Forest Ecosystem Management:

An Ecological, Economic, and Social Assessment

Report of the Forest Ecosystem Management Assessment Team

Excerpts from

FOREST ECOSYSTEM MANAGEMENT:

An Ecological, Economic and Social Assessment

Report of the Forest Ecosystem Management Assessment Team
July 1993

United States Department of Agriculture
Forest Service

United States Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

United States Department of the Interior
Bureau of Land Management

United States Department of the Interior
Fish and Wildlife Service

United States Department of the Interior
National Park Service

Environmental Protection Agency

Contents

This volume contains the Preface, Chapter II, and part of Chapter III of the report by the Forest Ecosystem Management Assessment Team (FEMAT). The Preface includes the mission statement issued to the Team. Chapter III constitutes a summary and overview of the analysis and principal conclusions of the report. The portion of Chapter III that has been excerpted here is the description of Option 9, which has been selected as the preferred alternative in the Draft 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 (July 1993). Maps showing the federal land allocations for Option 9 are also included in this volume.

Errata in the FEMAT report have been corrected. In other respects, the text is the same as in the complete report. The FEMAT report has been published by the Forest Service (U.S. Department of Agriculture) and the Bureau of Land Management (U.S. Department of the Interior) as an appendix to the Draft Supplemental Environmental Impact Statement.

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Preface

Following the April 2, 1993, Forest Conference in Portland, Oregon, President Clinton created three interagency working groups: the Forest Ecosystem Management Assessment Team, the Labor and Community Assessment Team, and the Agency Coordination Team. Direction for the Teams came in a Statement of Mission letter. The following excerpts from that letter outline the mission for the Forest Ecosystem Management Assessment Team.

TO: FOREST CONFERENCE INTER-AGENCY WORKING GROUPS
Ecosystem Management Assessment
Labor and Community Assistance
Agency Coordination

FROM: FOREST CONFERENCE EXECUTIVE COMMITTEE

Department of Agriculture	Office on Environmental Policy
Department of Interior	Office of Science and Technology
Department of Labor	National Economic Council
Department of Commerce	Council of Economic Advisors
Environmental Protection Agency	Office of Management and Budget

RE: STATEMENT OF MISSION

Together, we are working to fulfill President Clinton's mandate to produce a plan to break the gridlock over federal forest management that has created so much confusion and controversy in the Pacific Northwest and northern California. As well, that mandate means providing for economic diversification and new economic opportunities in the region. As you enter the critical phase of your work reviewing options and policy, this mission statement should be used to focus and coordinate your efforts. It includes overall guidance and specific guidance for each team.

Background

President Clinton posed the fundamental question we face when he opened the Forest Conference in Portland.

"How can we achieve a balanced and comprehensive policy that recognizes the importance of the forest and timber to the economy and jobs in 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?"

And he said, "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 President said five principles should guide our work:

"First, we must never forget the human and the economic dimensions of these problems. Where sound management policies can preserve the health of forest lands, sales should go

forward. Where this requirement cannot be met, we need to do our best to offer new economic opportunities for year-round, high-wage, high-skill jobs.

"Second, as we craft a plan, we need to protect the long-term health of our forests, our wildlife, and our waterways. They are a ... gift from God, and we hold them in trust for future generations.

"Third, our efforts must be, insofar as we are wise enough to know it, scientifically sound, ecologically credible, and legally responsible.

"Fourth, the plan should produce a predictable and sustainable level of timber sales and nontimber resources that will not degrade or destroy the environment.

"Fifth, to achieve these goals, we will do our best, as I said, 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."

Ecosystem Management Assessment

Our objectives based on the President's mandate and principles are to identify management alternatives that attain the greatest economic and social contribution from the forests of the region and meet the requirements of the applicable laws and regulations, including the Endangered Species Act, the National Forest Management Act, the Federal Land Policy Management Act, and the National Environmental Policy Act. The Ecosystem Management Assessment working group should explore adaptive management and silvicultural techniques and base its work on the best technical and scientific information currently available.

Your assessment should take an ecosystem approach to forest management and should particularly address maintenance and restoration of biological diversity, particularly that of the late-successional and old-growth forest ecosystems; maintenance of long-term site productivity of forest ecosystems; maintenance of sustainable levels of renewable resources, including timber, other forest products, and other facets of forest values; and maintenance of rural economies and communities.

Given the biological requirements of each alternative, you should suggest the patterns of protection, investment, and use that will provide the greatest possible economic and social contributions from the region's forests. In particular, we encourage you to suggest innovative ways federal forests can contribute to economic and social well-being.

You should address a range of alternatives in a way that allows us to distinguish the different costs and benefits of various approaches (including marginal cost/benefit assessments), and in doing so, at least the following should be considered:

- timber sales, short and long term;
- production of other commodities;
- effects on public uses and values, including scenic quality, recreation, subsistence, and tourism;

- effect on environmental and ecological values, including air and water quality, habitat conservation, sustainability, threatened and endangered species, biodiversity, and long-term productivity;

- jobs attributable to timber harvest and timber processing; and, to the extent feasible, jobs attributable to other commodity production, fish habitat protection, and public uses of forests; as well as jobs attributable to investment and restoration associated with each alternative;

- economic and social effects on local communities, and effects on revenues to counties and the national treasury;

- economic and social policies associated with the protection and use of forest resources that might aid in the transitions of the region's industries and communities;

- economic and social benefits from the ecological services you consider;

- region, national and international effects as they relate to timber supply, wood product prices, and other key economic and social variables.

As well, when locating reserves, your assessment also should consider both the benefits to the whole array of forest values and the potential cost to rural communities.

The impact of protection and recovery of threatened and endangered species on nonfederal lands within the region of concern should be minimized. However, you should not specific nonfederal contributions that are essential to or could significantly help accomplish the conservation and timber supply objectives of your assessment.

In addition, your assessment should include suggestions for adaptive management that would identify high priority inventory, research, and monitoring needing to assess success over time, and essential or allowable modification in approach as new information becomes available. You should also suggest a mechanism for a coordinated interagency approach to the needed assessments, monitoring, and research as well as any changes needed in decisionmaking procedures required to support adaptive management.

You should carefully examine silvicultural management of forest stands – particularly young stands – especially in the context of adaptive management. The use of silviculture to achieve those ends, or tests of silviculture, should be judged in ecosystem context and not solely on the basis of single species or several species response.

Your conservation and management assessment should cover those lands managed by the Forest Service, the Bureau of Land Management, and the National Park Service that are within the current range of the northern spotted owl, drawing as you have on personnel from those agencies and assistance from the Fish and Wildlife Service, the National Marine Fisheries Service, and the Environmental Protection Agency. To achieve similar treatment on all federal lands involved here, you should apply the "viability standard" to the Bureau of Land Management lands.

In addressing biological diversity you should not limit your consideration to any one species and, to the extent possible, you should develop alternatives for long-term management that meet the following objectives:

- maintenance and/or restoration of habitat conditions for the northern spotted owl and the marbled murrelet that will provide for viability of each species – for the owl, well distributed along its current range on federal lands, and for the murrelet so far as nesting habit is concerned;

- maintenance and/or restoration of habitat conditions to support viable populations, well-distributed across their current ranges, of species known (or reasonably expected) to be associated with old-growth forest conditions;

- maintenance and/or restoration of spawning and rearing habitat on Forest Service, Bureau of Land Management, and National Park Service lands to support recovery and maintenance of viable populations of anadromous fish species and stocks and other fish species and stocks considered "sensitive" or "at risk" by land management agencies, or listed under the Endangered Species Act; and,

- maintenance and/or creation of a connected or interactive old-growth forest ecosystem on the federal lands within the region under consideration.

Your assessment should include alternatives that range from a medium to a very high probability of ensuring the viability of species. The analysis should include an assessment of current agency programs based on Forest Service plans (including the Final Draft Recovery Plan for the Northern Spotted Owl) for the National Forests and the Bureau of Land Management's revised preferred alternative for its lands.

In your assessment, you should also carefully consider the suggestions for forest management from the recent Forest Conference in Portland. Although we know that it will be difficult to move beyond the possibility considered in recent analysis, you should apply your most creative abilities to suggest policies that might move us forward on these difficult issues. You also should address short-term timber sale possibilities as well as longer term options.

Finally, your assessment should be subject to peer review by appropriately credentialed reviewers.

Conclusion

We appreciate your efforts and recognize, as President Clinton said, that these are difficult issues with difficult choices. We'll also remind of something else the President said at the Forest Conference, talking to the people of the Pacific Northwest and northern California: "We're here to begin a process that will ensure that you will be able to work together in your communities for the good of your businesses, your jobs, and your natural environment. The process we [have begun] will not be easy. Its outcome cannot possibly make everyone happy. Perhaps it won't make anyone completely happy. But the worst thing we can do is nothing."

OVERVIEW AND SUMMARY

Background

Timber cutting and other operations on lands managed by the U.S. Department of Agriculture, Forest Service and the U.S. Department of the Interior, Bureau of Land Management, have been brought virtually to a halt by federal court orders for several reasons. Foremost has been the failure of the agencies to produce plans that satisfy the requirements of several laws including the National Forest Management Act of 1976, the Endangered Species Act of 1979, and the National Environmental Policy Act of 1969. Shortcomings have included delays in meeting court-imposed time schedules, inadequate environmental impact statements, and numerous proposed management actions (e.g., timber sale proposals) that resulted in "jeopardy opinions" from the U.S. Department of the Interior, Fish and Wildlife Service.

This series of events (Thomas et al. 1993: 32-45) can be dated back at least to 1972 when scientists first suspected that at least one sub-species (the northern spotted owl) might be closely associated with the habitat conditions most frequently found in old-growth forests.

Over the period 1972 to 1993, the issue evolved from a question of dealing with a single species, now considered by the Fish and Wildlife Service to be threatened, to dealing with several such species simultaneously within the same ecosystem, to considering the effects of broadscale management plans on *all* species associated with old-growth or late-successional forests. This latter consideration – and the evolving concerns with "sustainable forestry," "multiple-use," "threatened and endangered species," "retention of biodiversity," "landscape ecology," and other concepts – led the Bureau of Land Management, the Forest Service, and political leaders to embrace the concept of ecosystem management. In addition, these land managers and political leaders have reached the obvious conclusion that ecosystem management must exist in the context of human needs and desires that are most commonly measured in economics: the production of goods and services from those lands. Considering these factors, political decisions concerning ecosystem management must be made.

Brief History of Forest Management in the Pacific Northwest

Cutting of forests in the Pacific Northwest began in the 1800's when the first non-Indian immigrants began to settle and farm in the interior valleys of western Oregon and the Puget Sound region. Initially, the extensive forests that covered much of the landscape were viewed as an impediment to progress and were systematically cleared and burned to make way for agriculture.

In the late 1800's and early 1900's, extraction of timber for commercial purposes began to increase. Lumber camps sprang up 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 less accessible areas in more mountainous terrain. Logging in these early years frequently consisted of a clearcut and burn approach in which noncommercial species and many small diameter trees were left following logging, with little or no

attention to replanting after harvest. Because of the seemingly inexhaustible supply of trees and the considerable labor required to fell them with hand saws and axes, trees with low commercial value were frequently left standing.

Shortly after World War II and subsequent to the invention of the gas-powered chain saw and improvements in transportation, logging began in earnest 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, removal of logs and snags, slash burning, thinning, and planting of single species stands on cutover areas. The assumption was that forests managed in this manner could be cut and regrown at relatively short intervals (e.g., 40-80 years) without negatively affecting other resources such as water quality, fish, soils, or terrestrial animals.

As a result of over a century of logging and fire control, the forests of the Pacific Northwest presently consist of a highly fragmented mosaic of recent clearcuts, thinned stands and young plantations interspersed with uncut natural stands. The natural stands that remain range from 1,000-year-old or older forests of large trees to relatively young, even-aged stands that have regenerated following wildfires. Because wildfires and windstorms often killed only part of the trees in a stand, natural stands are frequently characterized by uneven-aged mixtures of trees that survived a catastrophic event and younger trees that filled in the understory after the event. Where many large old trees remain in the overstory, these stands are usually referred to as "old growth" or "ancient forests." Where only scattered individuals or patches of large old trees remain and the majority of the stand consists of young or mature trees, stands are referred to as "mixed age" or even "young." Mixed-age stands are particularly common in some areas, such as the Oregon Coast Range, where extensive fires occurred in the 1800's. Mixed-age stands defy categorization – they are not "old growth" in the classical sense (Franklin and Spies 1991; Spies and Franklin 1991), and they are certainly not young even-aged stands. It is these mixed-age stands that have led to much of the debate over how much "old growth" or "ancient forest" is left in the Pacific Northwest.

As studies on the ecology of late-successional forests 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 was not going to adequately protect the considerable biodiversity that was present in late-successional forests and their associated aquatic ecosystems. The northern spotted owl was the first species to receive recognition in this regard followed closely by the marbled murrelet, anadromous fish, and the recognition that a wide variety of species are closely associated with old forests (Thomas et al. 1993). More recently, ecologists, foresters, and the public have begun to recognize that the old forests that remain in the Pacific Northwest may be unique ecosystems that developed under climatic and disturbance regimes that may never be duplicated.

Changes in public perceptions and expectations concerning management on federal lands in the Pacific Northwest and elsewhere have led to a gradual increase in protection of unique ecosystems and species, increased concern with riparian areas, and experimentation with methods of "new forestry" designed to retain some of the structural features found in old forests and thereby more closely imitate natural disturbance regimes. As these changes have occurred, harvest rates of timber on federal lands have declined, and considerable controversy has ensued. The Forest Ecosystem Management Assessment Team was formed to develop and evaluate possible management options for resolving this issue.

Approach

It took a century and a half to arrive at the current crisis in the Pacific Northwest. From the beginning of their assignment, Forest Ecosystem Management Assessment Team members knew that 3 months was not enough time to develop a full-scale ecosystem management plan. Therefore, the team concluded that the shift to an ecosystem management approach could best be achieved through a continuing three-phase process. The first phase is development and assessment of management options for establishment of a network of late-successional/old-growth forest reserves and a prescription for the management of the intervening forested land (i.e., the Matrix). The first phase also included selection of an option and the completion of the procedures required by the National Environmental Policy Act (i.e., the environmental impact statement). The options developed were to attempt to meet the Administration's directives of achieving biological diversity while attaining economic and social goals including compliance with law. The second phase in the shift to ecosystem management is reinstituted forest planning – a process that must include federal, state, local government, and private interests if ecosystem management is to be achieved. The third phase is implementation, monitoring, and adaptive management.

There are several key biological objectives. First is assuring adequate habitat on the federal lands to aid in "recovery" of late-successional forest habitat-associated species listed as threatened under the Endangered Species Act (e.g., northern spotted owls and marbled murrelets). In addition, in keeping with agency responsibilities to prevent species from being listed under the Endangered Species Act and with the regulations issued pursuant to the National Forest Management Act, the Team assessed the risk of "viability" to all identified species of plants and animals under each suggested management option.

Then, considering that aquatic and riparian habitats and wetlands on federal lands are key to numerous aquatic organisms including some 13 species and approximately 260 runs (fish stocks) of anadromous fishes considered to be "at risk" of extinction, riparian management options for habitat adjacent to streams were developed. Without such appropriate management options, many aquatic and riparian associated species may become candidates for listing as threatened or endangered under the Endangered Species Act within the near future, indeed many of these species may well be listed as threatened in any case.

Development of management options for protection of stream corridors to enhance habitat conditions for associated aquatic and terrestrial species also established "connectors" between patches of forested habitats. Such connections are one way to permit individuals to move between habitat patches over both short and longer term thereby increasing the species' viability. Facilitated movement between habitat patches reduces the risk of both demographic and genetic isolations of plants and animals.

The selected option will provide the "backbone" of an ecosystem management approach. Full development and implementation of an ecosystem approach to management will be recognized through a renewed federal land management planning process that might occur over 3 to 5 years. The planning will be in two stages. The first is the short term with emphasis, of necessity, on assurance against losses in biological diversity (with emphasis on threatened species) and ecological processes. The second is the longer term, which will be aimed at achievement of restoration and more spatially appropriate conditions at landscape scale. Next in achieving ecosystem management is the implementation of the management approach described in the selected option in conjunction with monitoring and adaptive management.

Compliance with Law and Regulations

The instructions given to the Forest Ecosystem Management Assessment Team by the Forest Conference Executive Committee are set forth in the Preface to this volume. The Executive Committee stated that its objectives were "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 Management Act, and the National Environmental Policy Act."

The Team was not asked to interpret the applicable laws and regulations or to indicate whether a particular alternative satisfied those regulations or requirements. However, "in addressing biological diversity" the Team was instructed to:

> ...develop alternatives for long-term management that meet the following objectives:
>
> - maintenance and/or restoration of habitat conditions for the northern spotted owl and the marbled murrelet that will provide for viability of each species – for the owl, well distributed along its current range on federal lands, and for the murrelet so far as nesting habitat is concerned;
> - maintenance and/or restoration of habitat conditions to support viable populations, well distributed across their current range, of species known (or reasonably expected) to be associated with old-growth forest conditions;
> - maintenance and/or restoration of spawning and rearing habitat on Forest Service, Bureau of Land Management, National Park Service, and other federal lands to support recovery and maintenance of viable populations of anadromous fish species and stocks and other fish species and stocks considered "sensitive" or "at risk" by land management agencies, or listed under the Endangered Species Act;
> - maintenance and/or creation of a connected or interactive old-growth forest ecosystem on the federal lands within the region under consideration...

The Team was instructed to "include alternatives that range from a medium to a very high probability of ensuring the viability of species" and that the analysis "should include an assessment of current agency programs..."

The use of the term "viability" is an obvious reference to the regulations issued under the National Forest Management Act requiring that "fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired nonnative vertebrate species in the planning area" (36 CFR Ch. II; 7-1-91 Edition, 219.19). The regulations also require provision "for diversity of plant and animal communities and tree species" (id., 219.26 and 27).

The provisions of the Endangered Species Act are not limited to vertebrates but extend to any species of plant or animal that is endangered or threatened. The principal provisions come to bear when a species is formally listed as endangered or threatened. The threatened

species mentioned specifically in our instructions were the northern spotted owl and the marbled murrelet. The Team also paid particular attention to "at-risk" species and stocks of anadromous fishes.

Although the "viability regulation" is applicable only to lands managed by the Forest Service, the Team was told that "to achieve similar treatment on all federal lands involved here, you should apply the 'viability standard' to the Bureau of Land Management lands." As a practical matter, this instruction made little difference to the final results. In all of the options developed by the Team, potential harvest levels were affected primarily by the need for protecting the northern spotted owl, the marbled murrelet, at-risk fish species, and late-successional forest considerations. Consideration of the first two of these is required by the Endangered Species Act, which is equally applicable to both land management agencies. In addition, the Bureau of Land Management's preferred alternative from their Draft Resource Management Plans considered at-risk fish and other species that could be listed in the near future as species of special status. Moreover, the Team recognized that if the plan failed to consider at-risk species, the Bureau of Land Management could have been in a position of having to revise its planning as soon as those species become listed. The impact on Bureau of Land Management lands of considering the viability of other species (that is, other than the northern spotted owl, the marbled murrelet, and at-risk fish) was minimal.

Option Development and Description

As a first step in development of an ecosystem management plan with options that provided for varying levels of likelihood of "viability" for species of concern we considered 48 previously described plans (see chapter III of the complete report). These plans represented the full range of options that existed prior to our assignment (Preface). These plans were evaluated using criteria pertaining to the likelihood that such plans would provide habitat to maintain the viability of (1) northern spotted owls, (2) marbled murrelets, (3) at-risk fish species and stocks, and (4) other species closely associated with old-growth forests. The likelihood the plans would provide an interacting late-successional forest ecosystem was also evaluated. Such evaluations were used to select a set of options that were analyzed more thoroughly and then refined to better meet the Team's mission (see Preface). A total of 10 options were eventually developed. A general discussion of the options follows. For a more complete description of each option, see chapter III. See also the maps of the options that accompany the report.

Components of the Options

Each of the options included consideration of late-successional forests found in National Parks, Wilderness Areas, and Research Natural Areas. Such areas are referred to as Congressionally Withdrawn Areas. They are the same for all options. Other areas have been withdrawn from timber harvest by the federal agencies for varying reasons such as protection of unstable soil, trees retained along roadsides, wild and scenic river corridors, etc. These areas are called Administratively Withdrawn Areas.

The options vary in four principal respects: the quantity and location of land placed in some form of reserve; the activities permitted within those reserve areas; the delineation of areas outside the reserves; and the activities allowed within areas outside reserves.

Designation of Reserves

The Team found that to assure the viability of threatened and at-risk species (and thereby satisfy the requirements of current law) some system of reserves was required. Consequently, each of the options contains reserve areas in which timber harvests are either not allowed at all or are limited, and areas outside of reserves (referred to as the **Matrix**) where most timber cutting occurs.

The reserves are of two types: **Late-Successional Reserves**, encompassing older forest stands, and **Riparian Reserves**, consisting of protected strips along the banks of rivers, streams, lakes, and wetlands, which act as a buffer zone between the water and areas where cutting is allowed.

Late-Successional Reserves were developed in three ways. In some options, the starting point was the habitat needs of individual species, particularly the northern spotted owl. Most of these incorporate the features of the Final Draft Recovery Plan for the Northern Spotted Owl (USDI 1992) that was developed by the Interior Department as required by the Endangered Species Act. The primary owl protection areas under that plan are known as **Designated Conservation Areas**. These are relatively large areas, both sized and spaced across the landscape in a manner that meets the habitat needs for multiple pairs of owls. Other smaller areas for the protection of individual pairs of owls (or single owls) are known as **managed pair areas, reserved pair areas,** and **residual habitat areas**. In developing options based on this approach, the Team generally started with owl habitat and then designated additional habitat to contribute to meeting the habitat needs of other species.

- Options 4, 5, and 7 take this approach. Of these, the Reserves are largest under Option 4 and smallest under Option 7.

Other options develop Late-Successional Reserves by starting with remaining old growth. In an earlier study, the old growth remaining on federal land in the region was classified in three categories of **late-successional/old-growth (LS/OG)** forests.

The first category, **LS/OG1**, includes relatively large areas containing old growth that was deemed to be the most ecologically significant. (These areas also contain some younger forest stands that have been previously cut or burned.) The second category, **LS/OG2**, contains old growth areas that tend to be somewhat smaller and more fragmented but still ecologically significant. The third category, **LS/OG3**, comprises isolated patches or highly fragmented parcels of old growth that have ecological importance to some species.

Both the northern spotted owl and the marbled murrelet are associated with habitat conditions found in old-growth areas. LS/OG-based reserves provide much of the necessary protection for northern spotted owls on federal lands. However, some additional designations (referred to as **owl additions**) are required to provide the habitat conditions needed for the recovery of the spotted owl. Options 1, 2, 3, 4, 6, 8, and 10 take an approach that includes some combination of LS/OG areas and owl additions:

- Option 1 protects LS/OGs 1, 2, and 3 and owl additions. It has the largest Late-Successional Reserves of any option and the most restrictive rules about entry into the Reserves.

- Options 2 and 3 protect LS/OGs 1 and 2 plus owl additions. However, under Option 3, LS/OG2s outside a zone of primary marbled murrelet use are treated as Managed Late-Successional Areas (see below).

- Options 6, 8, and 10 protect LS/OG1s plus owl additions and in the primary marbled murrelet zone, LS/OG2s. Total acres in Late-Successional Reserves under these options are less than under Options 1, 2, and 3.

Option 4, which starts with Late-Successional Reserves based on spotted owl protection, adds all LS/OG1s and in the primary marbled murrelet zone LS/OG2s.

Option 9 is an integration of the other approaches because it starts with the Reserves developed under other options, both species-based and old-growth based, and attempts to provide an integrated Reserve system based on the protection of Key Watersheds (see below) that serve multiple purposes.

Under all options except Option 7, LS/OG1s and LS/OG2s, are established as Late-Successional Reserves within a zone of primary use by marbled murrelets to provide for that species' nesting habitat needs until a required recovery plan, being prepared under the auspices of the Fish and Wildlife Service, is complete. Option 7, based on the current land management plans of the agencies, includes no special protection for marbled murrelets and as a result has a relatively low likelihood of providing for murrelets. All options but Options 7 and 8 provide for surveys for and the protection of sites occupied by marbled murrelets found outside Reserves.

All options contain some form of **Riparian Reserves.** Riparian Reserves are intended to address the habitat requirements for fish and other aquatic and riparian species. They also protect water quality, maintain appropriate water temperatures, and reduce siltation and other degradation of aquatic habitat that results from timber cutting on adjacent land. This degradation has been an especially serious product of past road building and cutting practices and is a contributing reason why some fish species are now at risk of extinction. Riparian Reserves also serve as "connectors" that may help species to move among Reserve areas.

