Forest Institute
World Watch Institute
World Wildlife Fund
  Conservation Science Program
  US Lands & Wildlife Program
Wyeast Cumbers
Xerces Society
Yakima Resource Management Cooperative
Yamhill Valley Peacemakers
Yellow Ribbon Coalition
Yellow Wood Associates
Yolo Environmental Resource Ctr.
Yuba Watershed Institute

American Indian Tribes and Nations

Big Lagoon Rancheria
Blue Lake Rancheria
California Indian Legal Services
Central California Agency
Chehalis Business Council
Cloverdale Rancheria
Coast Indian Community Of The Resighini Rancheria
Coeur D'Alene Tribal Council
Columbia River Inter-Tribal Fish Commission
Colville Agency
Committee For The Nei
Confederated Modoc & Paiute Tribes
Confederated Tribes & Bands of the Yakima Indian Nation
Confederated Tribes of Coos, Lower Umpqua & Siuslaw Indians
Confederated Tribes of Siletz Indians of Oregon
Confederated Tribes of Umatilla Indian Reservation
Confederated Tribes of Warm Springs Reservation
Confederated Tribes of the Chehalis Reservation
Confederated Tribes of the Colville Reservation
Confederated Tribes of the Grand Ronde Community
Confederated Tribes of the Warm Springs Reservation
Coquille Economic Development Corp.
Coquille Indian Tribe
Cow Creek Band of Umpqua Tribe of Indians
Coyote Valley Reservation
Dry Creek Rancheria
Elk Valley Rancheria
Grindstone Rancheria
Hoh Indian Tribe
Hoopa Tribal Fisheries
Hoopa Tribal Forestry
Hoopa Valley Tribal Council
Hopland Reservation
Intertribal Timber Council
Jamestown Klallam Tribe of Indians
Karuk Tribe of California
Klamath River Indian
Laytonville Rancheria
Lower Elwha Tribal Community
Lumi Tribe of the Lummi Reservation, WA
Makah Indian Tribe of the Makah Indian Reservation
Manchester/Pt. Arena Rancheria
Mooretown Rancheria
Muckleshoot Indian Tribe
Neah Bay Field Station
Nisqually Indian Community
Nooksack Indian Tribe
Nor-El-Muk Band Of Wintu Indians Of N. California
Northern California Agency
Northwest Indian Fisheries Commission
Olympic Peninsula Agency
Pinoleville Rancheria
Pit River Tribal Council
Point No Point Treaty Council
Port Gamble Band of S'Klallam Indians
Potter Valley Ranchiera
Puget Sound Agency
Puyallup Tribe of the Puyallup Reservation
Quartz Valley Indian Reservation
Quileute Tribe of the Quileute Reservation
Quinault Indian Nation
Redding Ranchiera
Redwood Valley Ranchiera
Round Valley Indian Reservation
Sacramento Area Office
Sauk-Suiattle Indian Tribe
Sherwood Valley Rancheria
Shoalwater Bay Indian Tribe of the Shoalwater Bay Indian Reservation
Siletz Agency
Skokomish Indian Tribe
Smith River Rancheria
Spokane Agency
Squaxin Island Tribe
Stewarts Point Rancheria
Stillaguamish Tribe of Indians
Suak-Suiattle Indian Tribe
Supervisor, Branch Of Forestry
Suquamish Tribe of the Port Madison Reservation, WA
Swinomish Indian Tribal Community
The Klamath Tribe
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The Tulalip Tribes
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Umatilla Agency
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Yakima Agency
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Debbie Cummings
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Dr. Bruce Mccune — Department of Botany & Plant Pathology
Dr. Dan Norris — Department of Botany & Plant Pathology
E Charles Meslow — Oregon Cooperative Wildlife Res. Unit
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George Brown — Department of Forest Science
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Sherry Pittam — Department of Botany & Plant Pathology
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Steven Hiebert — Research
Susan Stevens — Forest Resources

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Eric Zwerling — Dept of Environmental Science
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Je Ward
John Ward
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June Ward
Rayner Ward
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Gay L Weaver
Hazel F Weaver
Robert R Weaver
Ronald O. Weaver
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A. Webber
Catherine Webber
Francis Webber
Jim Webber
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(Appendix F not included)

GLOSSARY

Those definitions in this glossary followed by the term FEMAT are taken directly from Chapter IX, Glossary, of the Forest Ecosystem Management Assessment Team's report, *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment*, which constitutes Appendix A of this SEIS.

50-11-40 Rule - One of the standards and guidelines of the Interagency Scientific Committee strategy designed to provide dispersal habitat for northern spotted owls on lands outside reserves. Calls for maintaining 50 percent of forested land within each quarter township (9 square miles) in forested condition with stands of trees averaging at least 11 inches diameter at breast height and with a stand canopy closure of at least 40 percent. FEMAT

Abiotic - Referring to the absence of living organisms.

Activity Center [Spotted Owl Activity Center] - An area of concentrated activity of either a pair of spotted owls or a territorial single owl.

Aquatic Ecosystem - Any body of water, such as a stream, lake or estuary, and all organisms and nonliving components within it, functioning as a natural system. FEMAT

Accretion - The process, driven by plate tectonics, whereby the continental margin grows by addition of ocean crust and sediments at a subduction zone. FEMAT

Adaptive Management - A continuing process of action-based planning, monitoring, researching, evaluating, and adjusting with the objective of improving implementation and achieving the goals of the selected alternative.

Adaptive Management Areas - Landscape units designated for development and testing of technical and social approaches to achieving desired ecological, economic, and other social objectives. FEMAT

Administratively Withdrawn Areas - Areas removed from the suitable timber base through agency direction and land management plans. FEMAT

Age Class - A management classification using the age of a stand of trees. FEMAT

Age-Class Distribution - The area in each age class of trees across a forest, watershed, stands or any other area of consideration.

Air Quality Related Values (AQRVs) - Values within Class I areas, such as visibility, biological diversity, and water quality, that under the Clean Air Act, should be protected from the adverse impacts of air pollution.

Alevin - Newly hatched salmon or trout with exterior yolk sac residing in the gravel prior to emergence to the stream.

Allowable Sale Quantity (ASQ) - The gross amount of timber volume, including salvage, that may be sold annually from a specified area over a stated period in accordance with management plans of the Forest Service or Bureau of Land Management. Formerly referred to as "allowable cut." FEMAT

Alluvial - Originated through the transport by and deposition from running water. FEMAT

Alternative - One of several policies, plans, or projects proposed for making decisions. FEMAT

Anadromous Fish - Fish that are born and rear in freshwater, move to the ocean to grow and mature, and return to freshwater to reproduce. Salmon, steelhead, and shad are examples. FEMAT

Arthropods - Invertebrates belonging to the largest animal phylum (over 800,000 species) including crustaceans, insects, centipedes and arachnids. Characterized by a segmented body, jointed appendages and an exoskeleton composed of chitin.

Associated Species - A species found to be numerically more abundant in a particular forest successional stage or type compared to other areas. FEMAT

Attainment Area - A geographic area in which the level of a criteria air pollutant meets the federal standards set by the Environmental Protection Agency. A single geographic area may have acceptable levels of one criteria air pollutant but unacceptable levels of other criteria pollutants, which means an area can be in both attainment and nonattainment status at the same time.

At-risk Fish Stocks - Stocks of anadromous salmon and trout that have been identified by professional societies, fish management agencies, and in the scientific literature as being in need of special management consideration because of low or declining populations. FEMAT

Banding - Marking with a band for identification.

Biogeography - Traditionally, the study of the distribution of plants and animals in their environment over space and time. In recent years, this term has included the interactions between humans and the ecosystem.

Biological Diversity - The variety of life forms and processes, including a complexity of species, communities, gene pools, and ecological functions. FEMAT

Biomass - The total quantity (at any given time) of living organisms of one or more species per unit of space (species biomass), or of all the species in a biotic community (community biomass). FEMAT

Board Foot - A unit of measurement equal to an unfinished board 1 foot square by one inch thick.

Bryophytes - Plants of the phylum Bryophyta, including mosses, liverworts and hornworts, characterized by the lack of true roots, stems and leaves.

Buffer - As specifically defined in the FEMAT Report, used in the context of marbled murrelet standards and guidelines: a forested area located adjacent to suitable (nesting) marbled murrelet habitat that reduces dangers of having sharply contrasting edges of clearcuts next to such habitat. Dangers include risk of wind damage to nest trees and young, increased predation, and loss of forest interior conditions.

Bureau of Land Management (BLM) Administered Lands - Oregon and California railroad lands (O&C), Public Domain (PD), Coos Bay Wagon Road (CBWR), acquired lands, and split estate (Federal Minerals).

Candidate Species - Those plants and animals included in Federal Register "Notices of Review" that are being considered by the Fish and wildlife Service for listing as threatened or endangered. Two categories that are of primary concern: Category 1 - Taxa for which there is substantial information to support proposing the species for listing as threatened or endangered. Listing proposals are either being prepared or have been delayed by higher priority listing work. Category 2 - Taxa information indicates that listing is possibly appropriate. Additional information is being collected. FEMAT

Canopy Closure - The degree to which the canopy (forest layers above one's head) blocks sunlight or obscures the sky. It can only be accurately determined from measurements taken under the canopy as openings in the branches and crowns must be accounted for. FEMAT

Cant - A log slabbed (milled) on one or more sides.

Categorical Exclusion - Under the National Environmental Policy Act, those actions that are categorically excluded from documentation in an environmental analysis or environmental impact statement (40 CFR 1508.4).

Cavity Nester - Wildlife species, most frequently birds, that require cavities (holes) in trees for nesting and reproduction. FEMAT

Class I Areas - National Parks or Wildernesses that receive the greatest air quality protection under the Clean Air Act's Prevention of Significant Deterioration (PSD) Program.

Closely Associated Species - A species is designated as "closely associated" with a forest successional stage if the species is found to be significantly more abundant in that forest successional stage compared to the other successional stages, if it is known to occur almost exclusively in that successional stage, or if it uses habitat components that are usually produced at that stage. FEMAT

Cluster - An area that contains habitat capable of supporting three or more breeding pairs of spotted owls with overlapping or nearly overlapping home ranges. FEMAT

Coarse Woody Debris (CWD) - Portion of a tree that has fallen or been cut and left in the woods. Usually refers to pieces at least 20 inches in diameter. FEMAT

Code of Federal Regulations (CFR) - A codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the Federal government. FEMAT

Commercial Thinning - The removal of generally merchantable trees from an even-aged stand, usually to encourage growth of the remaining trees (see definition of Even-aged Silviculture in the glossary in Appendix A). FEMAT

Conferencing - A process that involves informal discussions between a federal agency and the Fish and Wildlife Service or the National Marine Fisheries Service under Section 7(a)(4) of the Endangered Species Act regarding the impact of a federal action on proposed species or proposed critical habitat and recommendations to minimize or avoid the adverse effects.

Congressionally Reserved Areas - Areas that require Congressional enactment for their establishment, such as National Parks, Wild and Scenic Rivers, National Recreation Areas, National Monuments, and Wilderness. FEMAT. These are also referred to as Congressional Reserves.

Connectivity - A measure of the extent to which conditions among LS/OG forest areas provide habitat for breeding, feeding, dispersal, and movement of LS/OG-associated wildlife and fish species (see LS/OG Forest). FEMAT

Consultation - Formal consultation is a process that occurs between the Fish and Wildlife Service or the National Marine Fisheries Service and a federal agency that commences with the federal agency's written request for consultation under Section 7(a)(2) of the Endangered Species Act regarding a federal action which may affect a listed species or its critical habitat. It concludes with the issuance of the biological opinion under Section 7(b)(3) of the Act. Informal consultation is an optional process that includes all discussions, correspondence, etc., between the Fish and Wildlife Service and the federal agency, or the designated nonfederal representative, prior to formal consultation, if required. If the listing agency determines that there is no likely adverse affect to the listed species, it may concur with the action agency that formal consultation is unnecessary.

Cost Plus Net Value Change - A method used to determine economic efficiencies of fire management activities. It is the sum of presuppression, hazard reduction, and wildfire suppression costs minus the net value change to the resources as a result of a wildfire. The net value change may be either positive or negative. Traditionally, commodity resources have been emphasized. However, the value of noncommodity resources, as either monetary or relative values, is now being used; ongoing research efforts will provide a better means of equating widely varying physical, biological, and aesthetic values.

Cost Plus Loss - The cost of wildfire suppression plus the value lost from the wildfire and suppression effort-related damage. Traditionally, the emphasis on resources has been on commodities. However, the value of noncommodity resources, as either monetary or relative values, is now being used; ongoing research efforts will provide a better means of equating widely varying physical, biological, and aesthetic values.