Under different options, Riparian Reserves along rivers, streams, lakes, and reservoirs vary in width depending on the size of the body of water and the ecological importance of the **watershed** (literally the area that drains into a particular river or stream). Some options involve the designation of **Key Watersheds**, where riparian protection may be greater than in other locations. Options 1 and 4 provide the greatest amount of riparian protection. Options 7 and 8 provide the least. The rest are in the middle of the range of protection.

The options recognize three categories of water: (1) permanently flowing fish-bearing rivers, streams, lakes, and reservoirs; (2) permanently flowing nonfish-bearing streams, ponds, and wetlands larger than 1 acre; and (3) intermittent streams and wetlands smaller than 1 acre.

All options except Options 7 and 8 incorporate buffer widths that are a minimum of 300 feet on each side of the water for the first category of streams, and a minimum of 150 feet for permanently flowing streams of the second category. Option 7 uses buffers established by Forest Service and Bureau of Land Management plans, which are generally narrower. Option 8 uses 75-foot buffers for the second category.

In addition, all options except Option 7 prescribe minimum buffer widths for intermittent streams and for small wetlands:

- Options 1 and 4 use a buffer width of at least 100 feet for these areas.

- Options 2, 3, 5, 6, 9, and 10 use a 100-foot minimum width for intermittent streams in certain Key Watersheds and 50 foot minimum elsewhere. In Option 9 an effort was made to delineate the Late-Successional Reserves in Key Watersheds.

- Option 8 uses a 25-foot minimum for all intermittent streams and small wetlands.

- Option 7 is based on the plans of the Forest Service and Bureau of Land Management. Those plans do not generally prescribe a minimum buffer for intermittent steams; where they do, the buffer width is usually 25 feet.

Activities Within the Reserves

Late-Successional Reserves. Under Option 1, no timber harvest or salvage operations would be allowed in the Late-Successional Reserves. Under all other options (except Option 8 – see below), some thinning of younger stands would be allowed in the portion of the Reserve that does not currently meet the definition of late-successional forest. The objective of thinning in these options is to accelerate the development of late-successional forest conditions and provide timber volume. However, Option 9 also allows thinning that has a neutral effect on attainment of late-successional forest conditions. Some salvage would be allowed in Late-Successional Reserves in all options but Option 1. All silvicultural treatment and salvage must be approved by an interagency oversight team.

- Options 2, 3, 6, and 10: cutting in Reserves limited to thinning of stands no older than 50 years that have regenerated after timber harvest, and salvage of areas greater than 100 acres where trees have been killed by catastrophic events.

- Options 4, 5, and 7: thinning allowed in stands with tree sizes less than 11 inches diameter at breast height; salvage of areas larger than 10 acres where trees have been killed by catastrophic events.

- Option 8: thinning of stands up to 180 years old and unlimited salvage.

- Option 9: thinnings are allowed in any stand regardless of origin up to 80 years; salvage of areas larger than 10 acres where trees have been killed by catastrophic events.

Riparian Reserves. Initially, under all options but 7, no harvest would be allowed in Riparian Reserves, and agencies would be required to minimize the impact of roads, cattle grazing, and mining activities. Prescriptions under Option 7 are less restrictive. The options that prescribe buffers allow for the adjustment of buffer widths and may allow some timber cutting after completion of watershed assessments.

Activities Outside of Reserves (the Matrix)

Under all options, timber harvesting outside of Reserve areas (i.e., within the Matrix) will meet, at a minimum, the specifications in current plans of the Forest Service and the Bureau of Land Management. However, most of the options incorporate additional guidelines that would apply to timber harvests in the Matrix.

The 50-11-40 Rule. One such guideline, applicable under Options 1 through 7, is the 50-11-40 rule. This guideline was developed to provide habitat conditions to facilitate movement of juvenile and adult spotted owls across the landscape. The rule calls for 50 percent of the federal forested land within each quarter township to be in a forested condition with trees averaging at least 11 inches in diameter at breast height and with a canopy closure of at least 40 percent. "Canopy closure" refers to the degree to which the crowns of trees obscure the sky when viewed from below.

Options 8 through 10 do not apply the 50-11-40 rule. The rationale for not applying it under Options 9 and 10 is that the other features of the options (primarily the size of the Late-Successional Reserves, the connectivity provided by Riparian Reserves, and the requirements in some options for leaving a number of trees in cut areas) lessen the need for the rule. In addition, under Option 7, the rule is not applied on Bureau of Land Management lands.

Retention and rotation. The options call for varying degrees of retention of live or green trees following logging within the Matrix. Retention of green trees is important for the establishment of micro-habitats for various species, to provide connectivity, and to facilitate the future development of diverse landscapes. Some options also prescribe long timber harvest rotations.

- Options 1, 2, 6, and 10 require retention of at least six large green trees per acre that exceed the average stand diameter, two large snags per acre, and two large down logs per acre. In addition, Option 1 requires 180-year timber harvest rotations. It further requires that 10 percent of the trees in the Matrix be over 180 years old.

- Option 3 requires that 10 percent of harvested areas be retained in small well-distributed forest stands. On the remainder of the harvested areas, retention requirements are four large green trees per acre, retention of snags to support a percentage of the population of cavity nesting species, and retention of 12 logs per acre in the western region and 2-10 logs per acre in the eastern part of the range.

- Options 4, 5, 7, and 8 require only the retention of numbers of snags and logs as currently prescribed for each National Forest and Bureau of Land Management District. Generally, this means retention of less than two green trees per acre in National Forests in region 6 and six to nine per acre on lands administered by the Bureau of Land Management. Options 4 and 5 call for retention of additional snags in the eastern Cascades and Klamath Provinces based on Thomas et al. (1993).

    - The requirements for the Matrix under Option 9 vary by area:

        - For most National Forests in Washington, Oregon, and California, 15 percent of trees would be retained following harvest; half of that volume would be left in small intact patches of late-successional forest and the rest dispersed throughout the harvest unit.

        - For National Forests in the Oregon Coast Range, and the Olympic and Mt. Baker-Snoqualmie National Forests, retention requirements would be reduced because of the extent of Riparian Reserves and marbled murrelet protection in those areas.

- For Bureau of Land Management districts in Oregon, retention varies from 6 to 25 large green trees per acre depending on location, with 150-year rotations prescribed for some areas.

- For federal forests in northern California, long rotations are prescribed for conifer and mixed conifer/hardwood (180 years) and hardwood (100 years) forests.

Five options (1, 3, 4, 5, and 9) specifically require **protection of specified rare and locally endemic species** associated with late-successional forests within the Matrix. All options except 7 and 8 require surveys and protection of occupied marbled murrelet nesting sites. Other protective measures may be added to provide for at-risk species under each option.

Managed Late-Successional Areas

Under some options, there are areas that fall between Late-Successional Reserves and the Matrix in terms of permitted management activities. In these **Managed Late-Successional Areas**, cutting of trees can occur with less constraint than in Late-Successional Reserve Areas, but the primary objective remains the maintenance of late-successional forests on a landscape scale.

There are generally only small Managed Late-Successional Areas under Options 1, 2, and 9.

Under Options 4, 5, and 7, Managed Late-Successional Areas are **managed pair areas** (for spotted owls) where timber cutting is allowed as long as a specified amount of spotted owl nesting, roosting and foraging habitat is retained. A range of management techniques may be used to attain this goal and to reduce the risk of fire and insect infestation.

Option 3 involves the most extensive Managed Late-Successional Areas. These include LS/OG2 areas outside of marbled murrelet zone 1 and spotted owl additions in the eastern Cascades and California Cascades. Fifty percent of the area of each must be retained as late-successional forest with only special silviculture allowed. Within the portion of the spotted owl range west of the crest of the Cascades, timber harvests on the remaining 50 percent would be based on 250-year harvest rotations and contingent upon 40 percent of the forest stands being over 100 years old. Within the portion of the range east of the crest of the Cascades, the rotation would be between 100 and 350 years (depending on the species of tree), contingent upon 40 percent of the area being made up of stands greater than 80 years old. In the eastern portion, uneven-aged timber management could also be employed. Salvage would be allowed in part of the Managed Late-Successional Areas.

Adaptive Management Areas

Option 9 includes the concept of **Adaptive Management Areas**. Ten relatively large areas (84,000 to 400,000 acres) would be used for the development and testing of technical and social approaches to integration and achievement of desired ecological, economic, and other social objectives. The overarching objective is to improve knowledge of how to do ecosystem management, and in those areas, the agencies would be expected to pursue a variety of approaches to achieving the conservation objectives of Option 9. There would be more reliance on the experience and ingenuity of resource managers and communities, rather than traditional prescriptive approaches that are applied in many other areas. A full-scale monitoring program will be particularly important in these areas to assure adherence to

plans that will clearly spell out the goals (e.g., desired future conditions to be achieved through management).

-The concept of Adaptive Management Areas could be applied in any of the options presented. However, it only appears in connection with Option 9. If the concept is applied in other options it will be necessary to reconfigure arrangement on the landscape and reevaluate risk to species, particularly those listed as threatened.

Watershed Analysis

In planning for ecosystem management and establishing Riparian Reserves to protect and restore riparian and aquatic habitat, the overall watershed condition and the suite of processes operating there need to be considered. Watershed condition includes not only the state of the channel and riparian zone, but also the condition of the uplands, distribution and type of seral classes of vegetation, land use history, effects of previous natural and land-use related disturbances, and distribution and abundance of species and populations throughout the watershed. Watershed analysis is a systematic procedure for characterizing watershed and ecological processes to meet specific management and social objectives. This information then guides management prescriptions, including setting and refining boundaries of Riparian Reserves and other Reserves, sets restoration strategies and priorities, and reveals the most useful indicators for monitoring environmental changes. Watershed analysis is a stratum of ecosystem planning applied to watersheds of approximately 20-200 square miles. It provides a process for melding social expectations with the biophysical capabilities of specific landscapes. Watershed analysis is required in Key Watersheds before moving forward with all options except Option 7.

Silvicultural Manipulations Within Late-Successional Reserves

All of the options developed and presented in this report contain Reserves of late-successional forest. The treatment of Late-Successional Reserves varies between options in terms of size, location, arrangement, amount, and the management activities (primarily thinnings and salvage) allowed within such Reserves. All Late-Successional Reserves contain both stands of late-successional forest and stands of younger forest that are expected to achieve appropriate late-successional stand characteristics over time.

Thinning of Young Forest Stands Within Late-Successional Reserves

Some of the younger stands included within the Reserves have developed naturally following fires or blowdown or other stand-replacing disturbances while other such stands have been regenerated following cutting of the previous stand. Some of these stands, particularly those that had been cut, have been planted with seedlings with the intention that they be managed as plantations through intensive forestry to maximize wood production. The presence of these younger stands within Late-Successional Reserves raises the question of if and how they should be managed. Should these younger stands be silviculturally treated to accelerate their attainment of a condition that mimics late-successional forest conditions? Or should there be no silvicultural treatment of these younger stands under the assumption that such stands will evolve, given enough time, into the desired habitat conditions? It should be noted that no empirical evidence exists to support either conclusion as a blanket solution to the question of how to achieve desired future habitat conditions.

The Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl (Thomas et al. 1990) concluded that as no evidence existed that such treatment of younger stands would produce desired habitat conditions, it was best to leave those stands in unmanaged condition. That committee assumed that this prohibition against management within the designated reserves would continue until such time that clear empirical evidence existed to justify silvicultural treatment. The Interagency Scientific Committee's mission was to deal strictly with the management of the northern spotted owl. There was no consideration of the late-successional forest ecosystem per se.

After two additional years of consideration and intensified consultation with silviculturists and fire ecologists, a totally different team of scientists, technicians, attorneys, and political appointees was designated to prepare a recovery plan for the northern spotted owl (USDI 1992). That team concluded that some limited amount of silvicultural treatment of younger stands within "designated conservation areas" was warranted both to accelerate achievement of desired habitat conditions across the range of the northern spotted owl, to reduce fire danger in such reserves east of the Cascade crest and in the Klamath Province, and to provide some level of timber harvest compatible with those objectives. This group too was dealing strictly with the provision of a management strategy for the northern spotted owl and not with the late-successional forest ecosystem as such.

Biologists and foresters agree that, as a generality, thinning of forests stands, when appropriately prescribed and executed, produces larger trees at a rate significantly faster than would otherwise occur. However, there is more confidence that habitat attributes for the northern spotted owl could be produced through silviculture than that those treatments would likewise provide habitat for the myriad species (such as those listed by Thomas et al. 1993) associated with late-successional forest conditions. Conversely, some experts have reservations as to whether younger stands, particularly plantations of planted trees, would achieve desired habitat conditions in the future if left unmanaged.

Ecological attributes of the reserves designated for the northern spotted owl (Thomas et al. 1990 and USDI 1992c) vary across the range of the northern spotted owl (the area addressed in this report). The most marked difference is between the reserves west of the Cascade crest (which occur in more mesic circumstances) than those east of the cascade crest and in the Klamath Province (which exist in more xeric conditions and are much more prone to large-scale fire). Present conditions in the reserves east of the Cascade crest developed from many decades of selective logging (some would say "high grading") and determined efforts at fire exclusion. As a result, two fire-sensitive species (white-fir and/or grand fir) have come to be a major component of forest stands that make up these proposed reserves. A prolonged drought coupled with outbreaks of defoliating insects has caused extensive tree mortality in Douglas-fir and white fir. There has also been marked mortality in lodgepole and ponderosa pine due to mountain pine beetle outbreaks over the past decade. This extensive tree mortality has produced a build up of fuels (dead trees) in many of the proposed reserve areas that is unprecedented – at least within this century. Two recent reviews of the situation by respected biologists and ecologists (Everett et al. 1993; USDI 1992c) have concluded that management action inside Late-Successional Reserves in any areas east of the Cascade crest is advisable. This results from considering the risk of loss of significant portions of the proposed reserve system to fire versus the risk to the retention of the structure and function of such reserves from some level of silvicultural manipulation to reduce the risk from fire. The situation concerning the fire danger to late-successional forest reserves on the Eastern Cascades and the Klamath Provinces was extensively examined by Agee (1992) in the Final Draft Recovery Plan for the Northern Spotted Owl (USDI 1992c).

The debate over the advisability of silvicultural activities within late-successional forest reserves has philosophical attributes as well as technical ones. On one side of the debate there are those who, cognizant of past successes, believe that management can and will produce desired results. On the other side are those who, cognizant of past failures, are more cautious. They believe that proof should precede any silvicultural activities in reserves.

Closely related to differences in philosophical position is the matter of trust as to whether agencies will perform consistent with the selected management option. It is critical to separate matters of technical feasibility from matters of trust so that discussions are appropriately focused and appropriate solutions derived. The debate over whether to allow silvicultural treatment in late-successional forest reserves may revolve even more closely around the issue of trust than around technical feasibility. The focus of that distrust is that the desire to provide timber from the thinnings will override the overriding objective of the reserves – production and maintenance of late-successional forest conditions.

Fortunately, means at hand can be used to address some of the barriers to problem solutions created by this lack of trust. Foremost among those approaches are development or review of prescriptions for silvicultural treatment by appropriately composed multidisciplinary teams and the monitoring of both implementation of and response to management activities. The problem of lack of trust cannot be ignored and must be addressed head-on if any solution is to emerge. Too often the seemingly endless debate over technical points is, in reality, an issue of trust.

The options for management strategies present an array of approaches for the management of younger stands within Late-Successional Reserves. Younger stands subject to silvicultural treatment are defined differently among the options as less than 50, 80, and 180 years of age. Further, availability of younger stands for treatment is differentiated in some options between stands regenerated (often by planting) following logging and natural stands that evolved after fires or blowdown.

These varying prescriptions are described below.

In all the management options presented herein, save two, young stands older than a prescribed age (50 or 80 years) or a prescribed condition (11 inches or less diameter) are reserved from any manipulation. In other words, the late-successional stands within Late-Successional Reserves are not subject to thinning or harvest of any kind in eight options. The exceptions are Option 8, where stands up to 180 years could be thinned, and Option 7 where the Late-Successional Reserves on Bureau of Land Management lands could be subject to management in the future.

The various options include one of the four general prescriptions for treatment of younger stands in the Late-Successional Reserves.:

1. No silvicultural treatment of any kind.

2. Thinning of younger stands that were established after logging. There is no thinning of younger stands that resulted from naturally occurring events such as fire or blowdown.

3. Thinning of younger stands regardless of how those stands were established.

4. Within Managed Late-Successional Areas (as opposed to Late-Successional Reserves) a portion of the area (usually about 50 percent) is reserved from harvest

and the remainder is managed through 250-year or longer rotations or under uneven-aged management to maintain a portion (40-50 percent) in late-successional condition. In some cases, particularly on eastside forests, there is no cutting of large (more than 21 inches diameter at breast height) ponderosa pine or larch within Reserves.

There are advantages and disadvantages to each approach.

Prescription 1 - No thinning allowed.

Advantages - There is maximum protection against the risk that silvicultural techniques applied in other options will fail or be inappropriately applied. Options are retained for later application of such techniques once those techniques are demonstrated to achieve desired results. Watershed values are give the highest level of protection. There is no need to deal with issues evolving from lack of trust. If it is assumed that there would be reduced need to maintain or build roads in such an area, recreational activities to which roads would be a detriment would be enhanced, costs associated with road maintenance may be reduced, and human-related disturbance associated with roads would be lowered.

Disadvantages - There is no wood volume made available from within Reserves with the attendant economic and social opportunity costs. Management flexibility to deal with forest health problems and potential fire problems is absent or much reduced, leading to an increased risk of loss of significant portions of such Reserves to fire. Opportunities for achievement of desired late-successional forest conditions at a significantly accelerated rate is foregone. If it is assumed that there would be no need to maintain roads or construct new ones under the circumstances described, then there would be decreased access to such areas that would, in turn, impinge on harvest of other forest products, types of recreational use associated with vehicular access, and fire control activities.

Prescription 2 - Thinning in plantations only.

Advantages - It is assumed that naturally regenerated stands that are established from seed after naturally occurring stand-replacing events are more likely to achieve late-successional forest conditions over time than are stands that are established after logging. These natural stands, therefore, are not disturbed. However, thinning of stands that have become established after logging will provide jobs and timber. It is assumed stands so treated will achieve at least some attributes of late-successional forests more rapidly than would otherwise occur. Roads associated with such activities will provide access for harvest of other forest products, enhance recreational activities that are dependent on road access, and facilitate management activities including fire suppression. Management flexibility to deal with problems caused by disease, insects, and fuels buildup is increased.

Disadvantages - Prescribed thinnings may fail to produce the anticipated results and foreclose the alternate course of action to achieve late-successional forest conditions –letting young stands grow, age, and mature without human intervention. Thinning opportunities in natural stands is foregone. If there is no difference between treated and untreated stands in meeting late-successional forest conditions, the jobs and wood production associated with thinning of natural stands are lost. Further, the opportunity for those stands to achieve desired conditions at a earlier time is likewise foregone. Economic feasibility of such thinning may be problematic. Thinning may reduce natural stand mortality leading to a shortage of dead trees in such stands to support cavity nesters and species requiring dead wood on the forest floor. Safety regulations may require felling of standing dead trees during thinning operations, exacerbating this problem. Roads and soil disturbance

associated with such thinning activities may cause adverse watershed effects, introduce additional human disturbance, and adversely affect some types of recreational use.

Prescription 3 - Thinning permitted in all younger stands.

Advantages - All younger stands are candidates for thinning. More wood volume is therefore available with attendant associated benefits in jobs and economic activity than would occur under prescriptions 1 or 2. If successful, more habitat in late-successional structural condition would be more quickly provided. Economic feasibility of thinning activities would likely be enhanced due to economies of scale – particularly as related to establishment and maintenance of access roads. These roads will provide the same advantages as described for prescription 2. Management flexibility to deal with problems caused by insects, disease, and fuels buildup is enhanced.

Disadvantages - If it is demonstrated that naturally regenerated stands will provide for a wider array of species of plants and animals and ecological functions once they reach late-successional state as compared to stands that are thinned, there would be a loss in the ability of the Reserves to achieve the objectives for which they were intended. There will be problems with trust of the agencies to carry out the prescription. Economic feasibility of such activities is problematic. There may be a paucity of standing and down dead trees with the consequences described under prescription 2 above. Disadvantages related to the associated road system are as described for prescription 2.

Prescription 4 - Managed Late-Successional Reserves.

Advantages - Extensive flexibility is provided to deal with the situation that exists in the late-successional forest reserves on the eastside and in the Klamath Province that was described earlier. The thinning and salvage in the 50 percent of the area designated for preservation will improve the chances of retaining desired conditions over time by reductions of fire danger and, perhaps, by protecting the stands from insect damage. These activities will provide jobs and some wood to wood processors. The 50 percent of the Reserve that will be managed provides additional capability to produce wood and deal with forest health problems. Timber volume produced as a byproduct of such management to sustain late-successional forest conditions would provide economic benefits as well as jobs. The advantages to the associated road system are as described under prescription 2.

Disadvantages - It is not certain that such management activities will result, over the long term, in the retention of late-successional forest conditions suitable for the northern spotted owl and other species associated with late-successional forest conditions in eastside and Klamath Province forests. Distrust of agency motives can be expected to be high. There may be problems with retention of standing and down dead trees as described under prescription 2 above. The economic practicality of such a management strategy is problematic. The disadvantages of the associated road system are as described under prescription 2.

Salvage Within Late-Successional Reserves

The questions of whether salvage should be allowed inside late-successional forest reserves is contentious. The standards and guidelines developed in the Interagency Scientific Committee report (Thomas et al. 1990) allowed for salvage in habitat conservation areas set aside for northern spotted owls, provided that a review by an interagency team (Forest Service, Bureau of Land Management, and Fish and Wildlife Service) composed of foresters and wildlife biologists determined that such salvage was beneficial to maintaining habitat

conditions, over time, for the owl. Experience with these review procedures revealed that most situations reviewed do not meet that criterion. Conversely, the interagency team did not think, at least in some cases, that such salvage would be detrimental to achieving maintenance of habitat conditions for the northern spotted owl over the long term.

The question about whether or not to salvage in late-successional forest reserves is complicated by three factors. First, the value of the mature and old-growth timber involved is relatively great. Second, many of the public concerned about the ecological and other value of the late-successional forest are deeply distrustful of the motives of the land management agencies and logging operators when such salvage is contemplated. Third, there are no definitive data nor universal agreement among natural resource management professionals as to the effect of such salvage or the conditions that will impinge on stand development over the long term.

For those management strategy options that contain Late-Successional Reserves, two approaches to the salvage question are taken. These approaches and their comparative advantages and disadvantages are described below. Where salvage is allowed, it can occur only after an evaluation by an interagency interdisciplinary team that will evaluate whether the proposed salvage is neutral or beneficial to achievement of the purposes of the Reserve in both the short and long term. If the proposed salvage does not meet those criteria, the salvage will not take place. The exception is Option 8 where salvage can occur with only minimal guidelines outside of zone 1 for marbled murrelets. Salvage is limited to circumstances where there are patches of dead trees resulting from fire or blowdown or some other factor.

Prescription 1 - No salvage allowed in Late-Successional Reserves.

Advantages - Risk of disturbance to the Reserve (Late-Successional and Watershed) is minimized both from the salvage activity and the construction of roads and landings. The trust issue is negated. All standing dead trees are retained for cavity nesting wildlife as are logs that contribute to ecosystem function and provide habitat for associated wildlife species. This avoids making evaluations concerning the pros and cons of individual salvage opportunities and contentious decisions concerning if and how to salvage.

Disadvantages - The salvage of increasingly rare and increasingly valuable old growth or other large trees is foregone with the jobs and social and economic benefits that would result from such salvage. Unsalvaged areas may be particularly prone to hot fires. There may be risks to adjacent stands from fire or insects and disease that originate in patches of dead trees. There may be severe public criticism concerning the economic opportunities foregone.

Prescription 2 - Limited salvage is allowed in Late-Successional Reserves.

Advantages - Valuable trees that are dead can be used for commercial purposes with the attendant employment and economic benefits. These logs cannot be exported and so must be processed within the region. Increased fire danger or risk to insect and disease resulting from large accumulations of dead trees can be reduced in an economically feasible fashion. Avoided are the perceptions of economic waste if patches of dead trees are not salvaged.

Disadvantages - There is potential risk to watersheds from roads and soil disturbance associated with salvage operations. If hypotheses about effects of management prove incorrect, salvaged areas may be adversely affected in terms of their short and long-term contributions to the achievement of Late-Successional Reserves. Certain segments of the public will be distrustful of agency motives whenever salvage is allowed inside a Reserve,

particularly when such salvage occurs in portions of the Reserve that contain (or contained) trees considered to be true "old growth" or "ancient forest."

Prescription 3 - Salvage with minimal guidelines is allowed in Late-Successional Reserves.

Advantages - The advantages are the same as under prescription 2, except that more wood volume could be utilized with greater economic benefit. Opportunities to control fire, insect, and disease risk would also be greater.