Cover - Vegetation used by wildlife for protection from predators, or to mitigate weather conditions, or to reproduce. May also refer to the protection of the soil and the shading provided to herbs and forbs by vegetation. FEMAT

Critical Habitat - Under the Endangered Species Act, critical habitat is defined as (1) the specific areas within the geographic area occupied by a federally listed species on which are found physical and biological features essential to the conservation of the species, and that may require special management considerations or protection; and (2) specific areas outside the geographic area occupied by a listed species, when it is determined that such areas are essential for the conservation of the species. FEMAT

Criteria Air Pollutants - A group of common air pollutants regulated by the Environmental Protection Agency on the basis of criteria (information on health and/or environmental effects of pollution). Concentrations of these criteria pollutants are limited by National Ambient Air Quality Standards (NAAQS).

Cumulative Effects - Those effects on the environment that result from the incremental effect of the action when added to the past, present, and reasonably foreseeable future actions regardless of what agency (Federal or nonfederal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. FEMAT

Debris Flow - A rapid moving mass of rock fragments, soil, and mud, with more than halfä of the particles being larger than sand size.

Debris Slide - A slow to rapid slide, involving downslope translation of relatively dry and predominantly unconsolidated materials, with more than half of the particles being larger than sand size. FEMAT

Debris Torrent - Rapid movement of a large quantity of materials (wood and sediment)ä down a stream channel during storms or floods. This generally occurs in smaller streams and results in scouring of streambed.

Decay Class - See Log Decomposition Class.

Decommission - To remove those elements of a road that reroute hillslope drainage and present slope stability hazards. Another term for this is "hydrologic obliteration." FEMAT

Demography - The quantitative analysis of population structure and trends; population dynamics. FEMAT

Designated Conservation Area (DCA) - A contiguous area of habitat to be managed and conserved for spotted owls under the Final Draft Recovery Plan for the Northern Spotted Owl. This general description can be applied to two DCA categories: DCA 1 - Category intended to support at least 20 pairs of spotted owls. DCA 2 - Category intended to support one to 19 pairs of spotted owls. FEMAT

Detritivores - Organisms that feed on dead animals or partially decomposed organic matter.

Direct Effects for Employment and Income - Those effects that impact sectors eitherä exporting processed wood products from the economic area or selling those products to final consumers. An example of direct employment would be people working in a sawmill.

Dispersal Habitat - Habitat that supports the life needs of an individual animal during dispersal. Generally satisfies needs for foraging, roosting, and protection from predators. FEMAT

Dissected - Cut by erosional processes into hills and valleys, or into flat interstream areasä and valleys. FEMAT

District - An administrative unit within the Bureau of Land Management.

Disturbance - A force that causes significant change in structure and/or compositionä through natural events such as fire, flood, wind, or earthquake, mortality caused by insect orä disease outbreaks, or by human-caused events, e.g., the harvest of forest products. FEMAT

Drainage - An area (basin) mostly bounded by ridges or other similar topographic features, encompassing part, most, or all of a watershed and enclosing some 5,000 acres (see Subdrainage and Forest Watershed). FEMAT

Duff Layer - As specifically defined in the FEMAT Report, the layer of loosely compacted debris underlying the litter layer on the forest floor.

Early-Successional Forest - Forest seral stages younger than mature and old-growth age classes.

Earthflow - A mass-movement landform and slow to rapid process characterized by downslope translation of soil and weathered rock over a discrete shear zone at the base, with most of the particles being smaller than sand. FEMAT

Eastside - Generally, east of the crest of the Cascade Range.

Ecosystem Approach - As defined by the Forest Ecosystem Management Assessment Team: A strategy or plan to manage ecosystems to provide for all associated organisms, as opposed to a strategy or plan for managing individual species.

Ecosystem Management - The use of an ecological approach in land management to sustain diverse, healthy, and productive ecosystems. Ecosystem management is applied at various scales to blend long-term societal and environmental values in a dynamic manner that may be adapted as more knowledge is gained through research and experience.

Ecotone - A zone of intergradation between ecological communities.

Edge Effect - The effect of adjoining vegetative communities on the population structure along the margin, which often provides for greater numbers of species and higher population densities than either adjoining community. Edge may result in negative effects as well; habitat along an edge is different than in the patch of habitat, thus reducing the effective area of the habitat patch.

Effects - Effects, impacts, and consequences, as used in this environmental impact statement, are synonymous. Effects may be direct, indirect or cumulative and may fall in one of these categories: aesthetic, historic, cultural, economic, social, health or ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems).

Endangered Species - Any species of plant or animal defined through the Endangered Species Act as being in danger of extinction throughout all or a significant portion of its range, and published in the Federal Register. FEMAT

Endemic - A species that is unique to a specific locality. FEMAT

Environmental Analysis - An analysis of alternative actions and their predictable short-term and long-term environmental effects, incorporating physical, biological, economic, and social considerations. FEMAT

Environmental Assessment (EA) - A systematic analysis of site-specific activities used to determine whether such activities have a significant effect on the quality of the human environment and whether a formal environmental impact statement is required; and to aid an agency's compliance with the National Environmental Policy Act when no environmental impact statement is necessary. FEMAT

Ephemeral Streams - Streams that contain running water only sporadically, such as during and following storm events. FEMAT

Epizootic - Outbreak of disease (an epidemic) in a population of non-human animals.

Even-Aged Management - A silvicultural system which creates forest stands that are primarily of a single age or limited range of ages. Creation of even-aged stands may be accomplished through the clearcut, seed tree or shelterwood methods.

Extirpation - The elimination of a species from a particular area. FEMAT

Fauna - The animal life of a region or geological period.

Fault - A break or shear in the continuity of a body of rock on which there has been an observable displacement of the two parts. FEMAT

Fecundity - Number of female young produced per adult female in the population ofä interest. FEMAT

Federal Land Policy and Management Act (FLPMA) - A law passed in 1976 applying to the Bureau of Land Management directing the management of lands administered by that agency including the requirement to develop land use plans and prepare regulations to guide that development.

Final Environmental Impact Statement (FEIS) - The final report of environmental effects of proposed action on an area of land. This is required for major federal actions under Section 102 of the National Environmental Policy Act. It is a revision of the draft environmental impact statement to include public and agency responses to the draft. FEMAT

Fish-Bearing Streams - Any stream containing any species of fish for any period of time.