Disadvantages - The short- and long-term contributions of salvaged areas to Late-Successional Reserves would be decreased. There would be greater risks to watersheds than in prescription 2. There would be high levels of distrust of agency motives.

Discussion

No empirical evidence or unanimity of expert opinion exists on the question of whether silvicultural treatment of younger forest stands or salvage of dead trees will achieve the objective of the Reserves – production and maintenance of late-successional forest conditions. The advantages and disadvantages and the inherent uncertainties in biological/ecological responses and interactions must be considered. Ultimately, however, the decision must be made in a circumstance of uncertainty.

Ecological Assessment - Terrestrial Ecosystems

Forest Conditions Within Options

The range of the northern spotted owl encompasses about 57 million acres (including both forested and nonforested) within Washington, Oregon, and northern California (table 1). Of this total, 24.3 million acres (42 percent) are federally administered (fig. 1), of which 3.6 million acres are nonforested (table 2). Of the 7.0 million total acres of federal land within Congressionally Withdrawn Areas (e.g., National Parks, Wilderness), 5.7 million acres are forested (table 2).

Forest stands with trees averaging greater than 9 inches in diameter cover about 14.3 million acres of the 20.7 million acres federally administered forested lands within the range of the northern spotted owl (table 3). Late-successional forests – stands in mature (80+ years) and old-growth seral stages – compose a large percentage of this total. Seral stage inventory and classification differ among the federal land managing agencies. To achieve a common denominator that captured the full array of stands with late-successional forest characteristics, we adopted a three-category classification based on satellite imagery:

1. The youngest seral category includes stands of trees generally less than 21 inches in diameter, ranging down to 9 inches. A minority of the stands in this seral category have scattered large overstory trees that provide old-forest characteristics. From a functional view, this seral category provides suitable dispersal and some foraging habitat for northern spotted owls. We termed this category **small single-storied conifer.**

2. Stands with trees generally greater than 21 inches in diameter, including some trees greater than 32 inches in diameter, usually with only a single canopy layer, we

termed **medium/large single-storied conifer.** These stands qualify as late-successional forest.

3. Stands with trees greater than 21 inches in diameter and with two or more canopy layers we termed **medium /large multistoried conifer**. This category is generally similar to old-growth forest as defined by the Forest Service. Such stands cover about 4.5 million acres of which 2.2 million acres occur outside of Congressionally and Administratively Withdrawn Areas and are subject to harvest under current land management plans (fig. 2).

Collectively these three categories capture the extent of late-successional forest. However, most small, single-storied stands would not be considered late successional; for the remainder of this section we discuss only the latter two categories.

All options contain the same amount of Congressionally Withdrawn Areas (7.0 million total acres). The total for Administratively Withdrawn Areas is currently 4.1 million acres. There is considerable overlap between existing Administrative Withdrawals and the Late-Successional Reserves developed under the options. As a result, there are two ways to compute the acreage involved in Late-Successional Reserves. The first is to consider Late-Successional Reserves as an addition to existing Administrative Reserves. This approach focuses on the cumulative impact of the reserves (in addition to land that has already been withdrawn Congressionally or Administratively from the timber base). In that case, the total area of such Late-Successional Reserves varies between 8.5 million acres in Option 1 to 4.2 million acres in Option 7. Other options have intermediate amounts, as shown in figure 3a.

The other way to calculate acreage of Late-Successional Reserves is to consider them as superseding the existing Administrative Reserves and including as Late-Successional Reserves the acreage that overlaps the two categories. In that case, the total area of Late-Successional Reserves varies from 11.5 million acres in Option 1 to 5.9 million acres in Option 7 (fig. 3b); other options have intermediate fnord amounts. It should be recognized that the fate of Administrative Reserves outside of Late-Successional and Riparian Reserves will be determined in the phase II planning effort – i.e., the continued status as Administrative Reserves is not certain.

Conversely, Matrix lands are greatest in Option 7 (8.5 million acres) and lowest in Option 1 (2.8 million acres). The extent of Riparian Reserves (calculated to include only those lands outside of Late-Successional Reserves) is subject to change over time under any of the options based on results of watershed analysis. Under interim estimates, the total area within Riparian Reserves varies from 2.9 million total acres (forested and unforested) under Option 4 to 1.5 million total acres (forested and unforested) under Option 8 (fig. 3a).

The area of current late-successional and old-growth forest (medium/large single-storied and multistoried conifer) that is contained within Late-Successional Reserves and Riparian Reserves, and outside of Congressionally or Administratively Withdrawn Areas totals from 6.1 million acres under Option 1 to 2.8 million acres under Option 7 (fig. 4). It should be remembered that these Reserves contain a mix of late-successional and younger forests. Totals vary considerably among physiographic provinces (table 3, fig. 5). Conversely, the percentage of the total current late-successional and old-growth forest acres that is in the Matrix and available for harvest (subject to the standards and guidelines of each option) is nil in Option 1 and varies from 13 percent in Option 3 to 30 percent in Option 7 (fig. 6).

Table 1. Estimated total acres within the range of the northern spotted owl by ownership and physiographic province.

State/ Physiographic province	Acres by Ownership				
	US. Forest Service	Bureau of Land Management *	National Park Service	Other federal	Non-federal
Washington					
Eastern Cascades	3,329,000	0	137,200	6,000	2,210,000
Western Cascades	2,957,000	0	760,200	4,400	2,428,300
Western Lowlands	0	0	1,700	124,700	6,343,300
Olympic Peninsula	628,000	0	889,400	1,500	1,512,200
Total:	**6,914,000**	**0**	**1,788,500**	**136,600**	**12,494,900**
Oregon					
Klamath	1,284,800	821,200	200	0	1,894,200
Eastern Cascades	1,431,800	48,400	77,200	100	767,500
Western Cascades	3,724,600	666,300	86,800	500	2,161,700
Coast Range	618,600	776,300	100	1,700	4,374,400
Willamette Valley	0	16,800	0	8,700	2,632,600
Total:	**7,059,800**	**2,329,000**	**164,300**	**11,000**	**11,830,400**
California					
Coast Range	70,100	219,900	77,500	20,600	5,302,300
Klamath	4,358,200	101,600	0	0	1,621,100
Cascades	998,500	10,400	0	0	1,493,300
Total:	**5,426,800**	**331,900**	**77,500**	**20,600**	**8,416,700**
Three-State Total:	**19,400,600**	**2,660,900**	**2,030,300**	**168,200**	**32,742,000**

* No acres are tallied for Bureau of Land Management in Washington due to the dispersed nature of the ownership.

Table 2. Estimated total acres and federal forest areas in Congressionally Withdrawn Areas and Administratively Withdrawn Areas in the range of the northern spotted owl, by state and by physiographic province.

State/ Physiographic province	Federal land acres			Federal forest acres *		
	Total	Congressional Withdrawn Areas	Administratively Withdrawn Areas	Total	Congressional Withdrawn Areas	Administratively Withdrawn Areas
Washington						
Eastern Cascades	3,472,400	1,473,800	586,100	2,498,100	986,800	409,400
Western Cascades	3,721,700	1,749,400	630,300	3,083,200	1,377,900	531,500
Western Lowlands	126,300	1,700	0	1,700	1,700	0
Olympic Peninsula	1,518,800	976,700	45,400	1,440,200	960,100	43,200
Total:	**8,839,200**	**4,201,600**	**1,261,800**	**7,023,200**	**3,326,500**	**984,100**
Oregon						
Klamath	2,106,200	259,100	333,500	1,939,300	223,300	300,500
Eastern Cascades	1,557,400	425,200	320,400	1,444,500	379,300	288,200
Western Cascades	4,478,200	721,800	545,300	4,219,200	661,100	516,200
Coast Range	1,396,800	22,100	73,600	1,331,500	22,100	47,100
Willamette Valley	25,600	0	200	16,000	0	200
Total:	**9,564,200**	**1,428,200**	**1,273,000**	**8,950,500**	**1,285,800**	**1,152,200**
California						
Coast Range	388,200	94,700	96,500	198,500	90,200	45,400
Klamath	4,459,900	1,214,300	1,203,100	3,553,600	955,800	957,700
Cascades	1,009,200	44,300	211,000	732,200	18,200	144,600
Total:	**5,857,300**	**1,353,300**	**1,510,600**	**4,484,300**	**1,064,200**	**1,147,700**
Three-State Total:	**24,260,700**	**6,983,100**	**4,045,400**	**2-,458,000**	**5,676,500**	**3,284,000**

* Acre values for Forest Service, Bureau of Land Management, and National Park Service administered lands only.

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

State/ Physiographic province	Total			Portion in Congressionally Withdrawn Area			Portion in Administratively Withdrawn Area		
	Small conifer single story *	Medium/large conifer **		Small conifer single story *	Medium/large conifer **		Small conifer single story *	Medium/large conifer **	
		Single story	Multi-story		Single story	Multi-story		Single story	Multi-story
Washington									
Eastern Cascades	830,100	515,500	432,200	286,000	183,700	217,700	164,400	74,600	68,600
Western Cascades	1,009,000	676,000	515,700	373,000	309,600	209,000	175,500	112,800	143,900
Western Lowlands	0	0	0	0	0	0	0	0	0
Olympic Peninsula	485,800	47,400	446,700	274,300	23,000	327,700	17,800	3,000	16,600
Total:	**2,324,900**	**1,238,900**	**1,394,600**	**933,300**	**754,400**	**754,400**	**357,700**	**190,400**	**229,100**
Oregon									
Klamath	596,200	207,500	489,500	98,100	19,400	50,900	104,400	30,500	75,700
Eastern Cascades	968,500	207,000	81,100	250,700	68,400	22,200	203,100	49,100	16,900
Western Cascades	1,165,100	997,900	921,200	279,400	231,900	102,200	189,900	125,200	122,600
Coast Range	526,100	209,300	140,500	18,900	2,600	400	19,400	9,700	10,900
Willamette Valley	4,300	1,300	800	0	0	0	0	0	100
Total:	**3,260,600**	**1,623,000**	**1633,100**	**647,100**	**322,300**	**175,700**	**516,800**	**214,500**	**226,200**
California									
Coast Range	4,700	25,800	9,800	300	2,700	2,200	2,100	9,600	3,800
Klamath	140,300	963,200	1,303,900	37,100	304,500	368,000	28,800	214,500	462,600
Cascades	38,500	181,500	157,100	1,800	4,700	0	1,400	40,100	34,400
Total:	**183,500**	**1,170,500**	**1,470,800**	**39,200**	**311,900**	**370,200**	**32,300**	**264,200**	**500,800**
Three-State Total:	**5,769,000**	**4,032,400**	**4,498,500**	**1,619,600**	**1,150,500**	**1,300,300**	**906,800**	**669,100**	**956,100**

* Stands generally characterized by trees 9.0 - 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 in diameter at breast height (dbh) or larger.

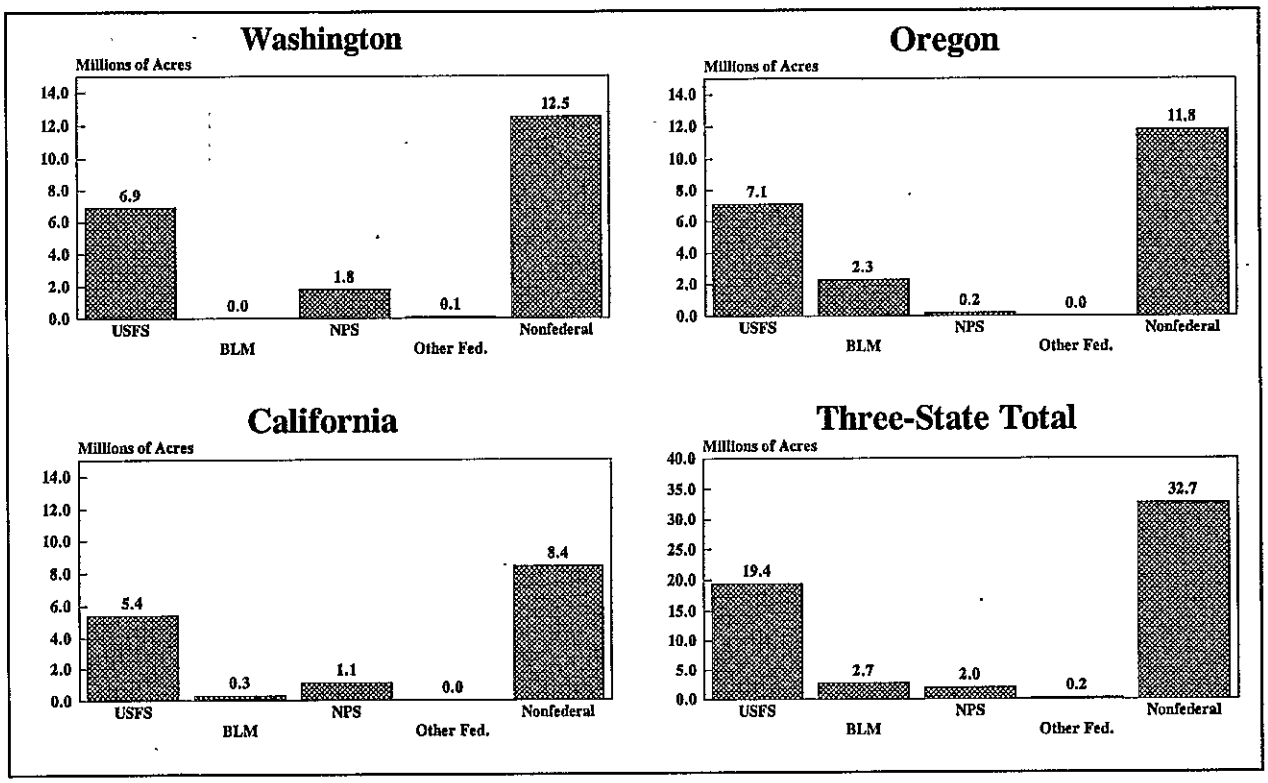


Figure 1. Gross area of lands administered by different agencies within the range of the northern spotted owl, by state.

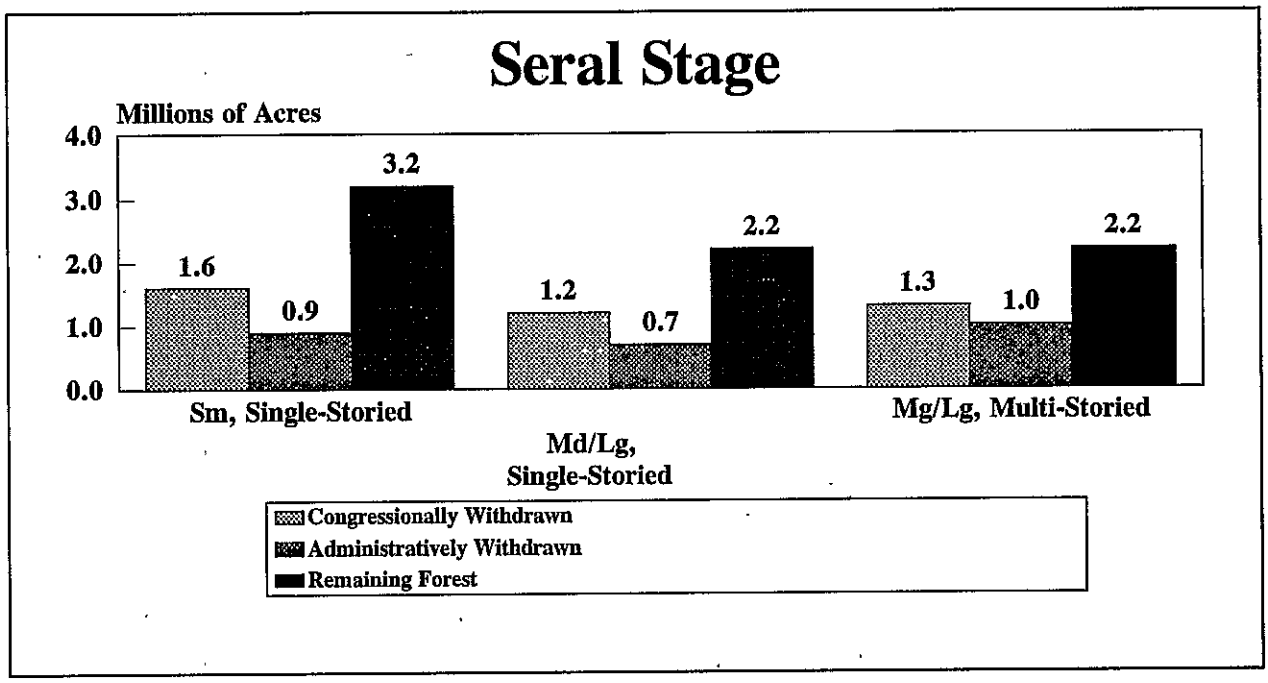
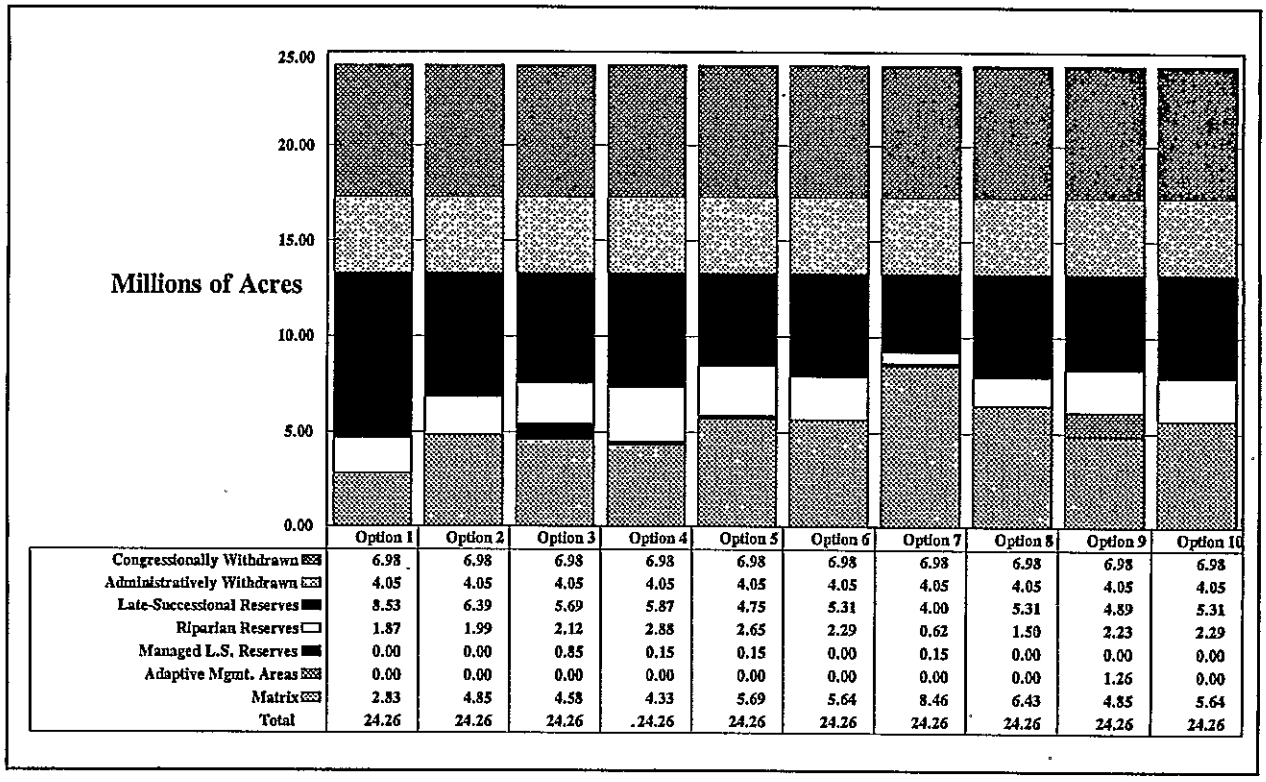
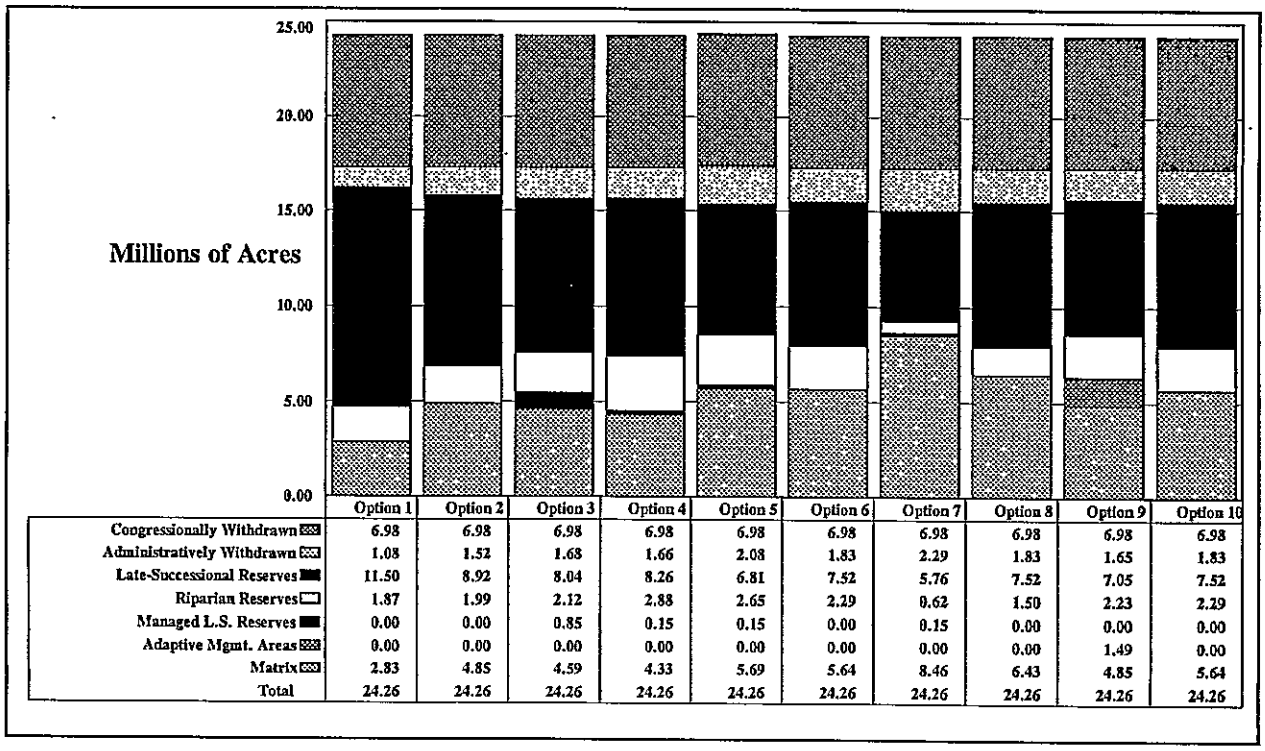


Figure 2. Current acreage of late-successional forest seral stages under different land allocations. See text for description of each seral-stage category.



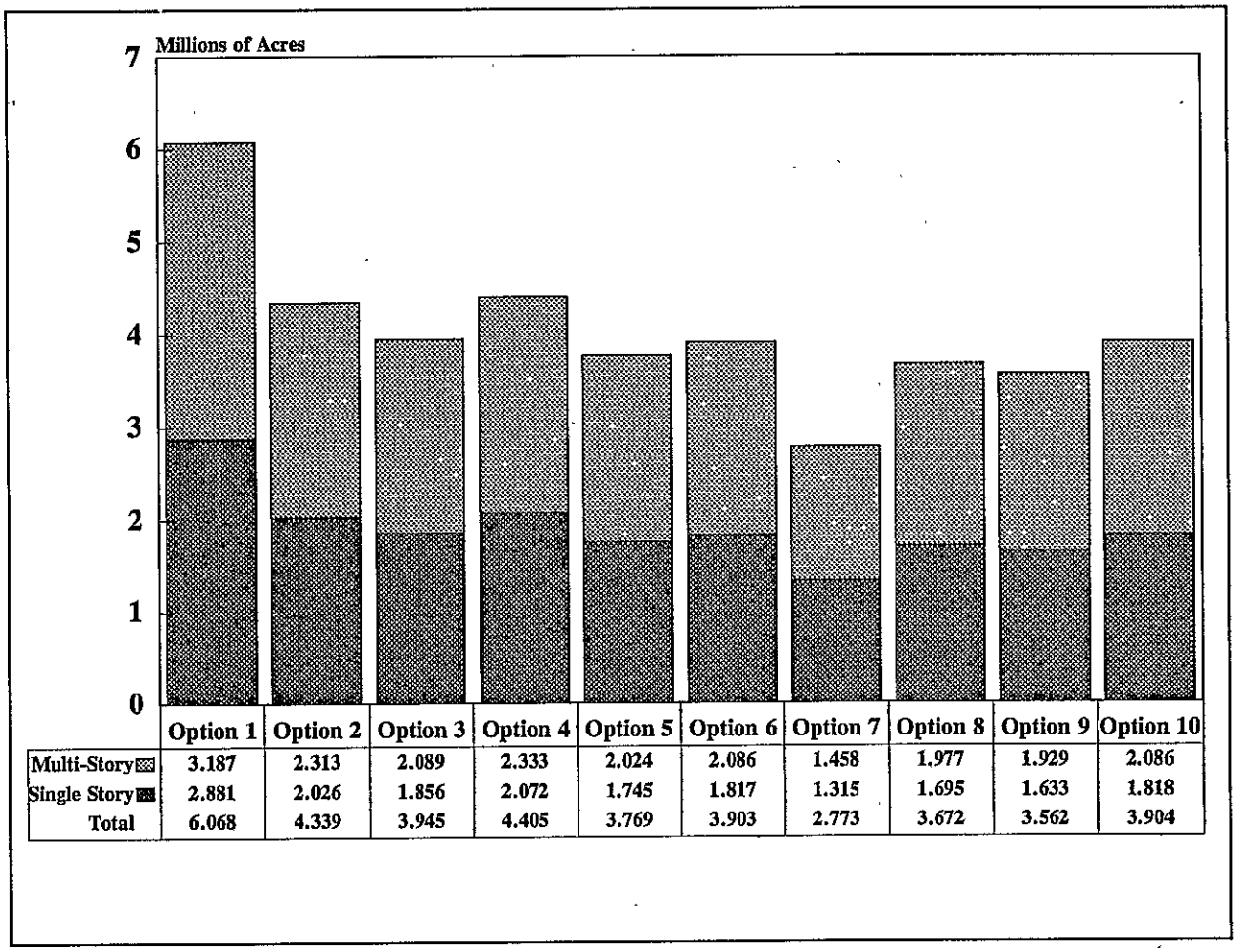
	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9	Option 10
Congressionally Withdrawn	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98
Administratively Withdrawn	4.05	4.05	4.05	4.05	4.05	4.05	4.05	4.05	4.05	4.05
Late-Successional Reserves	8.53	6.39	5.69	5.87	4.75	5.31	4.00	5.31	4.89	5.31
Riparian Reserves	1.87	1.99	2.12	2.88	2.65	2.29	0.62	1.50	2.23	2.29
Managed L.S. Reserves	0.00	0.00	0.85	0.15	0.15	0.00	0.15	0.00	0.00	0.00
Adaptive Mgmt. Areas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.26	0.00
Matrix	2.83	4.85	4.58	4.33	5.69	5.64	8.46	6.43	4.85	5.64
Total	24.26	24.26	24.26	24.26	24.26	24.26	24.26	24.26	24.26	24.26

Figure 3a. Allocation of federal lands by option. Administratively Withdrawn acres calculated before Late-Successional Reserves.



	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9	Option 10
Congressionally Withdrawn	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98
Administratively Withdrawn	1.08	1.52	1.68	1.66	2.08	1.83	2.29	1.83	1.65	1.83
Late-Successional Reserves	11.50	8.92	8.04	8.26	6.81	7.52	5.76	7.52	7.05	7.52
Riparian Reserves	1.87	1.99	2.12	2.88	2.65	2.29	0.62	1.50	2.23	2.29
Managed L.S. Reserves	0.00	0.00	0.85	0.15	0.15	0.00	0.15	0.00	0.00	0.00
Adaptive Mgmt. Areas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.49	0.00
Matrix	2.83	4.85	4.59	4.33	5.69	5.64	8.46	6.43	4.85	5.64
Total	24.26	24.26	24.26	24.26	24.26	24.26	24.26	24.26	24.26	24.26

Figure 3b. Allocation of federal lands by option. Administratively Withdrawn acres calculated after Late-Successional Reserves.



	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9	Option 10
Multi-Story	3.187	2.313	2.089	2.333	2.024	2.086	1.458	1.977	1.929	2.086
Single Story	2.881	2.026	1.856	2.072	1.745	1.817	1.315	1.695	1.633	1.818
Total	6.068	4.339	3.945	4.405	3.769	3.903	2.773	3.672	3.562	3.904

Figure 4. Amount of medium and large (>21 inches dbh) single-storied or multi-storied conifer stands located in Late-Successional or Riparian Reserves outside of Congressionally or Administratively Withdrawn Areas. Collectively these two categories comprise the bulk of the late-successional and old-growth forest stands.

Biological Assessment

For the ten options we evaluated the likelihood of maintaining sufficient habitat, well distributed on federal lands to provide for the continued existence of viable populations of northern spotted owls and marbled murrelets. For seven of the ten options we performed similar assessments for over 1000 plant and animal species closely associated with old-growth forests. The geographic bounds were the range of the northern spotted owl; the time frame was 100 years. We likewise assessed the likelihood of maintaining a functional, interacting late-successional and old-growth forest ecosystem on federal lands.

A series of panels of experts provided the primary information for these assessments. Leading experts, well-versed on the ecology of respective groups of organisms, were recruited from state and federal agencies, universities, and research organizations. The

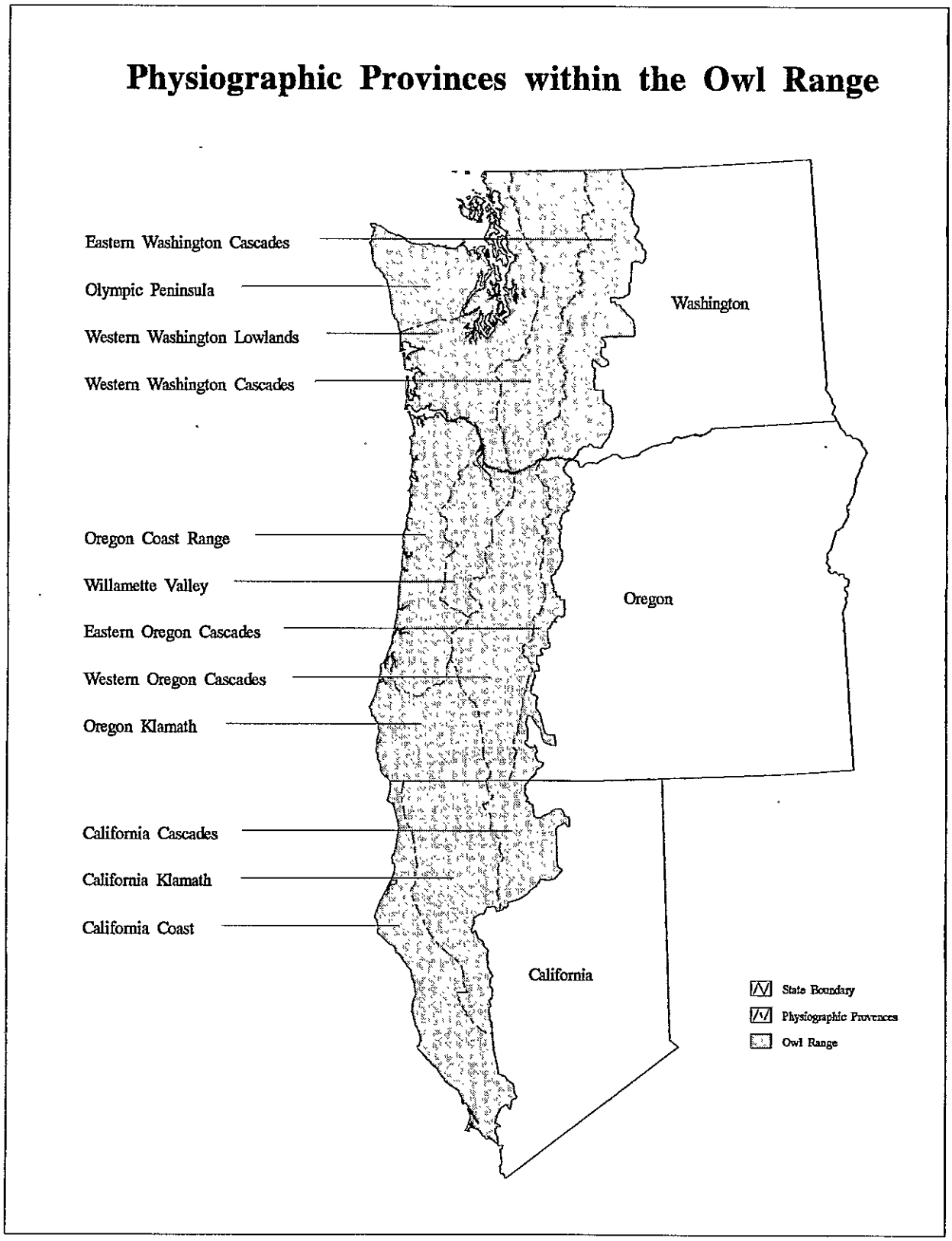


Figure 5. Physiographic provinces within the range of the northern spotted owl. Provinces as depicted in the Final Draft Recovery Plan for the Northern Spotted Owl (USDI 1992c).

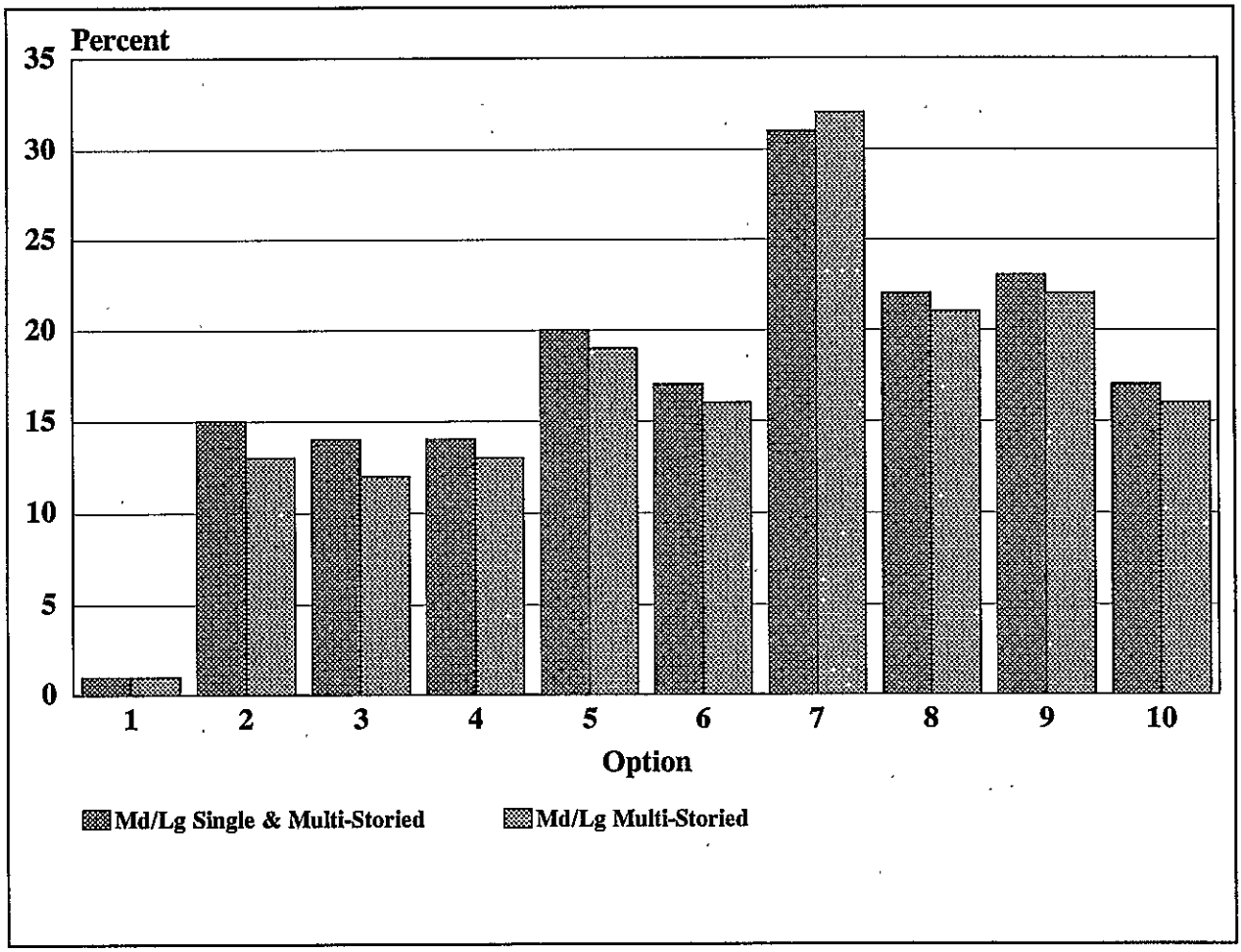


Figure 6. Percent of the total late-successional and old-growth forest (medium/large single and multi-storied conifer – 8.5 million acres) and old growth only (medium/large multi-storied conifer – 4.5 million acres) acres which are in the Matrix and are available for harvest subject to the standards and guidelines of each option.

panel process was designed to elicit the expert opinion and professional judgment of the panelists. We used the advice from the panel, other information, and our own expertise to make the final assessment of habitat sufficiency for species or groups of species under each option. Each panel was asked to determine the likelihood of achieving four possible outcomes as it related to habitat conditions on federal lands for each species presented to them for evaluation: Outcome A - Viable populations well-distributed; Outcome B -Viable populations with gaps in distribution; Outcome C - Populations relegated to refugia; and Outcome D - Extirpation(s) likely. We compared outcomes of options by assessing whether a species (or group) attained an 80 percent or greater likelihood of achieving outcome A: Habitat is of sufficient quality, distribution, and abundance to allow the species population to stabilize, well distributed across federal lands (see table IV-7 in the complete report for additional description). This basis of comparison represents a relatively secure level of habitat and thus provides a stringent criterion for comparison. The same process was used to assess the likelihood of maintaining a functional, interacting late-successional and old-growth forest ecosystem.

In focusing on the attainment of 80 percent likelihood of achieving outcome A, we 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.

We conducted 14 separate assessment panels for the status of species associated with late-successional forests during late April and again in June 1993. Evaluations were conducted for 82 species of vertebrates and 21 groups of fish, 102 species of mollusks, 124 vascular plant species, 157 species of lichens, 527 species of fungi, and 106 species of bryophytes. In addition, 15 functional groups of arthropods that may include 10,000 species were evaluated. More than 70 experts served on the panels. The assessments for terrestrial life forms are discussed below. Assessments for fish are discussed in the subsequent section on aquatic ecosystems.

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.

The spectrum of options provides an array of protection for late-successional and old-growth forests and associated organisms. We predicted that increased levels of protection of old forests provided by larger reserve systems should foster increased likelihood of successful persistence of organisms associated with late-successional and old-growth forest. That was in fact the case (fig. 7). Both numbers of species as well as individuals within a species respond favorably to increased protection of late-successional forest. If a species did not fare well under a particular option its response generally improved under a more conservative option.

However, we identified species and situations where particular organisms or groups did not respond to the level of habitat protection provided. Other species did not fare well under any option. Such species may simply be so rare, so sparsely distributed, that even under the most conservative options we cannot be assured of the continued persistence of sufficient habitat given the vagaries of natural processes, especially given human intervention. Some species occur within extremely limited geographic ranges or occur in relatively isolated pockets in association with specific microhabitats (e.g., seeps or springs, rock outcrops). For these species, mitigation measures to protect specific habitats on federal lands must be implemented to ensure viability. Without such mitigation measures in place, none of the options may provide habitat sufficient to assure viability of an assortment of species or groups.

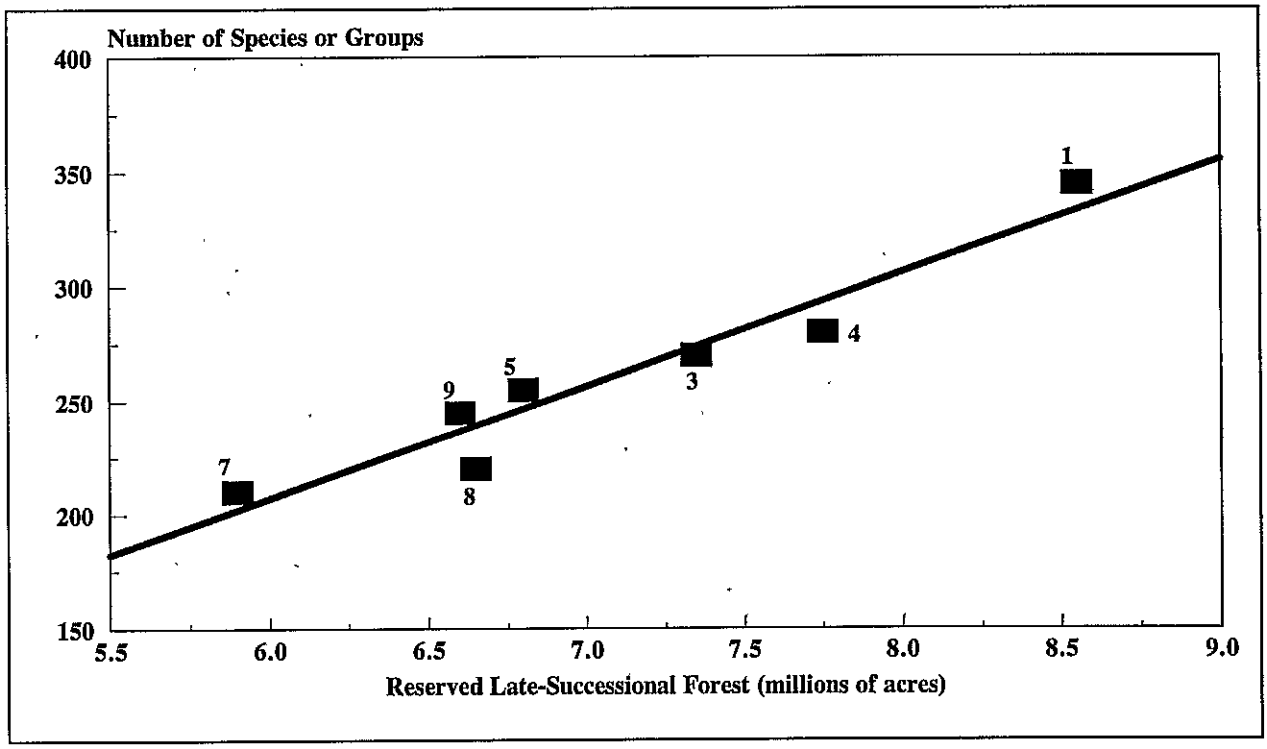


Figure 7. Numbers of species or groups of species which were rated as having a greater than 60 percent likelihood of having habitat sufficient to maintain populations well distributed on federal lands within the range of the northern spotted owl versus acreage of reserved late-successional forest in Options 1, 3, 4, 5, 7, 8, and 9.

Our analysis of the options was limited to assessing the sufficiency of habitat on federal lands to provide for the persistence of the species. We did not assess population viability per se. We noted, however, that some species are influenced so strongly by habitat on nonfederal lands or other conditions (i.e., air pollution) that their continued persistence is in question regardless of federal land management. In many of the above situations the fate of the species is not principally a function of the management of federal forest lands and must be addressed via other venues.

Viability of Life Forms

Listed Species

Eight federally listed threatened or endangered species are found in the area considered by this assessment (forests within the range of the northern spotted owl). In addition to the marbled murrelet and the northern spotted owl (addressed below), the six listed species include the gray wolf, grizzly bear, peregrine falcon, bald eagle, Sacramento River winter chinook salmon, and an endangered plant, MacDonald's rock cress. Recovery plans exist for four of the six (all but the wolf and grizzly bear); all options considered in this assessment incorporate appropriate measures from the respective recovery plans. Recovery plans for both the grizzly bear and gray wolf in the Cascade Mountains of Washington are currently under development; neither species is closely associated with late-successional and old-growth forests, and the options considered should not conflict with recovery actions.

Thus, for six of the eight federally listed threatened or endangered species, the 10 options for federal forest management either incorporate or should not conflict with proposed recovery measures, although this was not evaluated.

Both the northern spotted owl and the marbled murrelet are closely associated with late-successional and old-growth forests and are responsive to changes in management of federal forests within their range. The options evaluated were crafted to incorporate conservation measures providing a spectrum of protection levels for these two species.

Northern spotted owl. In comparison to other species, the northern spotted owl has been intensively studied and there is much information available that is pertinent to developing a conservation strategy. The elements of a conservation strategy appropriate for the northern spotted owl were proposed by the Interagency Scientific Committee (Thomas et al. 1990); the strategy was confirmed and refined during the preparation of the Final Draft Recovery Plan for the Northern Spotted Owl (USDI 1992). That conservation strategy employs a network of reasonably large (generally 30,000 to 100,000 acres) and closely spaced (six to twelve miles) Late-Successional Reserves set in a Matrix of forest adequate to provide for dispersal of owls among reserves. The Forest Ecosystem Management Assessment Team accepted the refined conservation strategy as presented in the Final Draft Recovery Plan as the appropriate basis for spotted owl management. The elements of the Recovery Plan are incorporated in most of the options considered; thus most options provided greater than 80 percent likelihood of providing habitat sufficient to maintain well distributed, viable populations of northern spotted owls on federal lands for 100 years (fig. 8).

All options except Option 7 incorporate the Scientific Analysis Team (Thomas et al. 1993) approach to late-successional and riparian forest management (which enhances both the connectivity between reserve areas and increases the acreage of late-successional and old-growth forest available to northern spotted owls). Some options include additional large blocks of late-successional and old-growth habitat, beyond that called for in the Recovery Plan; these options (1, 2, 3, 4, and 5) provide additional confidence that viability of spotted owls will be assured, especially in the long term. Options 7, 8, and 10 provide conservation measures for spotted owls significantly less than those specified in the Recovery Plan (fig. 8a).

Option 9 incorporates a reserve design different from that specified in the Recovery Plan but tailored to meet owl population objectives; it also substitutes Riparian Reserves and 15 percent green tree retention in the Matrix for the dispersal habitat provisions of the Recovery Plan. The managed pair areas (which occurred primarily in the marbled murrelet range) were dropped. The rationale was that enhanced retention of marbled murrelet habitat would meet or exceed this requirement. In all options, 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. These contributions can be negotiated by the Fish and Wildlife Service under the Habitat Conservation Plans or "4d" rules of the Endangered Species Act.

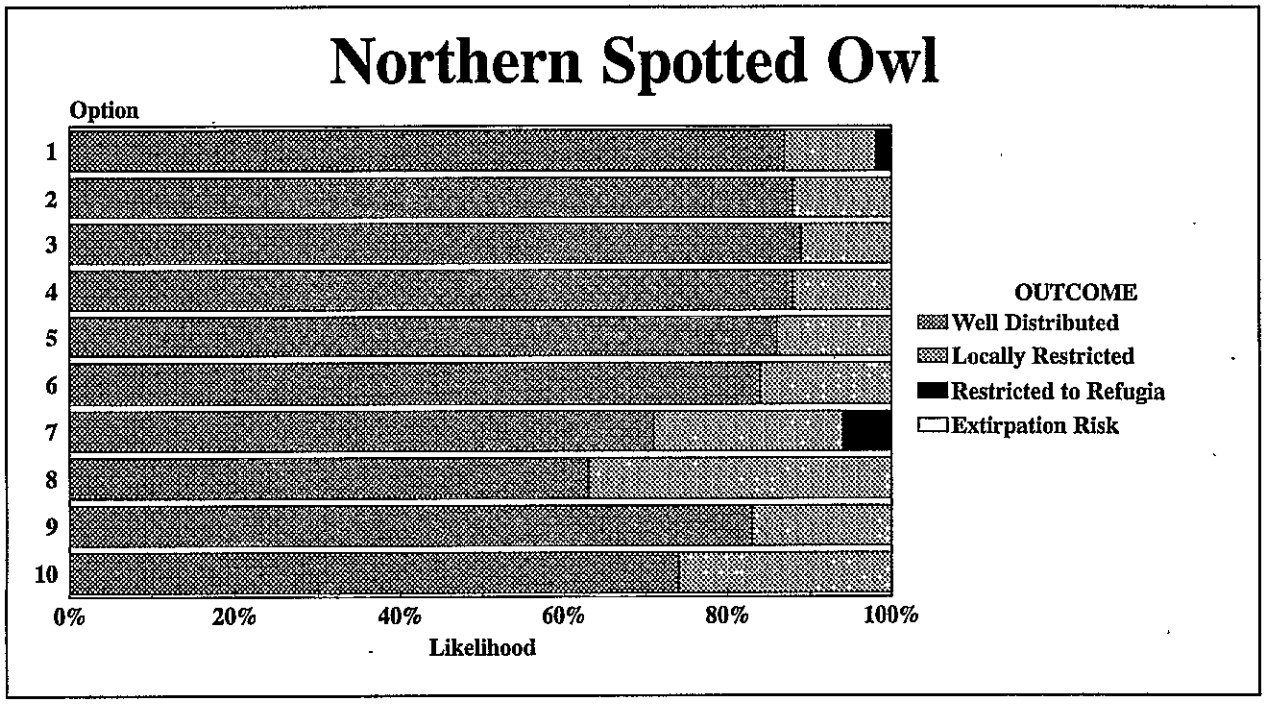


Figure 8. Outcomes for the northern spotted owl under each of ten land management options. Values shown are the likelihood of the species achieving the indicated outcome based on the habitat conditions provided on federal lands over the next 100 years.