Floodplain - Level lowland bordering a stream or river onto which the flow spreads at flood stage. FEMAT

Food Web - A modified food chain that expresses feeding relationships at various, changing trophic levels.

Flora - The plant life of a region or geological period.

Forest Land - Land that is now, or is capable of becoming, at least 10 percent stocked with forest trees and that has not been developed for nontimber use. FEMAT

Forest Types - A classification of forest land based on the tree species presently forming a plurality of basal area stocking or crown cover of live trees.

Forest Watershed - The forested drainage area contributing water, organic matter, dissolved nutrients, and sediments to a lake or stream. FEMAT

Fractured - A rock mass separated into distinct fragments. FEMAT

Fragmentation - The process of reducing size and connectivity of stands that compose a forest. FEMAT

Fuelbreak - An area of land on which the native vegetation has been removed or modifiedä so that fires burning into it can be controlled more readily. Some fuelbreaks contain firelines which can be quickly widened with hand tools or by burning.

Fuel Loading - The weight of fuel present at a given site; usually expressed in tons per acre. This value generally refers to the fuel that would typically be available for consumption by fire. Fuel loading varies as a result of disturbance (including human activities), theä magnitude of that disturbance, the successional stage of the vegetation, and other conditionsä of the site.

Fuel Profile - The amount and characteristics of live fuel and coarse woody debris in a given area. The amount is referred to as the fuel loading, while the characteristics include the horizontal and vertical arrangement and continuity of fuels that affect the spread and intensity of fire.

Geomorphic - Pertaining to the form or shape of those processes that affect the surface of the earth. FEMAT

Granitic - Any light-colored, coarse-grained rock formed at considerable depth by crystallization of molten rock. FEMAT

Green Tree Retention - A stand management practice in which live trees as well as snagsä and large down wood are left as biological legacies within harvest units to provide habitat components over the next management cycle. There are two levels:

> **High level** - A regeneration harvest designed to retain the highest level of trees possible while still providing enough disturbance to allow regeneration and growth of the naturally occurring mixture of tree species. Such harvest should allow for the regeneration of intolerant and tolerant species. Harvest design would also retain cover and structural features necessary to provide foraging and dispersal habitat for mature and old-growth dependant species.

Low level - A regeneration harvest designed to retain only enough green trees and other structural components (snag, coarse woody debris, etc.) to result in the development of stands that meet old-growth definitions within 100 to 120 years after harvest entry, considering overstory mortality. FEMAT

Habitat Capability - The estimated number of pairs of spotted owls that can be supported by the kind, amount, and distribution of suitable habitat in the area. As used in the Final Draft Recovery Plan for the Northern Spotted Owl, this means the same as capability to support spotted owl pairs. FEMAT

Helibase - A location within the general area of a wildfire or emergency event that is used to park, maintain, fuel and load helicopters.

Heterogeneity - The condition or state of being different in kind or nature.

Hibernacula - A case or covering which protects all or part of an animal or plant from extreme cold. A winter shelter for plants or dormant animals.

High Intensity Fire - A fire with the capability to be stand replacing or to cause excessive damage to late-successional forest characteristics.

High Severity Fire - A wildfire event with acute ecological impacts; usually, but not always of high intensity. FEMAT

Hybridization - The crossing or mating of two different varieties of plants or animals. FEMAT

Hypogeous - Living or maturing below the surface of the ground (i.e., seedling cotyledons).

Hyporheic Zone - The area under the stream channel and floodplain that contributes to the stream. FEMAT

Indirect Effects for Employment and Income - Those that impact other production, trade,ä and service sectors that provide the production inputs needed to manufacture the processed wood products. An example of indirect employment would be people who manufacture the saw blades used in the sawmills.

Ingrowth - The period after successional growth of a forest stand when it reaches a specified age or structure class. For instance, spotted owl forage habitat. FEMAT

Inner Gorge - A stream reach bounded by steep valley walls that terminate upslope into a more gentle topography. Common in areas of rapid stream downcuttng or uplift, such as northern California and southwestern Oregon. FEMAT

Insectivores - Plants or animals which feed on insects.

Interdisciplinary Team - A group of individuals with varying areas of specialty assembled to solve a problem or perform a task. The team is assembled out of recognition that no one scientific discipline is sufficiently broad enough to adequately analyze the problem and propose action. FEMAT

Intermittent Stream - Any non-permanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two criteria. FEMAT

Key Watershed - As defined by National Forest and Bureau Land Management District fish biologists, a watershed containing (1) habitat for potentially threatened species or stocks of anadromous salmonids or other potentially threatened fish, or (2) greater than 6 square miles with high-quality water and fish habitat. FEMAT

Known Pairs or Resident Singles [owls] - Northern spotted owl activity centers identified prior to January 1, 1994.

Landscape - A heterogenous land area with interacting ecosystems that are repeated in similar form throughout. FEMAT

Large-Scale Fire - A very large-sized fire compared to the natural range of fire sizes of the fire regime in the geographic area considered. Fires that greatly exceed the typical fire size are often of high intensity and may cause profound fire effects.

Late-Successional Forests - Forest seral stages which include mature and old-growth age classes.

Late-Successional Reserve - A forest in its mature and/or old-growth stages that has been reserved under each option in this report (see Old-growth Forest and Succession). FEMAT

Lava Flow - A congealed stream of lava. FEMAT

Litter Layer - The loose, relatively undecomposed organic debris on the surface of the forest floor made up typically of leaves, bark, small branches, and other fallen material (see also Duff Layer). FEMAT

Log Decomposition Class - Any of five stages of deterioration of logs in the forest. Stages range from essentially sound (class 1) to almost total decomposition (class 5). FEMAT

Long-Term Soil Productivity - The capability of soil to sustain inherent, natural growth potential of plants and plant communities over time.