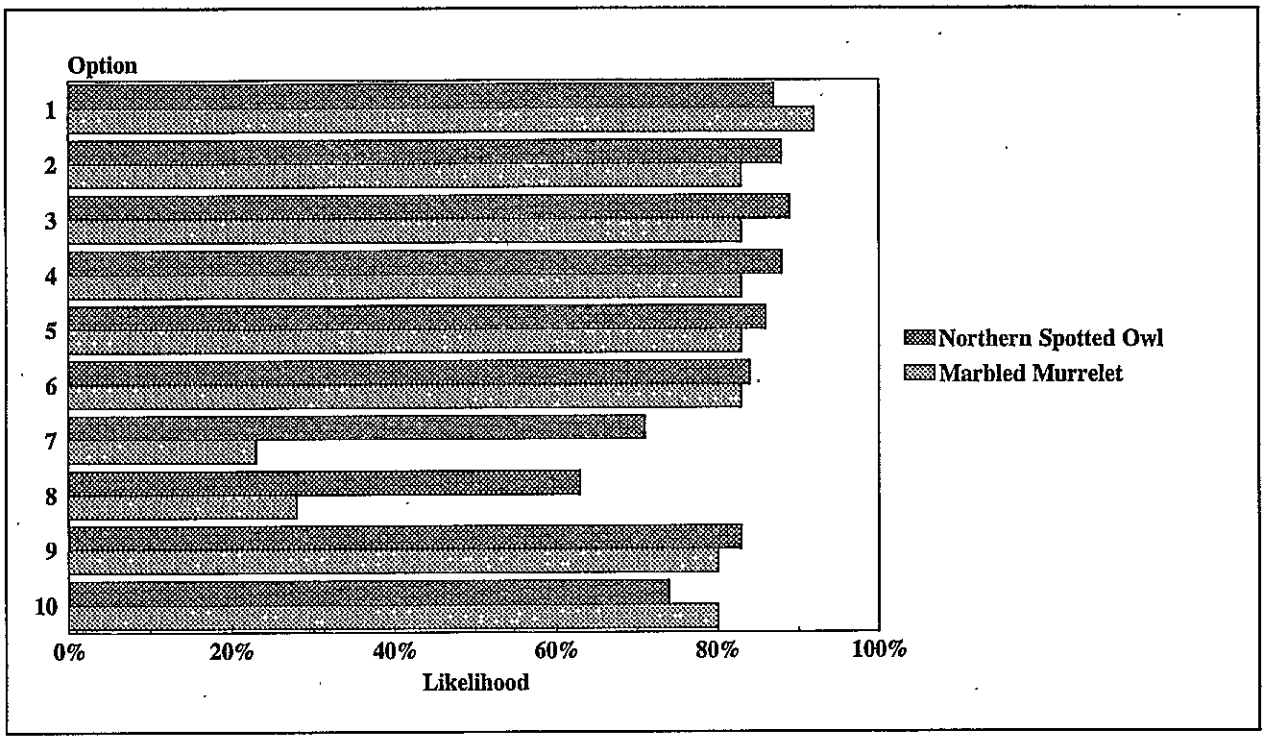


Figure 8a. Likelihood of achieving habitat suitable to maintain viable populations well-distributed on federal lands. Likelihood for Option 2, 6, and 10 are internal assessments; these Options were not rated by expert panel.

Marbled murrelets. The marbled murrelet, a sea-bird, nests in old-growth forests as far as 40 or more miles inland. Yet provision of abundant suitable federal forest nesting habitat is not sufficient, of itself, to ensure viability of the species. At sea, the murrelet remains vulnerable to such hazards as oil spills and net fishing. In addition, broad gaps exist within its nesting range where there are no federal forests to provide secure nesting habitat. Thus, the Team recognizes that the efforts to supply nesting habitat on federal forest land within the range of the northern spotted owl, however substantial and appropriate, will not alone suffice to ensure viability of the marbled murrelet.

We recruited a working team of biologists with marbled murrelet research and management experience to devise a strategy to provide sufficient nesting habitat within the range of the northern spotted owl on federal lands to accommodate a viable population. This initiative does not supplant the effort to fashion a marbled murrelet recovery plan that is already under way. The working team devised a strategy based on Late-Successional Reserves within the nesting range of the murrelet in the three state area. In addition, the strategy calls for surveys for murrelets and reservation of all occupied sites. The murrelet working team strategy is in place in Options 1, 2, 3, 4, 5, 6, and 10 and is exceeded in Options 1, 4, and 5; it is modified somewhat in Option 9 as related to retention of habitat and planning of management activities in adaptive management areas. Options with the murrelet working team strategy in place should provide sufficient protection for nesting habitat to support well-distributed populations of marbled murrelets on federal lands within the range of the northern spotted owl over the next 100 years (fig. 9). These actions alone, however, are not sufficient to provide adequate viability for the species because of its other life history requisites. The task of fashioning a comprehensive strategy to provide for viable populations remains for the marbled murrelet recovery team.

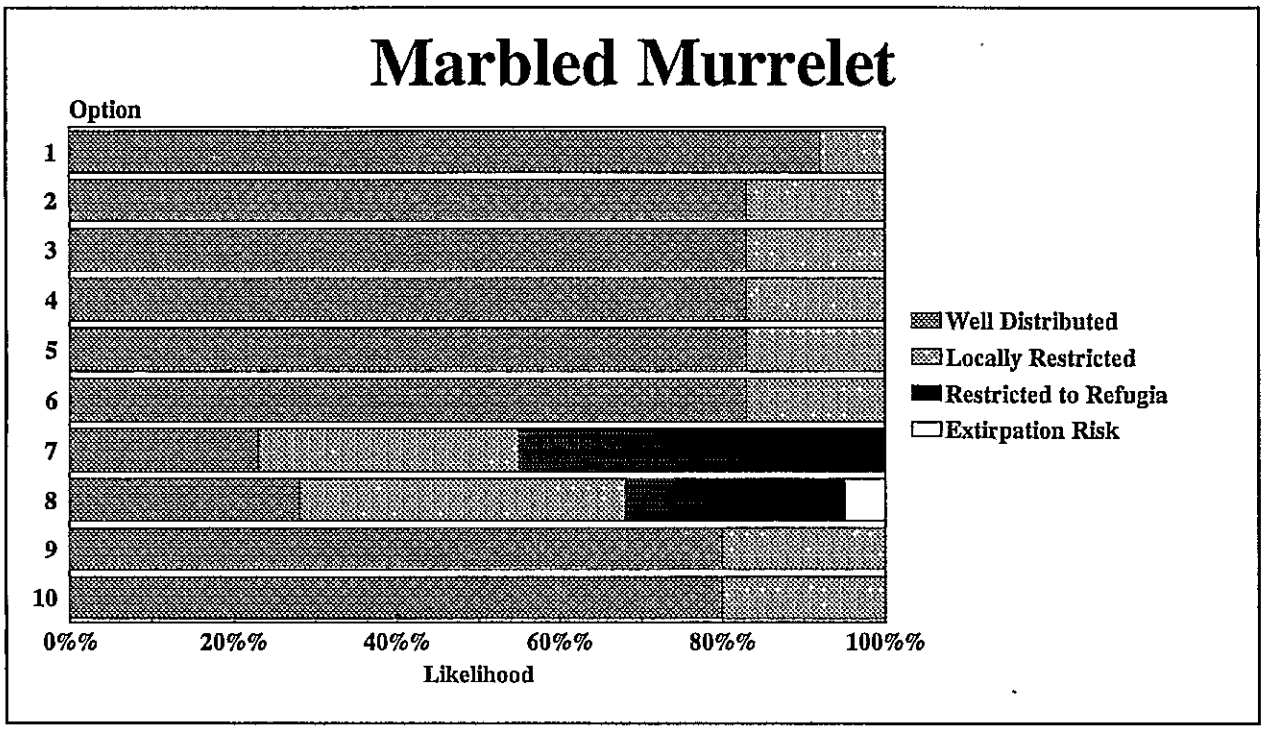


Figure 9. Outcomes for the marbled murrelet under each of ten land management options. Values shown are the likelihood of the species achieving the indicated outcome based on the habitat conditions provided on federal lands over the next 100 years within the range of the northern spotted owl.

Other Vertebrates (Other than Fish)

We believe we understand the life history requisites of vertebrates better than those of invertebrates and many other organisms and are therefore relatively confident in the outcomes predicted (fig. 10). For birds, all options but 7 and 8 provide at least 80 percent likelihood of habitat sufficient to maintain a well distributed population for all but one species; mitigation measures can raise that species to the 80 percent likelihood level. Among 26 mammal species, 11 fell below an 80 percent likelihood that habitat would be maintained adequate to assure a viable population well distributed within the planning areas in some options. Application of recommended mitigation measures suffices to bring four of the 11 species up to the 80 percent likelihood of habitat sufficient to maintain a well distributed population in all options. For the other seven mammal species, selection of a more conservative option is necessary; Options 1 and 3 provide an 80 percent likelihood for 6 species and Option 1 alone does so for the American marten. Under all the remaining options, except Option 7, the marten exceeds a 60 percent likelihood of habitat sufficient to maintain a well distributed population on federal lands.

For the amphibians, six of the ten species that did not achieve a rating of 80 percent likelihood of habitat sufficient to maintain a well distributed population can have mitigation measures applied that raise the likelihood to 80 percent or better under all options. The other species are local endemics and mitigation measures must involve both federal and other lands.

Other Species Associated with Late-Successional Reserves

The Forest Ecosystem Management Assessment Team considered six taxonomic groups of species in addition to the vertebrates: lichens, fungi, mosses and liverworts, vascular plants, mollusks, and arthropods. While there is in-depth knowledge for some of the species in these taxa, in general, we know less than for most vertebrate species. An exception is the vascular plants. Considerable in-depth information is available for this group and we were able to examine, species by species, how the vascular plants fare across the options. For the other taxa, except mollusks, both because there are so many species closely associated with old-growth forests (i.e., 10,000 estimated arthropod species – insects and spiders), and because we know less about them than about vertebrate species, we found it both convenient and necessary to combine species to form groups based on their ecological and taxonomic relationships.

The array of options provides a spectrum of Late-Successional Reserves and management opportunities on federal forest land to maintain habitat sufficient to support most common vascular plant species (fig. 11). Those vascular plants not rating 80 percent likelihood of habitat sufficient to maintain well distributed populations are rare or locally endemic species. As such they are amenable to mitigation that will raise them to the 80 percent likelihood level.

The lichens, bryophytes, fungi, arthropods, and mollusks are maintained as functionally effective groups or species at least within the Late-Successional Reserves where they occur. But many species of mollusks, for instance, are locally endemic and/or rare and do not rate well under any of the options; this situation extends to other taxa as well, and the taxa fare poorly under all options in comparison to the vertebrates and vascular plants (fig. 12). Even under the most conservative options (i.e., Options 1 and 3) only about a quarter of the species or groups rated an 80 percent likelihood of habitat sufficient to maintain well distributed populations. The lack of information on the species and their responses to habitat manipulations coupled with the large proportion that are inherently rare and/or locally

endemic and likely sensitive to habitat disturbance gave the expert panels and our Team little confidence to predict many species/groups would find habitat well distributed within the range of the northern spotted owl for the next 100 years. These results are troubling. Investigations of these taxa should receive priority attention because it is widely accepted that the vascular plants, fungi, and lichens, along with the invertebrates, are critically important for the maintenance of ecosystem function and productivity.

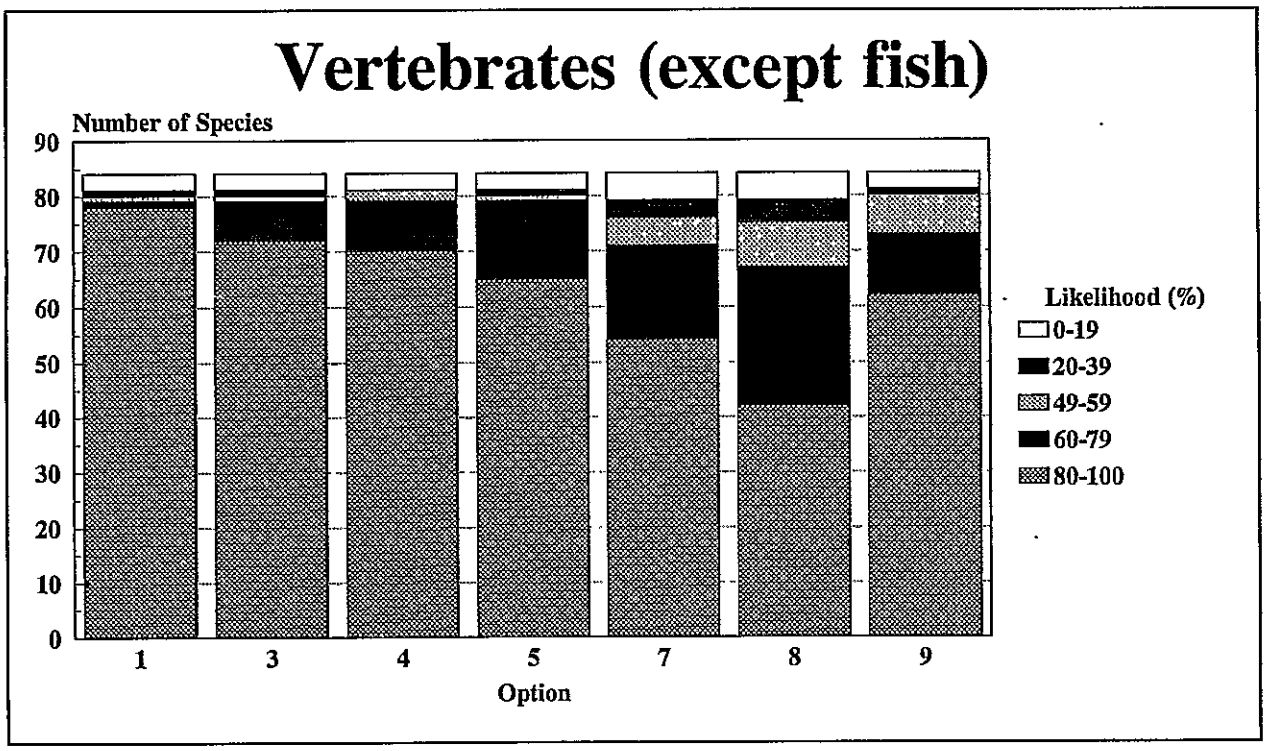


Figure 10. Number of vertebrate species (except fish) that are expect to achieve various likelihoods of attaining stable, well distributed populations in response to habitat conditions provided under land management options on federal lands within the range of the northern spotted owl over the next 100 years.

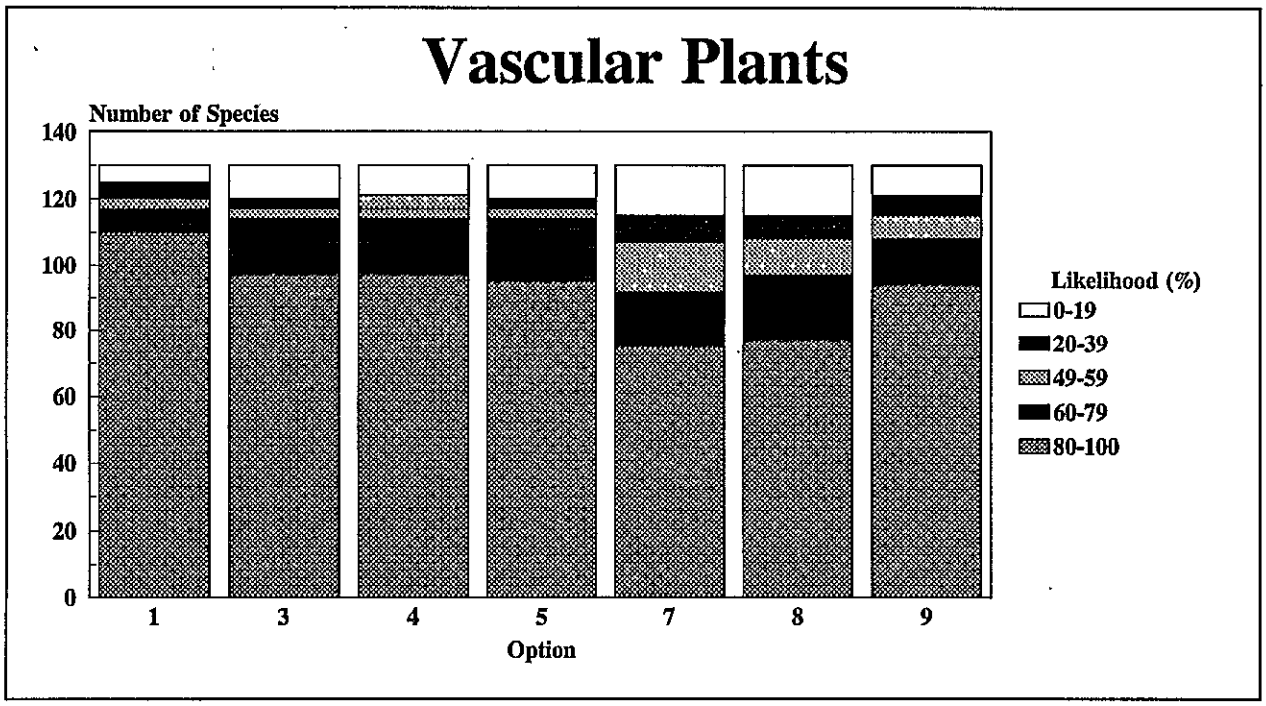


Figure 11. Numbers of vascular plant species that are expected to achieve various likelihoods of attaining stable, well distributed populations in response to habitat conditions provided under land management options on federal lands within the range of the northern spotted owl over the next 100 years.

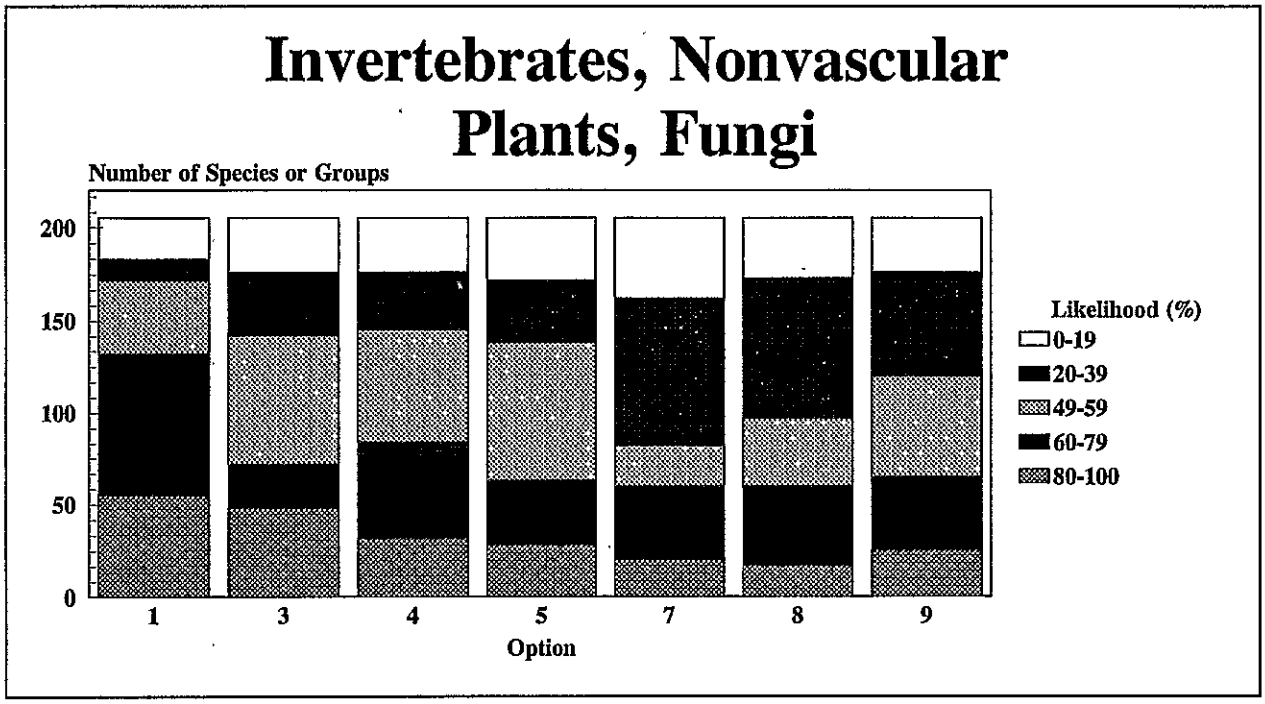


Figure 12. Numbers of invertebrates, nonvascular plants and fungi that are expected to achieve various likelihoods of attaining stable, well distributed populations in response to habitat conditions provided under land management options on federal lands within the range of the northern spotted owl over the next 100 years.

Functional Late-Successional and Old-Growth Forest Ecosystems

In many respects the test of providing a functional, interacting late-successional and old-growth forest ecosystem subsumes the test of viability for the system's component species and groups of organisms. But an ecosystem will likely continue to function in some fashion, even in the absence of some component and perhaps even important species. Such a system is, however, no longer providing the same array of processes and functions once present. An impoverished ecosystem is not likely to be as productive and sustainable as one in which all the functions are provided. Clearly, the goal is to maintain functional interacting ecosystems and their complement of component species to maintain biodiversity.

The Team assessed the likelihood of maintaining a functional interacting late-successional and old-growth forest ecosystem with the following characteristics:

1.A relatively high abundance and diversity of old-growth communities and subregional ecosystem types that are well distributed across the region.

2. The occurrence of ecological processes and functions that are characteristic of old forests and lead to the development and maintenance of these ecosystems.

3. An interacting system in which the distribution of patches, and the landscapes in which they occur, provide for biotic flow to maintain distributions of viable species.

Two major geographic areas are considered based on dramatic differences in the influence of fire: the "dry provinces" – Eastern Cascades of Washington, Oregon and California together with the Klamath Province; and the "moist provinces" – the more moist northern and western provinces. The stability of a functional interacting old-growth forest ecosystem is less in the Eastern Cascades and Klamath Provinces than in the moister provinces due to the likelihood of large-scale disturbance (especially fire), current stand conditions and the portent of global climate change within the 100-year evaluation period. The effects of human disturbance and land ownership patterns further weigh against maintenance of the old-growth forest ecosystems that were once present. Nevertheless, our evaluation of the moist provinces identified Options 1, 3, 4, 5, and 9 as having a greater than 70 percent likelihood of maintaining characteristics of late-successional ecosystems within the range of variation of conditions experienced in the presettlement period. For the dry provinces, Options 1, 3, 4, 5, and 9 had at least about 60 percent likelihood of maintaining ecosystem characteristics within the range of variation of presettlement conditions.

Aquatic Ecosystems

Critical issues in management of aquatic resources include: (1) at-risk fish stocks and species; (2) stream, riparian, and wetlands habitat; (3) water quality; and (4) nonfish species of aquatic and riparian-dependent organisms. An estimated 314 stocks of anadromous salmonid stocks have been identified as at risk, because of low or declining population numbers based on assessments by the American Fisheries Society and Oregon, Washington, and California fish management agencies. Of these, only 55 stocks occur solely on nonfederal land. Thus, federal agencies share in the responsibility for managing habitat for 259 at-risk stocks.

The decline of these fish stocks is indicative of a historic and continuing trend of aquatic resource degradation. Although several factors are responsible for declines of anadromous salmonid populations, habitat loss and modification are major determinants of their current

status. Aquatic systems in the range of the northern spotted owl exhibit signs of degradation and ecological stress. Approximately 55 percent of the 27,000 stream miles examined in Oregon are either severely or moderately impacted by nonpoint source pollution (Edwards et al. 1992). Over a third of Washington state's wetlands have been lost (Dahl 1990), and 90 percent of those remaining are considered degraded (Washington Department of Wildlife 1992).

Over the last century, federal land within the range of the northern spotted owl has become increasingly important for ensuring the existence of high quality aquatic resources. Privately held forest lands have been developed into farms, urban areas, transportation corridors, and industrial forests. Conversion of native forest to tree farms and agriculture decreases the capacity of these lands to supply high quality aquatic resources. Thus, society's reliance on federal forest lands to sustain aquatic resources continues to grow.