LS/OG Forest (or Stands) - Late-successional and/or old growth. Forests or stands consisting of trees and structural attributes and supporting biological communities and processes associated with old-growth and/or mature forests. FEMAT

Managed Forest - Any forest land that is treated with silvicultural practices and/or harvested. Generally applied to land that is harvested on a scheduled basis and contributes to an allowable sale quantity. FEMAT

Managed Late-Successional Areas - Selected harvest areas and managed pair areas. FEMAT

Managed Pair Areas - In some portions of the northern spotted owl's range it is necessary to provide additional protection in the matrix for pairs of owls and territorial singles. This consists of delineating a core habitat area, plus additional acreage of suitable habitat around the core. The acreage to be delineated around the core varies throughout the range, based on data for pairs in that area. The suitable acreage must be delineated in an area equal to the mean home range for that physiographic province. Appropriate silvicultural treatment is encouraged in suitable and unsuitable habitat in the acreage around the core. FEMAT

Management Activity - An activity undertaken for the purpose of harvesting, traversing, transporting, protecting, changing, replenishing, or otherwise using resources. FEMAT

Management Framework Plan (MFP) - A land use plan that established coordinated landä use allocations for all resource and support activities for a specific land area within a Bureauä of Land Management District. It established objectives and constraints for each resource and support activity and provided data for consideration in program planning. This process has been replaced by the Resource Management Planning process. FEMAT

Marbled Murrelet Zone 1 - A 10 to 40 mile-wide zone adjacent to marine areas in which the majority of marbled murrelet detections and nests are located. FEMAT

Marbled Murrelet Zone 2 - An inland zone that abuts marbled murrelet zone 1. Numbers of murrelet detections in zone 2 indicate that it is used by only a small fraction of the breeding population. FEMAT

Mass Movement - The downslope movement of earth caused by gravity. Includes but is not limited to landslides, rock falls, debris avalanches, an creep. It does not, however, include surface erosion by running water. It may be caused by natural erosional processes, or by natural disturbances (e.g., earthquakes or fire events) or human disturbances (e.g., mining or road construction). FEMAT

Matrix - Federal lands outside of reserves, withdrawn areas, and Managed Late-Successional areas. FEMAT

Merchantable Trees, Stands, Timber - Trees or stands that people will buy for the woodä they contain. FEMAT

Mesic - Pertaining to or adapted to an area that has a balanced supply of water; neither wet nor dry. FEMAT

Microhabitats - A restricted set of distinctive environmental conditions that constitute aä small habitat, such as the area under a log. FEMAT

Mitigation measures - Modifications of actions that (1) avoid impacts by not taking a certain action or parts of an action; (2) minimize impacts by limiting the degree or magnitude of the action and its implementation; (3) rectify impacts by repairing, rehabilitating, or restoring the affected environment; (4) reduce or eliminate impacts over time by preservation and maintenance operations during the life of the action; or (5) compensate for impacts by replacing or providing substitute resources or environments. FEMAT

Monitoring - A process of collecting information to evaluate if objective and anticipated or assumed results of a management plan are being realized or if implementation is proceeding as planned. FEMAT

Mosaic Burn - A burn pattern that leaves a range of spatial and temporal effects as a resultä of different fire intensities and durations. The objective of mosaic burning is to causeä differential fire effects across the landscape.

Multistoried - Forest stands that contain trees of various heights and diameter classes and therefore support foliage at various heights in the vertical profile of the stand. FEMAT

Mycotrophic - Feeding on or otherwise being nourished by fungi.

National Ambient Air Quality Standards (NAAQS) - Standards set by the Environmental Protection Agency that limit the concentrations of certain air pollutants that endanger public health or welfare.

National Environmental Policy Act (NEPA) - An Act passed in 1969 to declare a National policy that encourages productive and enjoyable harmony between humankind and the environment, promotes efforts that prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, enriches the understanding of the ecological systems and natural resources important to the nation, and establishes a Council on Environmental Quality (The Principal Laws Relating to Forest Service Activities, Agric. Handb. 453. USDA Forest Service, 359 p.). FEMAT

National Forest Management Act (NFMA) - A law passed in 1976 as an amendment to the Forest and Rangeland Renewable Resources Planning Act, requiring the preparation of Forest Plans and the preparation of regulations to guide that development. FEMAT

Nesting, Roosting, and Foraging Habitat - The forest vegetation with the age class, speciesä of trees, structure, sufficient area, and adequate food source to meet some or all of the lifeä needs of the northern spotted owl. FEMAT

Neotropical - Designating or of the biogeographic realm that includes South America, the Indies, Central America and tropical Mexico.

Nonattainment Area - A geographic area in which the level of a criteria air pollutant is higher than the level allowed by federal standards set by the Environmental Protection Agency. A single geographic area may have acceptable levels of one criteria air pollutant , but unacceptable levels of other criteria pollutants, resulting in an area that is in both attainment and nonattainment status at the same time.

Noncommercial Tree Species - Minor conifer and hardwood species whose yields are not reflected in the commercial conifer forest land allowable sale quantity. Some species may be managed and sold under a suitable woodland allowable sale quantity and, therefore, may be commercial as a woodland species. FEMAT

Nonforest Land - Land developed for nontimber uses or land incapable of being 10 percent stocked with forest trees. FEMAT

O&C Lands - Public lands granted to the Oregon and California Railroad Company or the Coos Bay Wagon Road Company and subsequently revested to the United States, which are managed by the Bureau of Land Management under the authority of the O&C Lands Act.

Off-Channel Habitat - Channels or ponds in a floodplain, at least seasonally connected toä the primary channel, that are in addition to and frequently parallel the primary flowingä channel. These most frequently occur in unconstrained reaches.

Old-Growth Associated Species - Plant and animal species that exhibit a strong association with old-growth forests. FEMAT

Old-Growth Emphasis Areas (OGEA) - In Bureau of Land Management Draft planning documents of 1992, areas where management emphasis will be given to providing for old-growth associated species and biological diversity. Management would provide for timber production when consistent with local and landscape level diversity. FEMAT

Old-Growth Forest - A forest stand usually at least 180-220 years old with moderate to high canopy closure; a multilayered, multispecies canopy dominated by large overstory trees; high incidence of large trees, some with broken tops and other indications of old and decaying wood (decadence); numerous large snags; and heavy accumulations of wood, including large logs on the ground. FEMAT

Orographic - Influenced or caused by the effect of mountains, as in moisture laden air being forced across mountains, thereby cooling and condensing, and if in sufficient quantity, this is deposited on the higher terrain as precipitation. The amount of precipitation on the higher terrain may be significantly greater than on the surrounding landscape.

Overstory - Trees that provide the uppermost layer of foliage in a forest with more than one roughly horizontal layer of foliage. FEMAT

Packing - A temporary influx of organisms of various sex and age classes into remaining suitable habitat as previously available habitat is changed to unsuitable conditions. FEMAT

Pair Site - An amount of habitat that is considered capable of supporting one pair of spotted owls. FEMAT

Partial Cutting - Removal of selected trees from a forest stand. FEMAT

Passerine - Pertaining to an order (Passeriformes) of small or medium-sized, chiefly perching songbirds having grasping feet with the first toe directed backward.