We developed a set of options for management of aquatic and riparian ecosystems based on scientific understanding of the functional links between stream and wetland ecosystems and adjacent terrestrial vegetation. Streamside forests, for example, profoundly influence habitat structure and food resources of stream systems for lateral distances exceeding a tree height for many functions. Tree height distance away from the stream is a meaningful indicator of an area that is crucial for providing aquatic habitat components, including wood recruitment and degree of shade. We defined a site-potential tree as the average maximum height of the tallest dominant trees (200 years or more) on a given site.

Another critical linkage within stream systems is the downstream movement of material and disturbances. Small, steep intermittently flowing channels are often sources of woody debris and debris flows that enter larger, fish-bearing streams. Intermittent channels are also sites of management-initiated debris flows originating from channel heads or road failures, which can severely degrade aquatic habitat. Intermittent streams have a defined channel that shows evidence of sediment transport and scour. In this exercise, we estimated the number of these by intermittent streams to be 90 percent greater than estimated in forest plans and Johnson et al. (1991).

Nine of the 10 options incorporate an aquatic conservation strategy and have the following elements:

- A network of 162 Key Watersheds to protect at-risk fish stocks or basins with outstanding water quality.
- Riparian Reserves to maintain ecological functions and protect stream and riparian habitat and water quality.
- Watershed analysis (which is also significant to welfare of terrestrial species) is a procedure for planning further protection or management, including restoration practices within a basin.
- Restoration to speed ecosystem recovery in areas of degraded habitat and to prevent further degradation.
- No new road construction in designated roadless areas in Key Watersheds to prevent further effects of roads as sources of sediment and flood flows.

Key Watersheds

A system of Key Watersheds that serve as refugia is critical for maintaining and recovering habitat for at-risk stocks of anadromous salmonids and resident fish species. These refugia include areas of good habitat as well as areas of degraded habitat. Areas in good condition would serve as anchors for the potential recovery of depressed stocks. Those of lower quality habitat have a high potential for restoration and will become future sources of good habitat with the implementation of a comprehensive restoration program. We identified a network of 162 Key Watersheds (fig. 13) located on federal lands including both 139 Aquatic Conservation Emphasis Key Watersheds (Tier 1), selected specifically for directly contributing to anadromous salmonid and bull trout conservation, and 23 Water Quality Emphasis Key Watersheds (or Tier 2), which are important sources of high quality water.

Riparian Reserves

Riparian Reserves are portions of watersheds where riparian-dependent resources receive primary emphasis and where special standards and guidelines apply. Riparian Reserves include those portions of a watershed that are directly coupled to streams and rivers, that is, the portions of a watershed that directly affect streams, stream processes, and fish habitats. Every watershed in National Forests and Bureau of Land Management Districts within the range of the northern spotted owl will have Riparian Reserves. Land allocated to Riparian Reserve status varies between options from 0.62 to 2.88 million acres (see chapter III, table III-5).

All options recognize three categories of water: (1) fish-bearing streams and lakes; (2) permanently flowing nonfish-bearing streams and wetlands greater than 1 acre; and (3) intermittent streams and wetlands smaller than 1 acre. All options but two (Options 7 and 8) incorporate buffers that are a minimum 300 feet or two site potential tree heights on each side of the stream for the first category and 150 feet or one site potential tree height for streams and wetlands for the second category. Under all options, intermittent streams in Tier 1 Key Watersheds use a 100 feet or one site potential tree height and 50 feet or one-half tree height in watersheds elsewhere. Options 7 and 8 have little or no protection for these small but important channels. These scenarios are components of the set of 10 forest management options.

Restoration

Stream and riparian systems have been significantly degraded by past management actions, including selective or complete cutting of streamside forests, removal of woody debris from channels, and construction of roads that increase streamflow and sediment production. Therefore, watershed restoration should be an integral part of a program to aid recovery of fish habitat, riparian habitat, and water quality and will be a significant contribution to stream conservation in all options. The most important elements of a restoration program are (1) to control and prevent road-related runoff and sediment production, (2) to improve the condition of riparian vegetation, and (3) to improve habitat structure in stream channels.

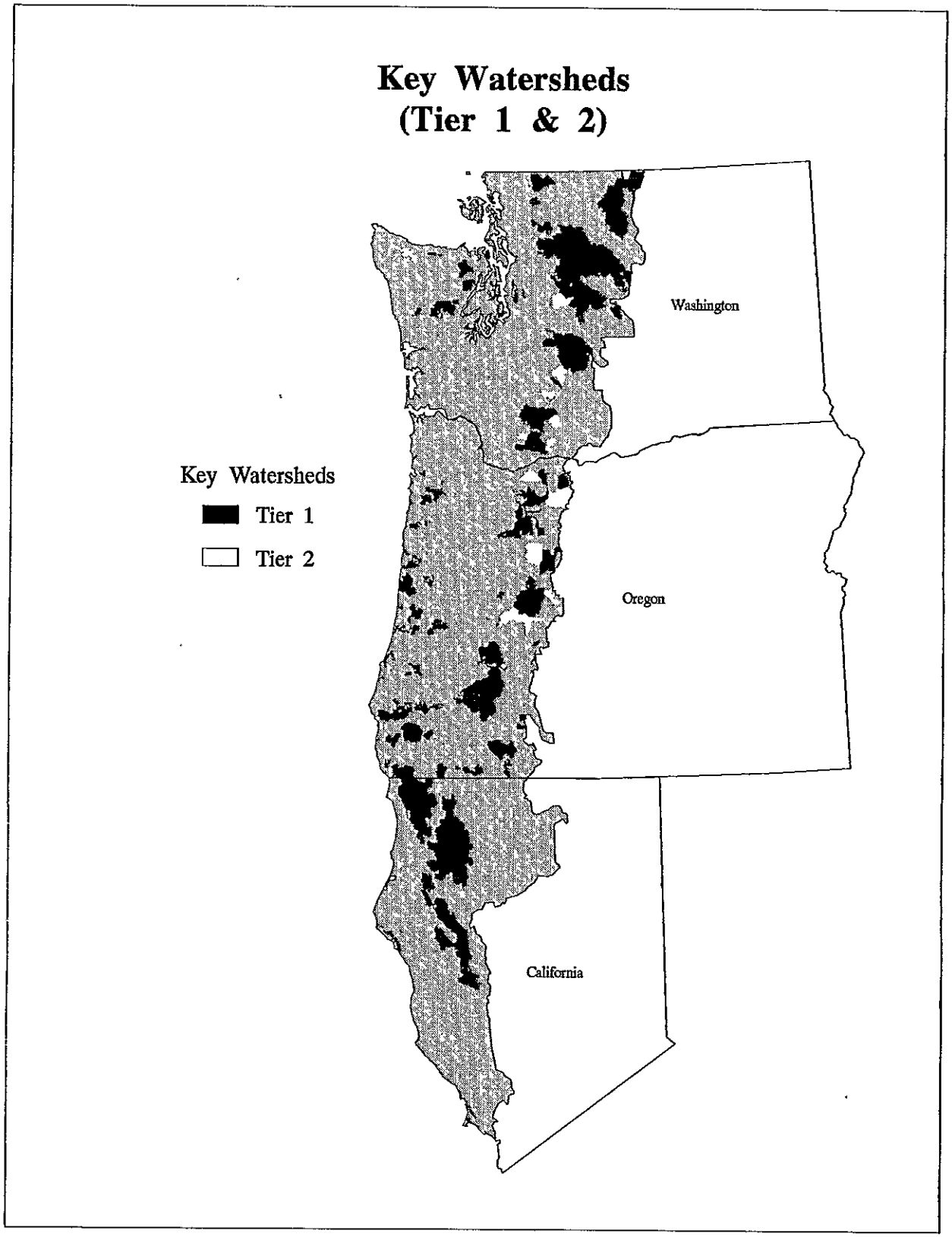


Figure 13. Key watersheds.

Of particular concern is that the federal lands within the northern spotted owl's range contain approximately 110,000 miles of roads. Much of this network adversely affects water quality and peak flow levels. The capacity of the Forest Service and Bureau of Land Management to maintain roads has declined dramatically as both appropriated and traffic-generated funds for maintenance and timber purchaser-conducted maintenance have been reduced. Without an active program of identifying and correcting problems, habitat damage will continue for decades.

Roads and Roadless Areas

There are over 3 million acres of inventoried roadless areas within National Forests in the range of the northern spotted owl. Over 50 percent of this area is in identified Key (Watersheds, with about 48 percent contained in Tier 1 Key Watersheds. Roadless areas are often characterized by significant amounts of unstable land. Road networks are the most important sources of accelerated delivery of sediment to fish-bearing streams. Road-related landslides, surface erosion, and stream channel diversions often deliver large quantities of sediment to streams, both catastrophically during large storms and chronically during smaller runoff events. Older roads in poor locations and with inadequate drainage systems pose high risks of future sediment production. Road surfaces and ditches can also serve as extensions of the stream network, thereby increasing flood peaks and efficiently delivering road-derived sediments to streams.

Management activities in roadless areas would increase the risk of aquatic and riparian habitat damage and impair the capacity of Key Watersheds to function as intended and to contribute to achieving the objectives of the conservation strategy. To protect the best habitats in the identified Key Watersheds, no new roads should be constructed in roadless areas within Key Watersheds. This criterion was applied in all but Option 7.

Summary

In assessing the options, we considered five factors: (1) assessments for the individual races/species/groups made by the expert panel; (2) amount of Riparian Reserves and type and level of land-management activity allowed within in them; (3) extent of other reserves (e.g., Congressionally designated withdrawals, Late-Successional Reserves, etc.) and type and level of land management activity allowed within them; (4) presence of a watershed restoration program; and (5) prescriptions for management of Matrix lands. The expert panels also considered items 2-5.

This assessment of habitat on federal lands does not directly correspond to population viability of the affected species. This is due, in part, to impacts or cumulative effects from nonfederal habitat sectors where the species might spend a portion of their life cycles. Furthermore, with anadromous fish, there is 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 difficulty of translating these impacts into population numbers.

The analysis rated the sufficiency, quality, distribution and abundance of habitat to allow the species populations to stabilize across federal lands. In this assessment, Options 1 and 4 had the greatest likelihood, 80 percent or greater, of attaining sufficient quality, distribution, and abundance of habitat to allow all races/species/groups to stabilize, well distributed across federal lands (outcome A, see chapter IV, table IV-7; fig. 14). The

positive outlook for these options resulted from the relatively larger amount of area in Late-Successional Reserves and the Riparian Reserves.

Options 2, 3, 5, 6, 9, and 10 generally had a 60-70 percent likelihood of attaining Outcome A – habitat for the seven species/groups of anadromous fish sufficient to support quality spawning and rearing habitat well-distributed across federal lands. These options had a smaller likelihood of attaining this outcome than Options 1 and 4 because of less area in Late-Successional Reserves and the Riparian Reserves. Options 7 and 8 had the lowest likelihoods of attaining Outcome A for all races/species/groups. The likelihood of obtaining Outcome A for Option 7 ranged from 10-15 percent. Option 7 was ranked low primarily because of the relatively (compared to other options) small amount of Riparian Reserves and the amount of activity that was allowed within them in Bureau of Land Management land management plans and in many National Forest plans. Likelihood of obtaining Outcome A for Option 8 ranged from 20-25 percent for all groups. Again, the reduced likelihood was due to reduced size of Riparian Reserves, particularly along intermittent streams.

The likelihood of achieving Outcome A for fish habitat is lower for Options 2, 3, 5, 6, 9, and 10 than for Options 1 and 4. However, we think all options except Option 7 and 8 will 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 option will completely recover all degraded aquatic systems within the next 100 years. The likelihood of attaining a functioning late-successional/old-growth ecosystem

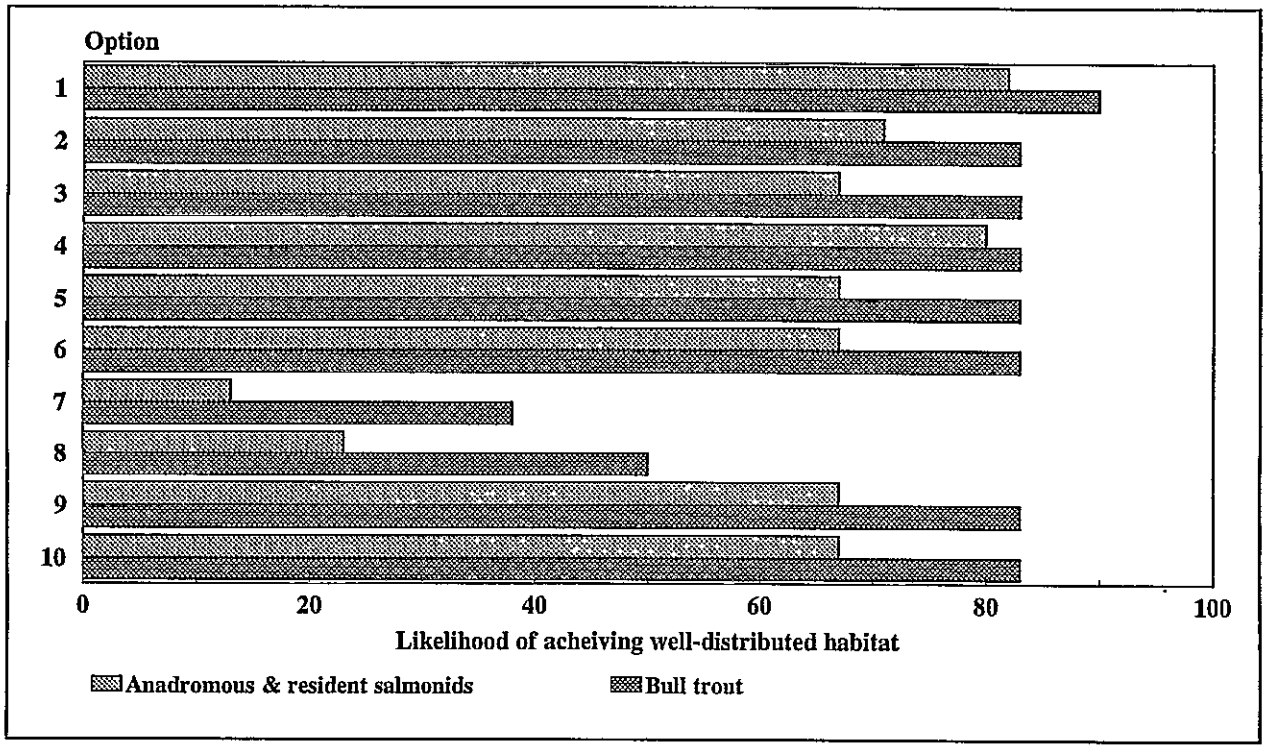


Figure 8a. Likelihood of achieving habitat suitable to maintain viable populations well-distributed on federal lands. Likelihood for Option 2, 6, and 10 are internal assessments; these Options were not rated by expert panel.

in the next 100 years is impaired because some characteristics of these terrestrial ecosystems will not be obtained for at least 200 years (see chapter IV). Similarly, we expect that degraded aquatic ecosystems will not be fully functional in 100 years. Faster recovery rates are probable for aquatic ecosystems under Options 1 and 4 due to reduced disturbance across the landscape that results from application of a larger Late-Successional Reserve network and the use of the Riparian Reserve 1 scenario which requires wider interim Riparian Reserves for intermittent streams in non-Key Watershed than in other scenarios.

Finally, in considering the effects of any federal land management option on aquatic resources, two points are key: overharvest, disease, artificial propagation practices, and habitat impacts such as urbanization and agricultural practices have degraded and may continue to degrade aquatic habitat; and a plan for managing federal lands alone will not solve these problems. Ecosystem management cannot be successful without participation of all federal and nonfederal landowners and agencies that affect a watershed. The federal agencies must foster a partnership for ecosystem management with these entities to ensure conservation and prevent further degradation of the region's aquatic resources.

Economic Assessment of the Options

The Forest Ecosystem Management Assessment Team was charged with addressing a broad range of forest resource outputs and their economic implications. The economic assessment of proposed forest ecosystem management options was designed to evaluate resource yields and values, local and regional economic conditions, National Forest product markets, and additional policy considerations. The economic analysis focused upon the management of the federal forests within the range of the northern spotted owl and the counties directly within their influence (fig. 15).

Outlook for Federal Timber Harvests

Federal harvests must be viewed from two perspectives: (1) the implications of the land allocation and management guidelines on anticipated timber sales quantities per decade (i.e., the sustainable harvest level) and (2) the implications of these guidelines on the potential near-term sale levels.

Comparison of Forest Service Estimates of Annual Sale Quantity Levels Between Various Reports (1990-1993)

Prior to evaluating the probable sustainable harvest levels, a comprehensive assessment of Forest Service annual sale quantity estimates for the period 1990-1993 was conducted. The probable sale quantity estimates developed for Forest Service Region 6 forests under Option 7 (based on individual forest plans with the imposition of the Final Draft Recovery Plan for the Northern Spotted Owl; USDI 1992) were compared to estimates derived by Forest Service analysts for the Northern Spotted Owl Final Environmental Impact Statement (USDA 1992). Estimates of the probable sale quantity for the Region 6 National Forests within the range of the northern spotted owl were 1.01 billion board feet for Option 7. When this was compared to the estimates of annual sale quantity (with a similar owl management strategy Thomas et al. 1990) from the Northern Spotted Owl Environmental Impact Statement (USDA 1992), the estimate was 1.54 billion board feet. This represented a 34 percent reduction (table 4). In the assessments made for the Forest Ecosystem Assessment Team, Forest Service and Bureau of Land Management analysts were asked to

provide feasible harvest levels that might be achieved. This estimate was referred to as the probable sale quantity. This is a departure from the concept of annual sale quantity that was a ceiling that should not be exceeded during the decade.

Table 4. National Forest annual sale quantity estimates for Region 6 (Oregon and Washington), in millions of board feet.

National Forest	Option 7 - Forest Plans with Recovery Plan[a] (1993)	Forest Plans with ISC Strategy - Northern Spotted Owl FEIS (1992)	Forest Plans with ISC Strategy - Hamilton Report (1990)	Final Forest Plans (1988-1990)
State of Oregon	781	1,214	1,362	1,846
State of Washington	234	328	419	752
Total of Forest Within Owl Range	1,015[b]	1,542	1,781	2,598
Forest Plan for Areas[c] Outside the Owl Range	989	843	843	843
R6 Total	2,004	2,385	2,624	3,441

[a] Option 7 estimates for the Northern Spotted Owl Recovery Plan give "probable sale quantities" as opposed to "allowable sale quantities" as done in the other three columns. The term "probable sale quantity" is used instead of "allowable sale quantity" because National Forests were asked for estimates of the likely harvest level rather than the maximum harvest level (allowable sale quantity) as previous done.

[b] Total probable sale levels for forests within the range of the northern spotted owl should fall within 10 percent of this result.

[c] Forest Plan Nonowl – The annual sale quantity for those forests outside the range of the northern spotted owl and, for Option 7, the value plus harvest from the Deschutes, Winema, and Okanogan National Forests outside the range of the owl.

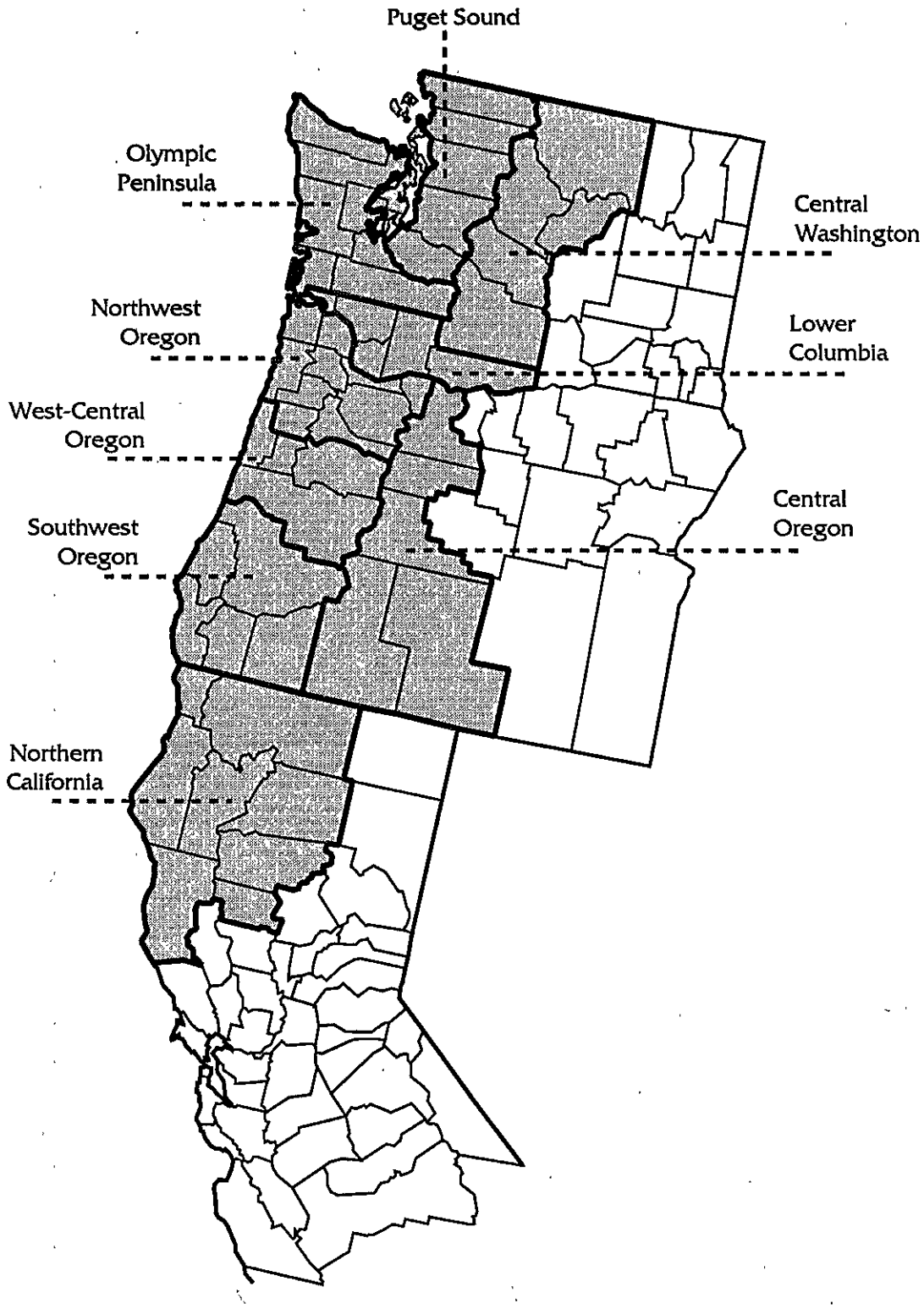


Figure 15. Counties and sub-counties included in the impact region (counties shaded).

Three primary reasons for this reduction were detected:

1. The computations for the Deschutes, Okanogan, and Winema National Forests were based on a different land base. Computations for Option 7 included only those portions of the forests within the range of the northern spotted owl. Computations performed in connection with the Northern Spotted Owl Environmental Impact Statement included the entire forests. After compensating for differing land bases, the difference between the estimates decreased by 9 percent, leaving a difference of 25 percent.

2. The land area in the "habitat conservation areas" (Thomas et al. 1990) used in the Northern Spotted Owl Final Environmental Impact Statement (USDA 1992) differed from that reported for the "designated conservation areas" in the Recovery Plan (USDI 1992) used in Option 7. The areas designated in both plans were similar but 250,000 additional acres of designated conservation area were added in the Recovery Plan. In addition, a modified version of the 50-11-40 rule (which required 50 percent of each quarter township in the Matrix to be maintained in stands of trees averaging 11 inches diameter breast high with 40 percent canopy closure) was employed in Option 7. In this modification, 50 percent of a quarter township that does not meet the 50-11-40 requirement is released for timber harvest or silvicultural treatments while the remaining 50 percent is targeted to achieve the 11-40 part of the rule at a future date. Further, deciduous trees were removed from consideration in meeting the rule. The net effect of these factors was to reduce the difference between the two estimates by another 8 percentage points, leaving a difference of 16 percent.

3. Incorporation of new information and altered management practices into management planning reduced the annual sale quantity that was computed in preceding planning efforts. In calculating the annual sale quantity levels for Option 7 Forest Service analysts were asked to use their most up-to-date information. This information included insights field personnel had gained from experience in applying the standards and guidelines that were inherent in the forest plans, in developing the Northern Spotted Owl Environmental Impact Statement, and in the Interagency Scientific Committee's report (Thomas et al. 1990).

   Examples of the developing insights incorporated in these assessments were:

   - Implementation of standards and guides, such as retention of "wildlife trees" and logs following regeneration cuttings, had a greater impact on the timber volume achieved in harvests than had been originally anticipated.

   - The delineated habitat conservation areas, in many cases, included the more productive timber growing sites leaving somewhat less productive areas available for timber harvest resulting in lower estimates of harvest volumes.

   - Fires within the period between assessments resulted in stands that had been counted on for harvest in the near future being converted into the "young plantation" condition class, thereby reducing the present allowable sale quantity.

   - Decisions were made to significantly reduce the use of clearcutting as a silvicultural prescription and substitute various prescriptions in which significant numbers of green trees were left in place after harvest. This resulted in less timber volume being attained per unit area.

   - Applications of standards and guidelines to protect special habitats, cultural resources, locations of threatened or rare plant species, etc. have reduced timber harvest per unit of area more than had been anticipated.

- Increasing awareness of the critical nature of watershed health to water quality and fish habitat has produced a management response in which more trees are being protected along stream courses. This, in turn, reduced annual sale quantity.

- Updated resource inventories (soils, stream condition, vegetation, etc.) have resulted in updated, and reduced, timber harvest estimates.

It seems likely that such factors in combination or in interaction account for all or most of the remainder of the difference between the two estimates.

The Northern Spotted Owl Final Environmental Impact Statement had already reduced the estimate of annual sale quantity from that in the Final Forest Plans for Region 6 (Oregon and Washington) and those in the so-called Hamilton Report (USDA 1990) in which the impacts of the Interagency Scientific Committee Report on annual sale quantity was estimated (table 4). The Hamilton Report computed downward adjustments from the Final Forest Plans based primarily on the shift of forest areas that had been assumed to be available for timber production into habitat conservation areas reserved from cutting. A further assumption in that report has proven incorrect with accumulating experience. It was assumed in the Hamilton Report that meeting the 50-40-11 rule would cause only minor negative adjustments in the annual sale quantity. Experience has revealed the impacts of meeting the 50-11-40 rule to be much greater than originally thought.

The difference between the annual sale quantity estimates for the Forest Plans, including the owl conservation strategy put forward by the Interagency Scientific Committee, as represented in the Hamilton Report, differs from the estimates for Option 7 after adjustment for land base differences by 35 percent. This is derived from the data displayed in table 4. The probable sale quantity in Option 7 for the area included within the range of the northern spotted owl (1.01 billion board feet) is adjusted to place it on a comparable land base used in the Hamilton Report by adding 0.15 billion board feet (the difference between the 0.99 billion board feet estimated in Option 7 and the 0.84 billion board feet estimated in the Hamilton Report or 0.15 billion board feet) to 1.01 billion board feet yielding an estimate of 1.16 billion board feet including eastside forests. The difference between the 1.78 billion board feet in the Hamilton Report and the adjusted figure for Option 7 of 1.16 billion board feet is 0.62 billion board feet (35 percent). Thus, over the past 3 years (1990-1993) the estimates of declines in the timber sale quantity required to attain the objective of protecting habitat for northern spotted owls (in conjunction with the objectives in the forest plans) have continually increased based on accumulating experience with "real world" conditions and refinements in the data.

Sustainable Harvest Levels

Probable sale levels for the first decade under the rules for each option are summarized in table 5 and in figure 16 along with recent harvest levels. Each of these options start with existing forest plans (Forest Service, Region 6) or proposed plans (Forest Service, Region 5 and Bureau of Land Management) as the base. The new allocations and management rules for each option are then overlayed on these plans and the more restrictive set of management rules are retained. Option 7, which has the highest harvest level, simulates the agencies' existing or proposed plans overlayed with the Draft Recovery Plan for the Northern Spotted Owl (USDI 1992). The remaining options contain various additional levels of protection for streamside habitat, marbled murrelet habitat, habitats of other species, and ecologically significant old growth. The additional protection measures impact harvest levels through precluding areas from harvest, distributing the harvest, extending rotations, and requiring more stringent green tree retention standards.

The probable sale quantity figures do not include removal of cull volume or small-scale salvage operations that would not have been calculated in annual sale quantity estimates. Historically, this "other wood" volume has averaged about 10 percent of the annual sale quantity (fig. 17).

In addition, probable sale estimates do not include additional volume that might be obtained under some options from thinning, salvage, and other treatments within reserves. An additional volume of up to 150 million board feet per year might be obtained from these activities depending on the option.

It is difficult to determine fully the actual sale levels that will result from some of the management rules for the different options. As an example, 15-20 percent of the sale levels comes from Tier 1 Key Watersheds (those with potentially threatened fish stocks) in most options. These watersheds will need a watershed assessment before sales go forward. We do not know when this analysis will be finished nor what the outcome will be. The probable sale levels were based on a set of interim rules for these watersheds. Therefore it is problematic as to what level will be achieved after assessment. In addition, a portion of the sale levels in most options come from lands within the near and far zones of the marbled murrelet. This land could (in theory) be captured by marbled murrelet "activity centers." As marbled murrelets are found, creation of additional activity centers will further prohibit harvest levels. Also, Option 9 creates Adaptive Management Areas. The probable sale calculations are based on the assumption that harvest levels would not be reduced significantly in these adaptive management areas compared to the Matrix in which they exist. Depending on how the management rules are written for these areas, the availability of this volume could also be problematic. Finally, it is difficult to fully capture the impact of these new rules, especially a more extensive riparian protection network, on the area actually available for timber production. Much of this area is in fairly small pieces and slivers. While an operability assessment was conducted, and a reduction for inoperable acres was factored into the harvest numbers presented here, concern remains as to whether the full extent of this difficulty has been recognized.

All options yield probable timber sale levels that are substantially less than was historically sold and harvested from the federal forests in the region. This applies to both the period 1980-1989 (before the sales were enjoined by the federal courts) harvest of 4.6 billion board feet from the owl forests and the period 1990-1992 (after sales were enjoined by the federal courts) harvest of 2.4 billion board feet. The value of the 1990-1992 harvest exceeded $650 million per year in terms of stumpage and $1 billion per year in terms of logs.

Table 5. Historic federal harvests and probable average timber sales in the first decade by option, in million board feet, scribner.[a]

Administrative Unit	Average Harvest 1980-1989	1990-1992	Option[c] 1	2	3	4	5	6	7	8	9	10
National Forests - Owl Forests												
Region 6 - Owl Forests												
Western Washington	824	404	22	69	75	67	119	87	186	133	131	94
Eastern Washington	195	124	11	31	33	30	26	37	47	65	47	52
Western Oregon	1902	897	68	207	239	284	392	300	716	473	429	357
Eastern Oregon	127	100	15	45	45	37	49	47	65	53	59	52
Total	**3048**	**1525**	**116**	**352**	**391**	**418**	**585**	**471**	**1015**	**726**	**666**	**555**
Region 5 - Owl Forests												
Total	**561**	**291**	**20**	**127**	**132**	**106**	**146**	**141**	**242**	**246**	**152**	**220**
Bureau of Land Management - Owl Forests												
Western Oregon/ California	880	568	41	134	142	146	177	158	406	298	260	200
Eastern Oregon	35	5	0	3	3	3	6	4	7	6	6	4
Total	**915**	**573**	**41**	**137**	**145**	**149**	**183**	**162**	**413**	**304**	**266**	**204**
Total Owl Forests	**4524**	**2389**	**177**	**616**	**668**	**673**	**915**	**774**	**1669**	**1274**	**1084**	**979**
National Forests - NonOwl Forests[b]												
Region 6 - NonOwl Forests												
Eastern Washington	134	138	102	102	102	102	102	102	102	102	102	102
Eastern Oregon	942	831	422	422	422	422	422	422	422	422	422	422
Total	**1076**	**969**	**524**	**524**	**524**	**524**	**524**	**524**	**524**	**524**	**524**	**524**

[a] Probable sale levels should be within 10 percent of the final results and include no "other wood" estimates. Historic numbers are "gross" volumes and thus include historic levels of other wood. Historic numbers for 1990-92 are estimates.

[b] Nonowl forests have not been subject to rigorous analysis for the various alternatives and appear only for regional price projections. Fate of the eastside forests is highly uncertain at the present time.

[c] Volumes for Options 1, 3, and 10 have been approximated on the basis of analysis on the other seven options.

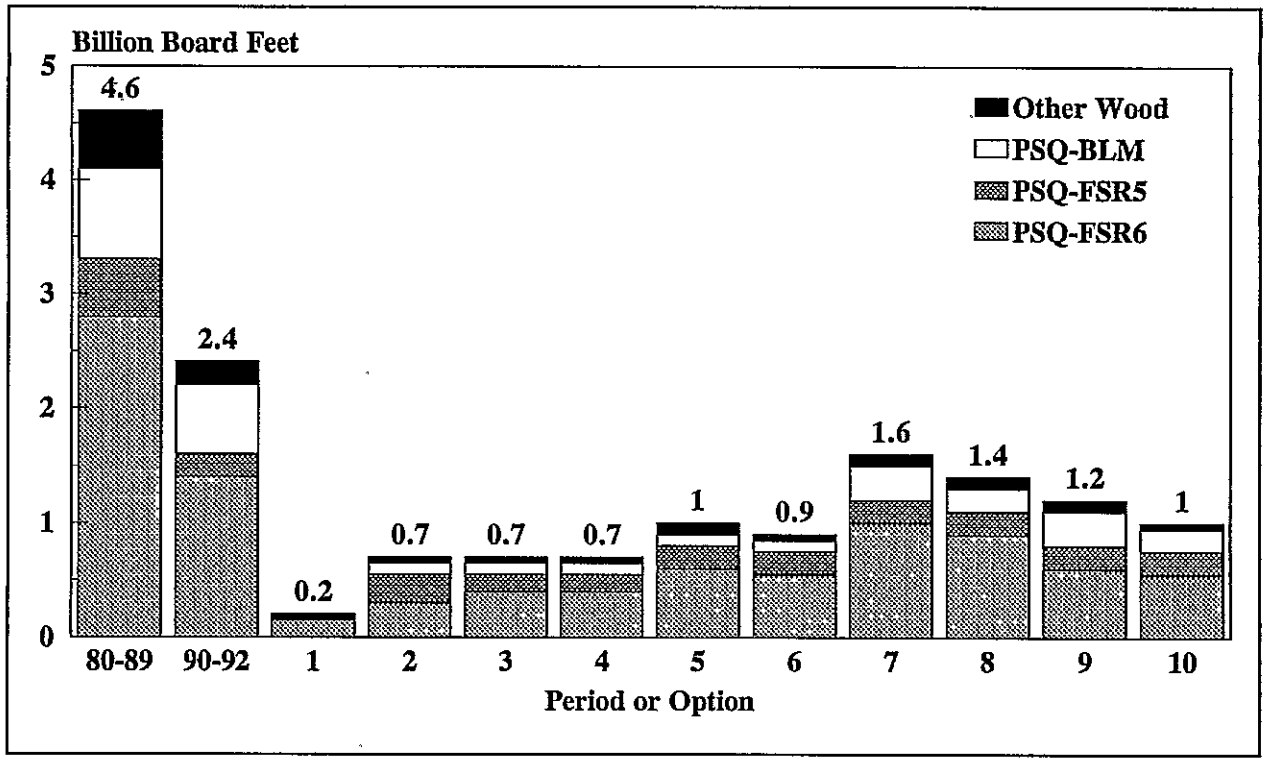


Figure 16. Historic average for federal timber harvests and first decade's probable sale levels from federal forests within the impact region by agency ownership and option.

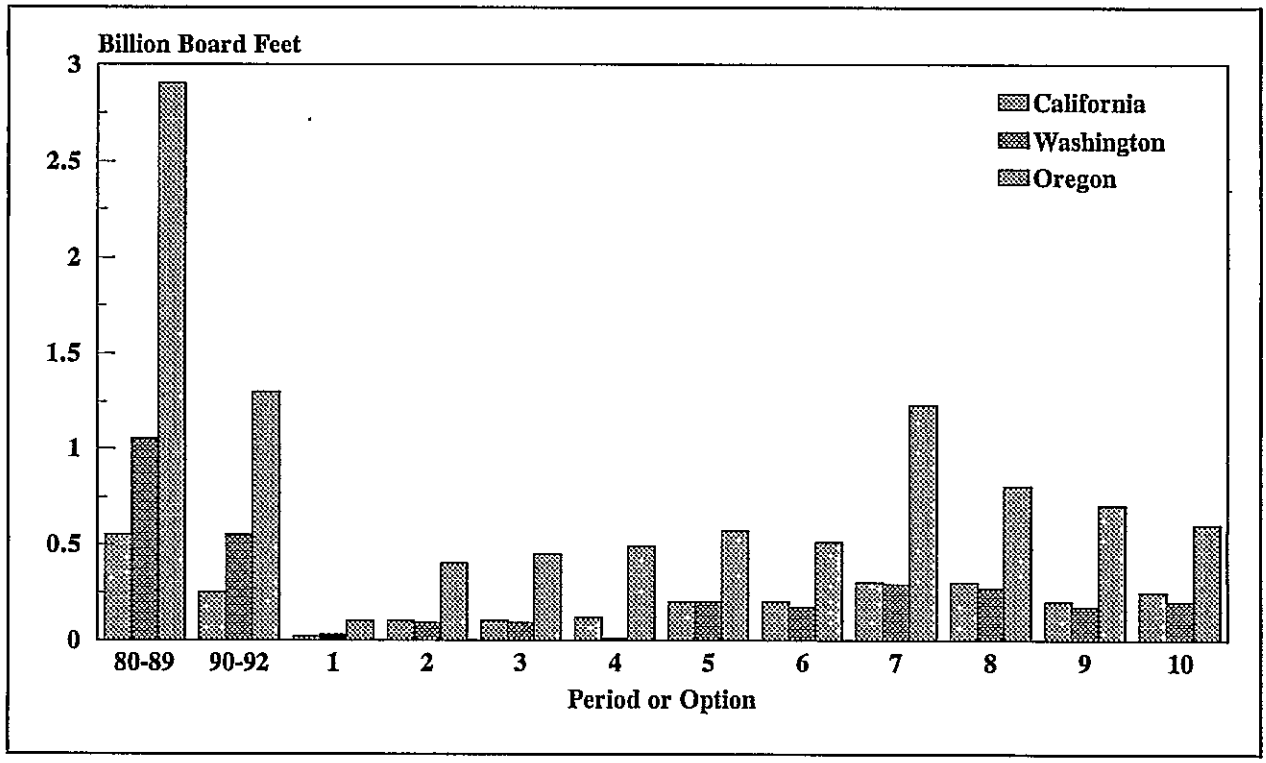


Figure 17. Historic average federal timber harvests and first decade's probable sale levels from federal forests within the impact region by state and option.

The largest federal harvest reductions will be in Oregon, although the federal harvest in Washington is characterized by a larger percentage reduction (fig. 17). Timber harvest in the coastal forests will be the most affected due to the combination of fisheries, marbled murrelet, and northern spotted owl protection.

Near-Term Outlook for Timber Sales

The near-term sale outlook from federal land is difficult to estimate and may differ from the sustainable harvest level due to required surveys and assessments prior to resumption of sales and due to time required to distill proposals into a new timber sales program.

Execution of timber sales that have already been prepared to provide short-term volume may prove difficult because of their location in Late-Successional Reserves, Key Watersheds containing potentially threatened fish stocks, Riparian Reserves, roadless areas, Fish and Wildlife Service critical habitat for the northern spotted owl, or in the "near zone" for the marbled murrelet. Only one of those options is described in detail. As an example, under Option 9, of the 1.7 billion board feet currently prepared for sale (or nearing completion in preparation) on Forest Service lands in the owl region, approximately 0.60 billion (slightly more than one-third) lies outside of these potentially controversial areas. Close to half of this 0.60 billion board feet would come from stands over 200 years of age. Even the offering of this volume for sale may be delayed for some time while sales are redesigned to come into compliance with the rules (especially the riparian rules) for the option that is selected. Similar results can be expected across most other options.

An analysis of Bureau of Land Management timber sales produces similar results, although less of its potential sale volume is over 200 years of age. On Bureau of Land Management land, there may be 0.1 billion board feet outside of these potentially controversial areas in sales nearing completion of preparation.

The agencies may be able to prepare some additional sales in fiscal year 1994 beyond those discussed above, but requirements for design surveys and consultation make it difficult to develop new sales to offer in fiscal year 1994. Recent new sale preparation has focused on sales in nonowl habitat or acceptable sales as determined by consultation with the Fish and Wildlife Service in owl habitat. Thus, more of these sales might be ready before the end of fiscal year 1994. It must be pointed out, though, that some of the sales listed above (nonowl habitat sales) will be sold before the end of fiscal year 1993. Thus, the new sales would replace, to some degree, the depletion of these sales. It seems unlikely that the total sales on Forest Service and Bureau of Land Management lands within the owl region outside of potentially controversial areas could rise much above 1 billion in fiscal year 1994 in most of the options.

Beyond fiscal year 1994, the picture brightens somewhat if it is assumed that the agency(s) develop clear rules for project design and an efficient process exists to evaluate sales within Late-Successional Reserves. Starting in 1993 with the preparation of the fiscal year 1995 program would provide enough lead time (almost 2 years) to prepare substantial amounts of new timber volume for sale. This timber sale volume is to be determined by the option chosen to guide management action. One specific concern, however, is the continuing reduction in force that is rapidly depleting the ranks of agency personnel required to prepare timber sales. Unless this reduction is slowed and (in some cases) reversed, the agency work force may not be in place to prepare a future sales program of the desired amount.

Outlook for Other Commodity Production

The four other resource commodities produced on federal lands in the region are "special forest products", livestock grazing (range), commercial fisheries, and minerals.

In the near-term, significant growth is expected to continue in the special forest products sector (e.g., mushrooms, boughs, ferns). Current annual harvest values are in excess of $50 million.

Near-term reductions in livestock grazing levels are likely, although this is a minor segment of the economy of the region.

Proposals are also apt to have little near-term impact upon the commercial fisheries whose fate is more strongly tied to "groundfish" and other ocean species. Longer term commercial fisheries yields may be enhanced over present conditions through all the options considered in this report (except Option 7).

In the long-term, potential limitations on mineral development could have significant economic implications, because the forests in the region are situated on some potentially valuable mineral terrains.

Outlook for Noncommodity Production

In addition to commodity products (i.e., those that are marketed), a number of noncommodity outputs from the forest are influenced by forest management. While market prices may not exist for these outputs, they do have economic value.

Recreation

Recreational visits to the federal forests in the region in 1990 exceeded 134 million people. These visitors spent $2.8 billion and expressed a willingness-to-pay an additional $1.6 billion beyond their expenditures for access to the recreational areas.

Increasing the availability of primitive and semiprimitive nonmotorized recreation opportunities may spur more visits as these are the only forest-based recreation activities viewed as being in deficit supply in the region.

Scenic Quality, Water Quality, Air Quality, and Other Public Goods

All of these are elements of the region's quality of life. Many in the region contend that these quality of life considerations may have helped spur the region's greater than U.S. average employment growth since 1985 and may be prime considerations in the future attractiveness of the region for economic development.

Outlook for Nonfederal Timber Harvests

Nonfederal timber historically accounted for two-thirds of the harvest in the region in the 1980's (fig. 18). State-to-state variations are large, with Oregon harvests being about half from nonfederal sources. The outlook for nonfederal timber harvests will be a vital component of the outlook for the timber industry in the region. In addition, the future

marketing of this nonfederal timber will be important, as it dictates whether domestic or foreign buyers will receive the raw materials.

Timber Prices

Market pressures are anticipated to result in regional stumpage prices in 1995 being 33 percent higher than in 1990 (in real terms). By the year 2000, stumpage prices are projected to be 25 percent higher than 1990. The options considered contribute to these projected price increases, but are not the sole source of the rise.

Rate of Harvests

In the 1990's, private and state timber growers in the impact region seem likely to respond to higher prices and cut at levels greater than is sustainable over the long-term. In the decade ahead, the nonfederal harvests processed in the impact region are anticipated to rise from the 1980-1989 level of 9.5 billion board feet and the 1990-1992 level of 9.1 billion board feet to 9.4-9.8 billion board feet (fig. 18). In the following decade, nonfederal harvests are projected to decline slightly as a result of that accelerated rate of harvest.

The outlook differs geographically as California appears poised for decreases in nonfederal harvests, while Washington and Oregon will likely see some increases.

These projections are based upon the current operating conditions for nonfederal owners. Additional restrictions on operations would likely reduce the harvests forthcoming from these nonfederal lands.

Aggregate Timber Harvests

In aggregate, timber harvested and processed from all owners will be approximately 0.8-2.1 billion board feet (7-17 percent) less than the level of 1990-1992 and 3.5-4.7 billion board feet (24-32 percent) less than the levels of the 1980's (fig. 18). Thus, the nonfederal landowners mitigate only a part of the federal harvest reductions. Because Oregon is the most federally timber-dependent state, and it incurs the largest federal timber harvest reductions, it will clearly be the most impacted state (fig. 19). The state of Washington is buffered by its large nonfederal forest land base which has, historically, provided over 80 percent of the state's timber harvest. This situation has potential to off-set some of the short-term effect of reductions in timber harvest on federal lands.

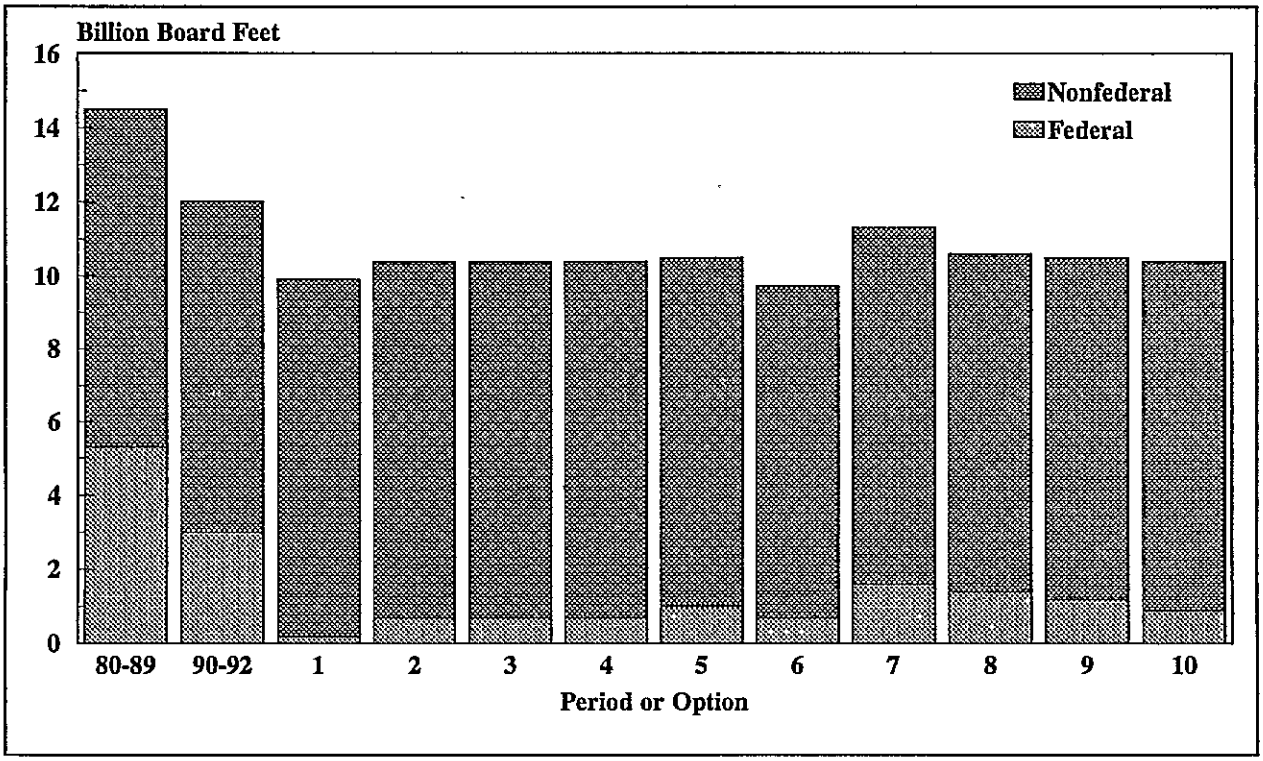


Figure 18. Historic average and first decade's projected annual average wood volume processed in the impact region from all owners by option.