Patch - A small (20-60 acre) part of the forest. This term is often used to indicate a type of clearcutting (patch cuts) associated with the "staggered setting" approach to distributing harvest units across the landscape. FEMAT

Perennial Stream - A stream that typically has running water on a year-round basis. FEMAT
Persistence - As in population persistence, is a term for the capacity of a population to maintain sufficient numbers and distribution over time.

Physiographic Province - A geographic area having a similar set of biophysicalä characteristics and processes due to effects of climate and geology which result in patterns of soils and broad-scale plant communities. Habitat patterns, wildlife distributions, andä historical land use patterns may differ significantly from those of adjacent provinces. FEMAT

Planning Area - All of the lands within a Federal agency's management boundary addressed in land management plans. FEMAT

Plateau - A table-land of flat-topped region of considerable extent and elevation. FEMAT

PM10 - Particulate Matter smaller than 10 micrometers in size. A criteria pollutant comprised of airborne solid and liquid particles that are 10 micrometers or smaller in size. Because of its small size, PM10 readily lodges in the lungs, thus increasing respiratory and cardiac diseases in humans and other organisms.

Population Viability - Probability that a population will persist for a specified period across its range despite normal fluctuations in population and environmental conditions. FEMAT

Precommercial Thinning - The practice of removing some of the trees less than merchantable size from a stand so that remaining trees will grow faster. FEMAT

Prescribed Fire - A fire burning within an approved, predefined and planned prescription. The fire may result from either a planned or natural ignition. When a prescribed fire exceeds the prescription and/or planned perimeter, it may be declared a wildfire.

Presuppression - Activities organized advance of fire occurrence to ensure effective suppression action and/or to minimize risk to humans and resource damage. FEMAT

Prevention of Significant Deterioration (PSD) - A program under the Clean Air Act thatä sets forth regulations to prevent degrading the air in areas where the air is already cleanerä than required by the National Ambient Air Quality Standards.

Probable Sale Quantity (PSQ) - Probable sale quantity (PSQ) was used by the Assessment Team rather than allowable sales quantity (ASQ) to describe the allowable harvest levels for the various alternatives that could be maintained without decline over the long term if the schedule of harvests and regeneration were followed. "Allowable" was changed to "probable" to reflect some uncertainty in the calculations for the various alternatives, for example, many of the alternatives require watershed analysis in Key Watersheds before timber harvest can occur. Estimates were made of probable sale levels using a set of interim rules for those Key Watersheds. PSQ is otherwise comparable to ASQ. PSQ includes only scheduled or regulated yields from the matrix and does not include "other wood", or volume of cull and other products that are not normally part of ASQ calculations.

Propagule - A reproductive structure of brown algae.

Quarter-Township - An area approximately 3 miles square containing nine sections of land. FEMAT

Range of the Northern Spotted Owl - The range of the northern spotted owl in the United States is generally comprised of lands in western Washington and Oregon, and northern California. See Figure 2-1 in Chapter 2.

Receipts - Those priced benefits for which money will actually be paid to the managing agency: recreation fees, timber harvest, mineral leases and special use fees.

Record of Decision - A document separate from but associated with an environmentalä impact statement that states the management decision, identifies all alternatives includingä both the environmentally preferable and selected alternatives, states whether all practicableä means to avoid environmental harm from the selected alternative have been adopted, and ifä not, why not. FEMAT

Recovery Plan - A plan for the conservation and survival of an endangered species or a threatened species listed under the Endangered Species Act, to improve the status of the species to justify delisting in accordance with the Endangered Species Act.

Reforestation - The natural or artificial restocking of an area with forest trees; most commonly used in reference to artificial stocking. FEMAT

Refugia - Locations and habitats that support populations of organisms that are limited to small fragments of their previous geographic range (i.e., endemic populations). FEMAT

Region - A Forest Service administrative unit. The two Regions affected by this proposed action are the Pacific Northwest Region (Region 6) which includes National Forests inä Oregon and Washington, and the Pacific Southwest Region (Region 5) which includesä National Forests in California. FEMAT

Regional Guide - The guide developed to meet the requirements of the Forest andä Rangeland Renewable Resources Planning Act of 1974, as amended by the National Forestä Management Act. Regional Guides provide standards and guidelines for addressing majorä issues and management concerns which need to be considered at the Regional level toä facilitate National Forest planning. FEMAT

Regulations - Generally refers to the Code of Federal Regulations. FEMAT

Rescue Effect - Immigration of new individuals sufficient to maintain a population thatä might otherwise decline toward extinction. FEMAT

Research Natural Area (RNA) - An area set aside by a public or private agency specificallyä to preserve a representative sample of an ecological community, primarily for scientific and educational purposes. In Forest Service usage, research natural areas are areas designated to ensure representative samples of as many of the major naturally occurring plant communities as possible. FEMAT

Reserved Pair Areas - In those portions of the species' range where habitat and owl populations were inadequate to apply the criteria creating designated conservation areas, then individual pair areas were also reserved. These are areas of suitable habitat identified for pairs and territorial single owls. The acreage of these areas varies throughout the range, based on data for pairs in each physiographic province. All suitable habitat is reserved in an area equal to the mean home range for that province. FEMAT

Resource Advisor - A resource specialist designated to assist fire management personnel in the protection of resource values (biological, physical, social, or cultural) during the suppression of a wildfire. This protection is intended to limit the negative impacts of bothä the wildfire and the fire suppression actions.

Resource Management Plan (RMP) - A land use plan prepared by an agency under current regulations in accordance with the Federal Land Policy and Management Act. FEMAT

Riparian Area - As specifically defined in the FEMAT Report, a geographic area containing an aquatic ecosystem and adjacent upland areas that directly affect it. This includes floodplain, woodlands, and all areas within a horizontal distance of approximately 100 feet from the normal line of high water of a stream channel or from the shoreline of a standing body of water.

Riparian Habitat Conservation Area - Portions of a watershed that contribute to the creation and maintenance of fish habitat. FEMAT

Riparian Reserves - Designated riparian areas found outside Late-Successional Reserves. FEMAT

Riparian Zone - As specifically defined in the FEMAT Report, those terrestrial areas where the vegetation complex and microclimate conditions are products of the combined presence and influence of perennial and/or intermittent water, associated high water tables, and soils that exhibit some wetness characteristics. Normally used to refer to the zone within which plants grow rooted in the water table of these rivers, streams, lakes, ponds, reservoirs, springs, marshes, seeps, bogs, and wet meadows.

Ripping - The process of breaking up or loosening compacted soil (e.g., skid trails or spur roads) to better assure penetration of roots of young tree seedlings. FEMAT

Roadless Area - Areas typically exceeding 5,000 acres that were inventoried during theä Forest Service's Roadless Area Review and Evaluation (RARE II) process and remain in aä roadless condition.

Rock Stability Groups - Groups of rocks having similar resistance to physical and chemical weathering. These properties strongly influence rates of soil development, types of mass wasting and other erosion processes, and hydrologic and biologic processes. Groups with decreasing resistance are described as resistant, intermediate, weak, and unconsolidated.

Rotation - The planned number of years between regeneration of a forest stand and its final harvest (regeneration cut or harvest). A forest's age at final harvest is referred to as rotation age. In this report, an extended rotation is 120-180 years, a long rotation 180 years. FEMAT

Roost - The resting behavior of an animal. FEMAT

Rural Interface (urban/wildland interface) - A line, area, or zone where structures and other human developments meet or intermingle with undeveloped wildland or vegetative fuels.

Salmonid - Refers to fish of the family Salmonidae. Within the range of the northern spotted owl these include all salmon, trout, and whitefish.

Scour - Evidence of movement of material, erosion or deposition, in a downslope direction due to transport of water. Substrate in channel different than surrounding substrate (mineral or litter layers). Similar substrate underlays surrounding mineral or litter layers.

Scribner - A system for estimating the number of board feet that may be produced from a tree or log.

Seasonally Saturated Soil - A soil that is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions.

Second Growth - Relatively young forests that have developed following a disturbance (e.g., wholesale cutting, serious fire, or insect attack) of the previous old-growth forest. FEMAT

Sediment Yield - The quantity of soil, rock, particles, organic matter, or other dissolved or suspended debris is transported through a cross-section of stream in a given period. Measured in dry weight or by volume. Consists of dissolved load, suspended load, and bed load. FEMAT

Seeps - Places where water oozes from the ground to form a pool.

Selection Cutting - a method of uneven-aged management involving the harvesting of single trees from stands (single-tree selection) or in groups (group selection) without harvesting the entire stand at any one time. FEMAT

Sensitive Species - Those species that (1) have appeared in the Federal Register as proposed for classification and are under consideration for official listing as endangered or threatened species or (2) are on an official state list or (3) are recognized by the U.S. Forest Service or other management agency as needing special management to prevent their being placed on Federal or state lists. FEMAT

Seral Stages - The series of relatively transitory planned communities that develop during ecological succession from bare ground to the climax stage. FEMAT

Serpentine Soils - Soils developed on altered ultramafic rocks. FEMAT

Serpentinite/Peridotite - The association of dark-colored, coarse-grained, iron and magnesium-rich igneous rock (peridotite) with the products of hydrothermal alteration and faulting of these rocks (serpentinite). FEMAT

Shelterwood - A regeneration method under an even-aged silvicultural system. A portion of the mature stand is retained as a source of seed and/or protection during the period of regeneration. The mature stand is removed in two or more cuttings. FEMAT

Shoreline/Coastline ratio - The ratio of the actual shoreline length to the length of a line running north-south between the northern and southern coastal borders of the analysis area.

Short List - Refers to Appendix 5-D , Attributes of Terrestrial (Non-Fish) Vertebrates Closely Associated With Old-Growth Forests in National Forests Within the Range of the Northern Spotted Owl (Short List) of the Scientific Analysis Team Report (Thomas et al. 1993).

Silvicultural Prescription - A professional plan for controlling the establishment,ä composition, constitution and growth of forests. FEMAT

Silvicultural System - A planned sequence of treatments or prescriptions over the entire life of a forest stand needed to meet management objectives.

Site-Potential Tree - A tree that has attained the average maximum height possible given site conditions where it occurs. FEMAT

Slope Stability - The resistance of a natural or artificial slope or other inclined surface to failure by landsliding (mass movement). FEMAT

Snag - Any standing dead, partially dead, or defective (cull) tree at least 10 inches in diameter at breast height and at least 6 feet tall. A hard snag is composed primarily of sound wood, generally merchantable. A soft snag is composed primarily of wood in advanced stages of decay and deterioration, generally not merchantable. FEMAT

Soil Productivity - Capacity or suitability of a soil, for establishment and growth of a specified crop or plant species, primarily through nutrient availability. FEMAT

Speciation - The process by which a new species comes into existence; the origin of a new species.

Spotted Owl Additions - Areas of LS/OG or suitable spotted owl habitat or potential owl habitat added to most significant LS/OG forest (LS/OG1) to ensure compliance with the Interagency Scientific Committee Strategy. FEMAT

Staging Areas - Temporary locations near wildfires or other emergency events where fire suppression resources (e.g., firefighting personnel and heavy equipment) are available to respond at very short notice.

Stand (Tree Stand) - An aggregation of trees occupying a specific area and sufficiently uniform in composition, age, arrangement, and condition so that it is distinguishable from the forest in adjoining areas. FEMAT

Standards and Guidelines - The rules and limits governing actions, and the principles specifying the environmental conditions or levels to be achieved and maintained.

State Implementation Plan (SIP) - A detailed description of the programs and regulations a state will use to reduce air pollution. The Clean Air Act requires the Environmental Protection Agency to review and approve each SIP.

Stocked/Stocking - The degree an area of land is occupied by trees as measured by basal area or number of trees. FEMAT

Structural Diversity - The diversity of forest structure, both vertical and horizontal, that provides for a variety of forest habitats for plants and animals. The variety results from layering or tiering of the canopy and the die-back, death, and ultimate decay of trees. In aquatic habitats, the presence of a variety of structural features such as logs and boulders that create a variety of habitat. FEMAT

Subadult - A young, spotted owl that has dispersed but not yet reached breeding age. Subadults are in their second, or in some cases, third year of life. FEMAT

Subdrainage - A land area (basin) bounded by ridges or similar topographic features, encompassing only part of a watershed, and enclosing on the order of 5,000 acres; smaller than, and part of, a watershed. (See Drainage and Forest watershed.) FEMAT

Subspecies - An aggregate of phenotypically similar (i.e., similar in appearance) populations of a species generally inhabiting a geographic subdivision of the range of the species and differing taxonomically (e.g., different color, different size, differing in a set of morphological characteristics, differing behaviorally) from other populations of the species.

Substrate - Any object or material upon which an organism grows or is attached.

Succession - A series of dynamic changes by which one group of organisms succeedsä another through stages leading to potential natural community or climax. An example is the development of series of plant communities (called seral stages) following a major disturbance. FEMAT

Surface Erosion - A group of processes whereby soil material are removed by running water, waves and currents, moving ice, or wind. FEMAT

Sustained Yield - The yield that a forest can produce continuously at a given intensity of management. FEMAT

Take - Under the Endangered Species Act, take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect an animal, or to attempt to engage in any such conduct. FEMAT

Talus - A slope landform, typically covered by coarse rock debris forming a more or less continuous layer that may or may not be covered by duff and litter. FEMAT

Taxon - A category in scientific classification system, such as class, family, or phylum. FEMAT

Territory - The area that an animal defends, usually during breeding season, against intruders of its own species. FEMAT

Threatened Species - Those plant or animal species likely to become endangered species throughout all or a significant portion of their range within the foreseeable future. A plant or animal identified and defined accordance with the 1973 Endangered Species Act and published in the Federal Register. FEMAT

Threshold Phenomenon - Pattern or trend in population growth rate that exhibits relatively long periods of slow change followed by precipitous increase or response to an environmental gradient. FEMAT

Timber Management - A general term for the directing, managing or controlling of forest crops and stands of trees.

Timber Production - The purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use other than for fuelwood. FEMAT

Torpor - A state of being dormant or inactive.

Total Suspended Particulates (TSP) - A broad category of particulate matter that includes essentially all solid or liquid particles in the ambient air. The Environmental Protection Agency previously recognized TSP as a criteria pollutant, but in 1987 the standard was revised to cover only particulate matter less than 10 micrometers in size (PM10).

Township - (See Quarter Township)

Ultramafic - Dark-colored igneous rocks composed of minerals which are enriched in iron and magnesium. (See Serpentinite/peridotite.) FEMAT

Unconsolidated Deposits - Sediments that are loosely arranged, with particles that are not cemented together. Includes alluvial, glacial, volcanic, and landslide deposits. FEMAT

Underburning - Prescribed burning of the forest floor or understory for botanical or wildlife habitat objectives, hazard reduction, or silvicultural objectives. FEMAT

Understory - The trees and other woody species growing under the canopies of larger adjacent trees and other woody growth. FEMAT

Uneven-aged Management - A combination of actions that simultaneously maintains continuous tall forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes. Cutting methods that develop and maintain uneven-aged stands are single-tree selection and group selection. FEMAT

Ungulate - A hoofed mammal.

Unstable and Potentially Unstable Lands - The unstable land component of the Riparian Reserves includes lands which are prone to mass failure under natural conditions (unroaded, unharvested), and where human activities such as road construction and timber harvest are likely to increase landslide distribution in time and space, to the point where this change is likely to modify natural geomorphic and hydrologic processes (such as the delivery of sediment and wood to channels), which will in turn affect aquatic ecosystems including streams, springs, seeps, wetlands, and marshes.

The following types of land are included: 1) active landslides and those which exhibit sound evidence of movement in the past 400 years; 2) inner gorges; 3) those lands identified as unstable by geologic investigations, using the criteria stated above (includes lands already classified by the Forest Service as unsuited for programmed timber harvest due to irreversible soil loss, and by the BLM as nonsuitable fragile lands). Highly erodible landsä (i.e., lands prone to sheet and rill erosion) are not included in this definition. FEMAT

Uplift - A structurally high area in the earth's crust, produced by positive movements that raise or upthrust the rocks. FEMAT

Viability - The ability of a wildlife or plant population to maintain sufficient size so that is persists over time in spite of normal fluctuations in numbers; usually expressed as a probability of maintaining a specific population for a specified period. FEMAT

Viable Population - A wildlife or plant population that contains an adequate number of reproductive individuals appropriately distributed on the planning area to ensure the long-term existence of the species. FEMAT

Water Quality - The chemical, physical, and biological characteristics of water. FEMAT

Watershed - The drainage basin contributing water, organic matter, dissolved nutrients, and sediments to a stream or lake. FEMAT

Watershed Analysis - A systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. Watershed analysis provides a basis for ecosystem management planning that is applied to watersheds of approximately 20 to 200 square miles. FEMAT

Westside - Generally, west of the crest of the Cascade Range.

Wetlands - Areas that are inundated by surface water or ground water with a frequency sufficient to support, and under normal circumstances do or would support, a prevalence of vegetative or aquatic life that require saturated or seasonally saturated soil conditions for growth and reproduction (Executive Order 11990). Wetlands generally include, but are not limited to, swamps, marshes, bogs, and similar areas. FEMAT

Wild and Scenic River System - Those rivers or section of rivers designated as such by Congressional action under the Wild and Scenic River Act (Public Law 90-542, 1968), as supplemented and amended, or those sections of rivers designated as wild, scenic, or recreational by an act of the legislature of the state or states through which they flow. FEMAT

Wilderness - Areas designated by congressional action under the 1964 Wilderness Act. Wilderness is defined as undeveloped Federal land retaining its primeval character and influence without permanent improvements or human habitation. Wilderness areas are protected and managed to preserve their natural conditions, which generally appear to have been affected primarily by the forces of nature with the imprint of human activity substantially unnoticeable; have outstanding opportunities for solitude or for a primitive and confined type of recreation; include at least 5,000 acres or are of sufficient size to make practical their preservation, enjoyment, and use in an unimpaired condition; and may contain features of scientific, education, scenic, or historical value as well as ecologic and geologic interest. FEMAT

Wildfire - Any wildland fire that does not meet management objectives, thus requiring a fire suppression response. Once declared a wildfire, the fire can no longer be declared a prescribed fire.

Wildfire Situation Analysis - Analysis of factors that influence suppression of an escapedä fire. A plan of attack developed from a Wildfire Situation Analysis includes the development of alternative strategies of wildfire suppression and estimates of the expected net result ofä each.

Windthrow - A tree or trees uprooted or felled by the wind. FEMAT

Woody Debris - See **Coarse Woody Debris**.

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