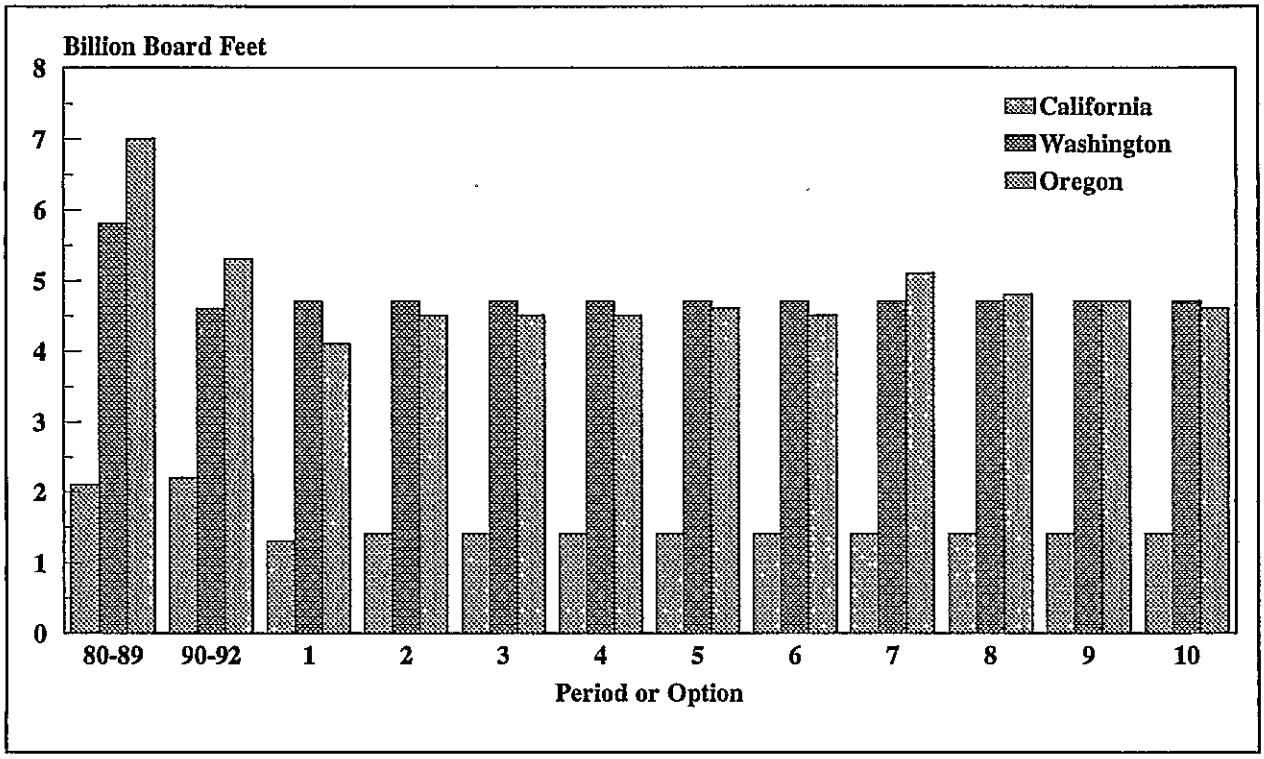


Figure 19. Historic and first decade projected annual average volume processed for all ownerships in the impact region by state and option - totals.

Export Levels

Traditionally, regional log exports accounted for 2.9 billion board feet per year in the 1980's (20 percent of total harvests). These exports represented the second highest valued product from the region, but they also represented a reduction in supply to domestic mills. The outlook for future exports is a reduction in quantities.

Domestic competition for logs and changing quality will likely reduce historic exports by a third to a half of their level in the late 1980's (3.7 billion board feet per year in 1988-1989). Much of this decrease has already occurred since 1990, and in the absence of trade restrictions (or tax law changes) log exports will likely stay about at their current level of 2.5 billion board feet per year.

Outlook for Regional Employment

A major concern in the region is the relationship between resource management and future employment, particularly in the rural areas.

Timber-Based Employment

Timber industry employment (including self-employed individuals) was approximately 144,900 in 1990. By 1992 this level had dropped to an estimated 125,400. Employment in this industry had been as high as 152,000 as recently as 1988.

Most of the options addressed here will likely result in a further drop in employment (table 6, fig. 20). Option 7 maintains employment close to its 1992 level of 125,400 but at 85 percent of the 1990 level of 144,900. Options 2 through 5 reduce employment to approximately 117,000, while Option 1 reduces employment to 112,900. Options 6, 8, 9, and 10 reduce employment to approximately 118,600 to 120,900.

Job reductions are heavily concentrated (one-third) in southwestern Oregon (Coos, Curry, Douglas, Jackson, and Josephine counties) – an area that is among the most dependent on federal timber in the region (fig. 21).

Other Natural Resource-Based Employment

A large recreation and tourism industry exists within the region. Currently between 50,000 and 80,000 full-time equivalent jobs can be directly attributed to forest-based recreation opportunities. Tourism employment surpasses 20,000 employees in the coastal counties alone. A large portion of this employment is tied to the recreational fisheries industry.

Federal forest fishing opportunities support about 4,000 to 5,000 recreation/tourism jobs, while ocean catch of salmon supports approximately an additional 1,000 recreation/tourism jobs to the 20,000 mentioned for the coastal counties.

Commercial fisheries employment stands at 5,000 employees and is tied primarily to groundfish, crab, and shrimp (less than 10 percent is currently associated with commercial salmon catch). Future reductions are likely in the fishing industry due to concerns with these other species, particularly groundfish.

Table 6. Historic and projected employment in timber industries in next decade, by subregion and option (in thousands of jobs).[a]

Administrative Unit	Actual	Estimated	Option									
	1990	1992	1	2	3	4	5	6	7	8	9	10
Washington - Owl Region												
Olympic Peninsula	13.9		12.0	12.1	12.1	12.0	12.1	12.0	12.0	12.0	12.1	12.0
Puget Sound	25.7		20.9	21.0	21.0	21.0	20.9	21.0	20.9	21.1	21.0	21.0
Lower Columbia	14.1		12.7	12.8	12.8	12.8	12.9	12.8	12.9	12.9	12.9	12.8
Central	4.2		4.0	4.2	4.3	4.2	4.3	4.3	4.4	4.5	4.3	4.4
Total	57.9	51.3	49.7	50.1	50.1	50.0	50.2	50.1	50.3	50.5	50.2	50.2
Oregon - Owl Region												
Northwest												
West-Central	21.9		20.4	20.8	20.9	21.0	21.3	21.0	22.3	21.4	21.3	21.1
Southwest	20.9		14.3	14.8	14.9	15.0	15.4	15.1	16.4	16.0	15.9	15.5
Central	21.4		11.0	12.3	12.5	12.6	13.1	12.8	15.7	14.2	13.9	13.2
Total	73.1	62.8	53.2	56.0	56.3	56.6	57.9	56.9	62.8	59.5	59.3	57.7
California - Owl Region												
Total	13.9	11.3	10.0	10.5	10.5	10.4	10.5	10.5	10.6	10.9	10.3	10.8
All States - Owl Region												
Total	144.9	125.4	112.9	116.6	116.9	117.0	118.6	117.5	123.7	120.9	119.8	118.7

[a] Includes self-employed in all solid wood products and pulp and paper sectors (SIC24 and SIC26). Wage and salary employment is approximately 7.5 percent less than total employment.

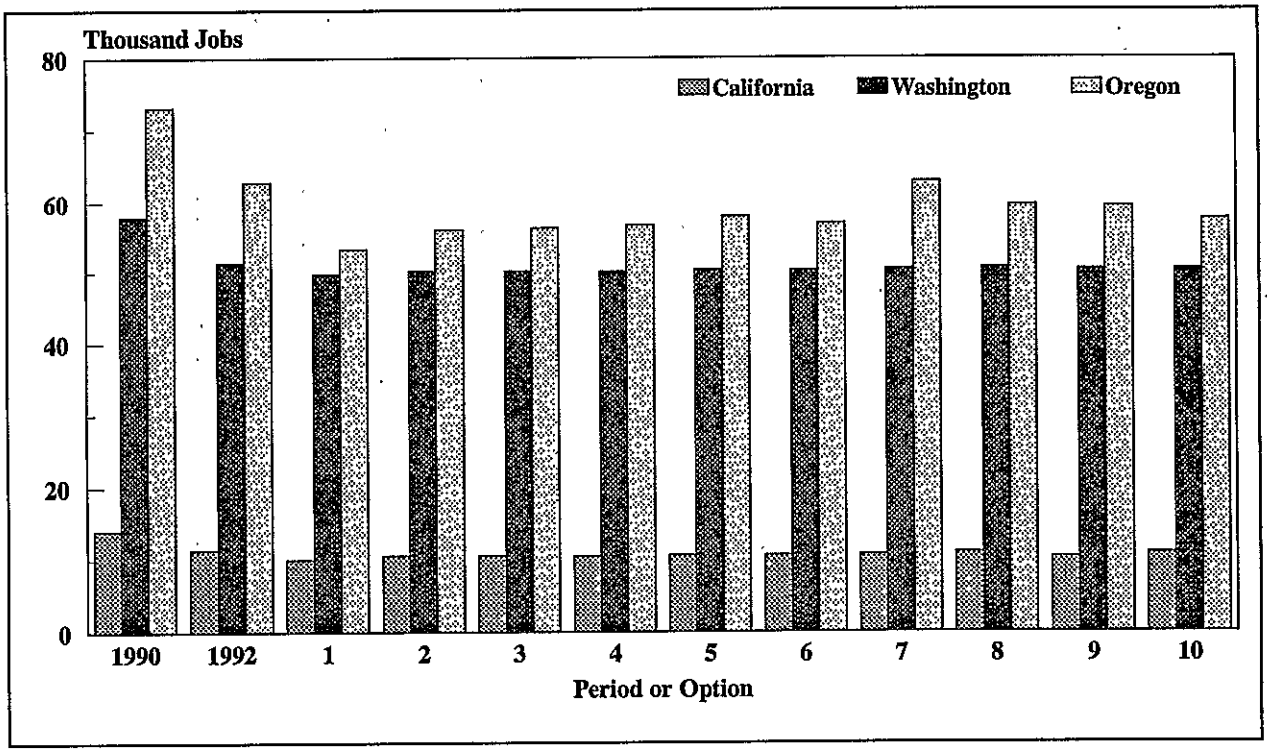


Figure 20. Historic and first decade annual average projected timber industry employment by state and option in the impact region.

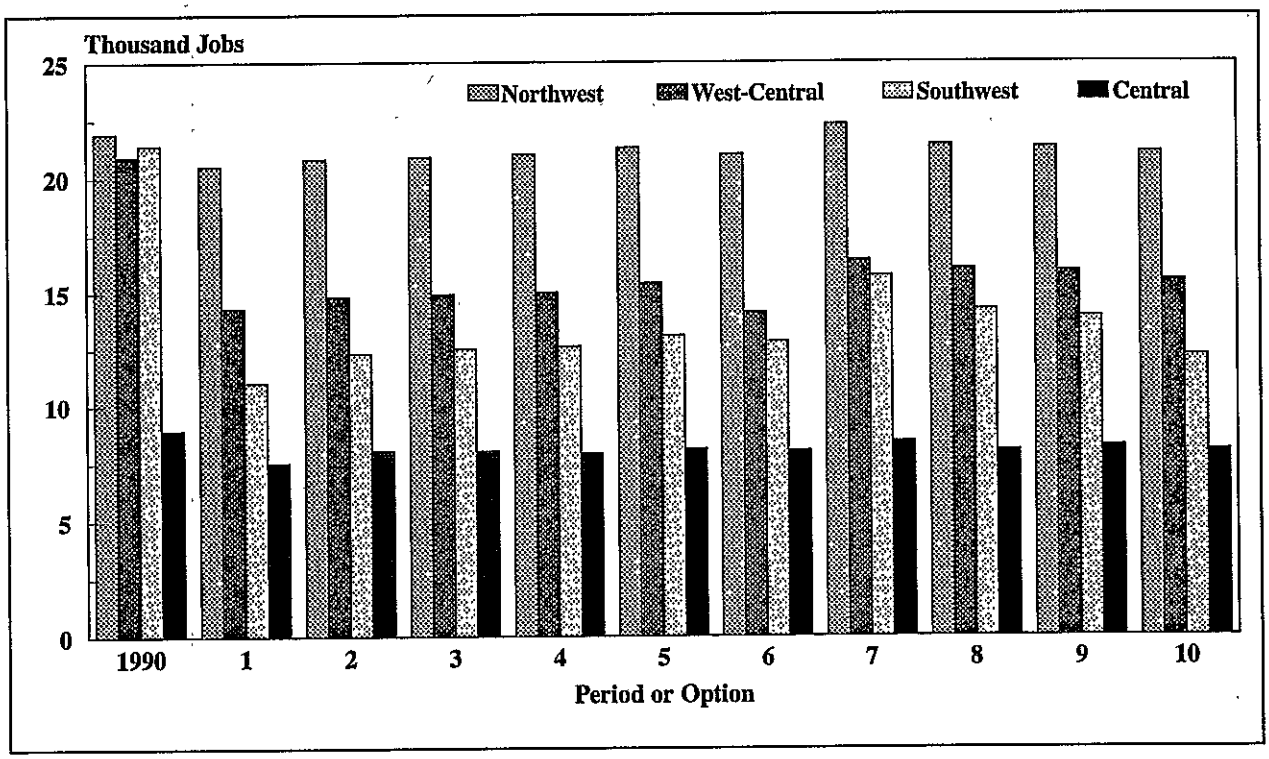


Figure 21. Historic and projected first decade annual average timber industry employment in Oregon by sub-region and option.

Almost 30,000 individuals are engaged in the harvesting and marketing of special forest products. However, many of these jobs are part-time and seasonal in nature. Significant growth may still be possible in this sector, but detailed assessments of potential sustainable yields of special forest products are required before such growth can be calculated.

Forestry Services Sector

Timber industry job numbers do not include tree planting, timber stand improvement, or other forestry labor. The reductions in commercial forest activities in the region will likely displace many of these workers as well, if there are not changes in the level of silvicultural intensity on remaining timber acres. If such changes are made, then opportunities for more intensive silviculture, monitoring, inventory, and restoration may maintain or improve employment in this sector.

Preliminary assessments indicate the potential for up to 6,000 additional jobs in these activities. But many of these are seasonal and the costs per job may be quite high (total program costs of $250 million to $300 million). In addition, startup time of at least 1 year is likely to be required for conducting assessments for designing needed projects. The near-term needs will thus be for highly trained resource professionals as opposed to traditional woods labor. Many of the options assessed by this Team, however, require the restoration and monitoring activities as critical components.

Overall Economic Outlook

In a static view of the Pacific Northwest economy, every job in the forest sector supports approximately one job in other sectors of the economy (induced and indirect effects). Thus, in a static sense, job impacts may be double the level suggested by direct jobs alone.

In a dynamic view of the economy, other industries are growing and/or entering the region and may render many of the indirect and induced effects equivalent to lost opportunities as opposed to actual job losses. The proportions of indirect and induced effects that are actual job losses are hard to deduce.

State-level forecasts for Washington and Oregon do indicate that the aggregate economy will continue to grow, regardless of which of the federal forest management options is selected. Between 1992 and 1995 aggregate employment in Oregon and Washington is anticipated to expand by 4 to 4.5 percent (total, as opposed to annual). Washington's outlook is rather stable, while the Oregon economy is viewed as poised for 7.4 to 8.7 percent aggregate growth between 1992 and 1995. Much of the growth is apt to be in the metropolitan areas, and job gainers may not be the same individuals as job losers.

Outlook for Government Revenues

Large-scale reductions will occur in federal receipts and the shares to local governments. Without legislation that mitigates these losses, local government shares in revenues are anticipated to decline by $147 million to $277 million from the 1990-1992 level of $294 million (depending upon the option) (fig. 22).

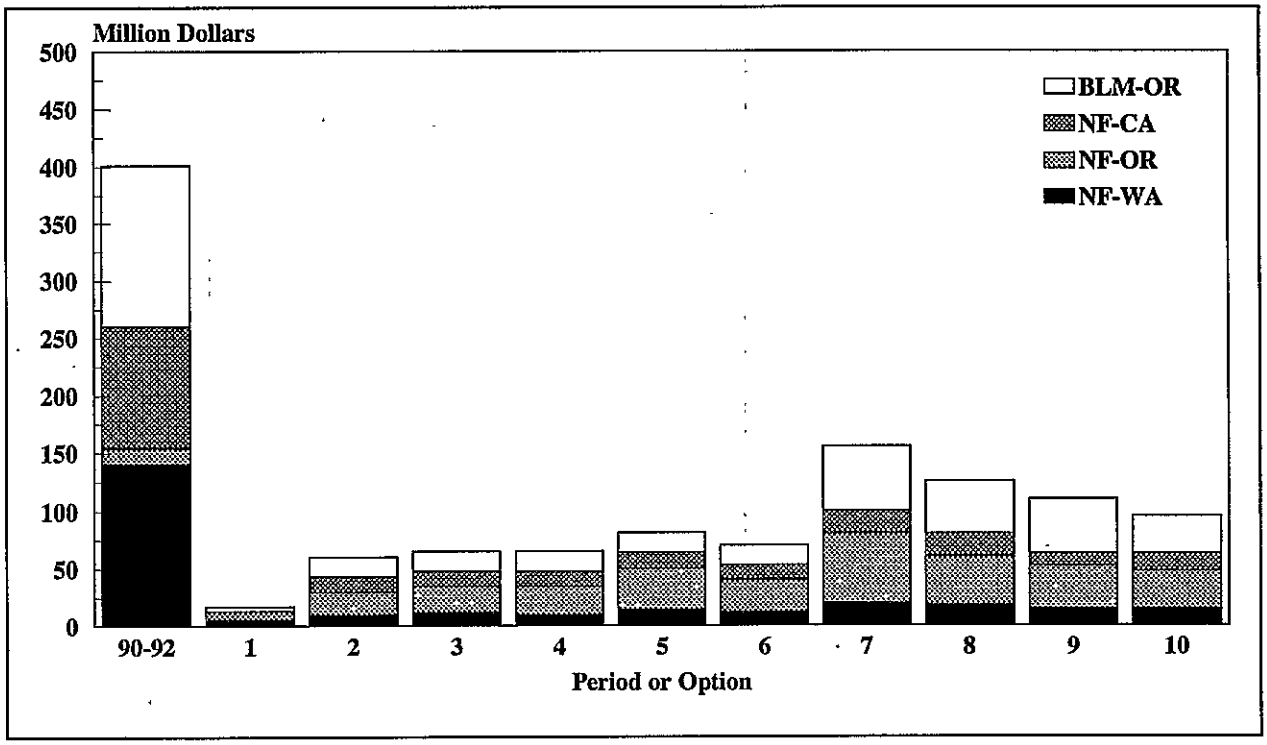


Figure 22. Historic and projected timber payments to counties by state and option.

The reductions would largely impact county governments and county road funds, due to the nature of the distribution formula. Studies from western Oregon show that county governments derived 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, the sum total of local government tax base reliance was 7 percent.

Southwestern Oregon counties would be the most impacted – largely due to the large reductions in Oregon and California Railroad lands receipts. In addition, these counties have historically been the most timber reliant with 55 percent of county funds, 4 percent of school funds, and 20 percent of aggregate local government funds being derived from federal timber receipts in 1988. Studies for Washington and California are still in process.

Outlook for National Wood Products Markets

Several concerns relate to the future of U.S. forest products markets, especially about where future U.S. wood will come from and what will happen to consumer prices.

Regional Harvest Levels

Southern United States timber production will continue to increase, and southern producers are a benefactor of changes in the Pacific Northwest. The Pacific Coast harvest reductions coupled with southern expansion will lead to the Pacific Coast
States' share of softwood timber harvests falling from the 1990 level of 38 percent to 26 percent of the U.S. total by the year 2000.

International Trade

The United States has been and will continue to be a net importer of forest products, primarily Canadian lumber. Wood product imports into the United States are apt to show only modest changes in the decades ahead. Some moderate increases are anticipated from Canada, but no other large changes are expected in the United States' importation of wood products.

Consumer Costs

The production from other regions (domestic and international) and from regional nonfederal timber sources buffers the U.S. consumer somewhat from the changes in the Pacific Northwest federal timber management. Some increase in consumer cost is anticipated from reducing federal supplies and increasing consumer demands, but most of the anticipated increase already occurred between 1990 and 1992 when prices increased 20 percent (in real terms). The large price spike experienced in the early part of 1993 has subsided, and prices within a few percent of 1992 prices are apt to persist through the decade ahead under all options considered (fig. 23). No perceptible differences exist among the options on the average cost of United States homes.

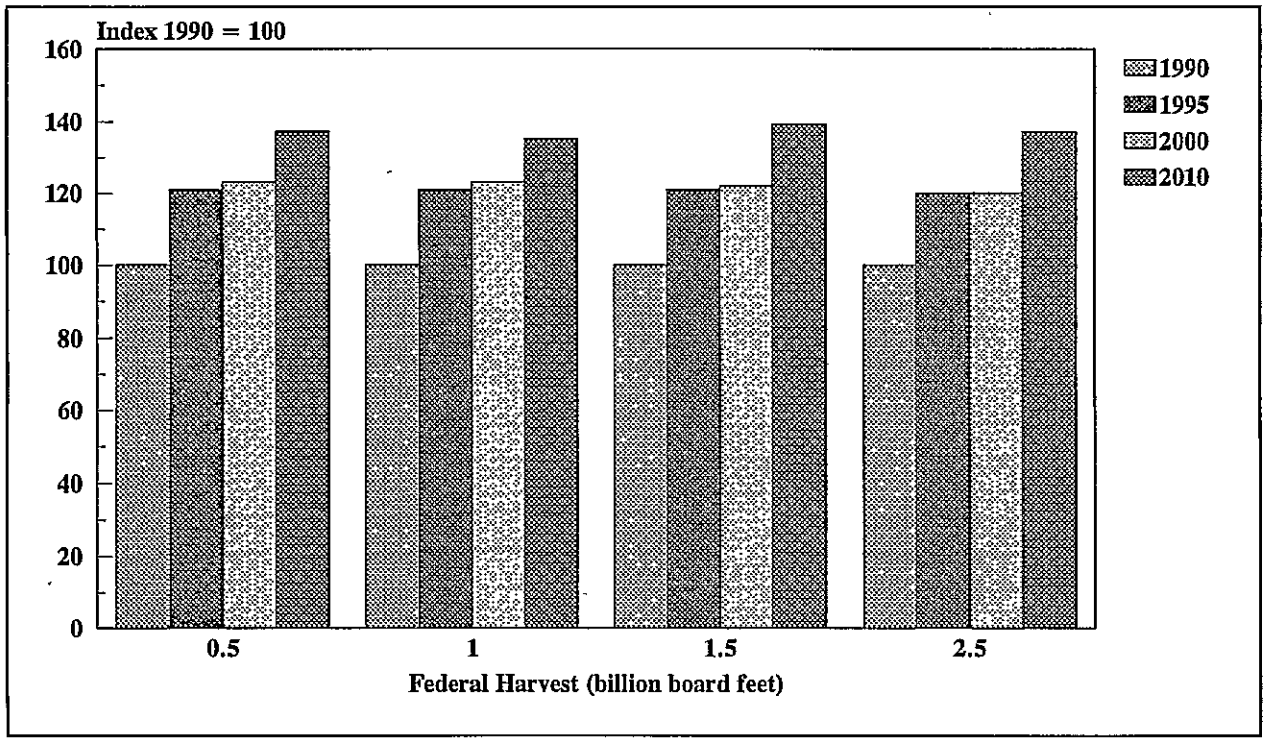


Figure 23. Projected softwood lumber price index under various federal forest harvest levels in the owl region (United States Dollars).

Additional Policy Considerations

Changing federal timber management will reduce wood quantity and quality in the region and place pressure upon the timber industry and the communities of the region. Wood quality available for milling will decline with the declining amount of fine-grained old-growth trees available to the market.

Timber Industry Considerations

Forest products will continue to be a major economic factor in the region. The combined federal and nonfederal harvests will still support employment of over 112,900 individuals in the region. Many questions, however, arise as to how to strengthen the operating position of the remaining industry.

Log supplies to mills will continue to be a concern in the region. These supplies may be increased by (1) more aggressively pursuing fiber supplies on nonindustrial private lands, (2) redirecting currently exported logs, and (3) increasing the importation of wood products that are suitable for further manufacturing.

Market forces will promote much of the incentive for active management of nonindustrial private lands, but in addition some education and training is required, and many landowners will still be hesitant to make long-term investments in timber. Increased management of the nonindustrial private lands could thus be further promoted through more active public service forestry, encouragement of industrial/nonindustrial partnerships through cooperative forest management programs, and increased public assistance either through current cost-share programs or forest trust programs such as that being proposed in Oregon. Currently, the infrastructure is not in place in the region for mobilizing this valuable nonindustrial private resource. Hastening the establishment of this infrastructure should pay benefits to the region in terms of short-term and long-term timber supply and near-term jobs. In the near-term, more than 100 million board feet per year could be realized through rehabilitation of poorly stocked lands.

Export restrictions would likely expand the volume of timber available for domestic processing, but the effects of bans may be less than expected. A ban on log exports would reduce stumpage prices in the log-exporting regions, and would result in less incentive to harvest. Thus, not all the volume of log exports would be realized as volume flowing into domestic mills. Most discussions of the bans ignore quality and geographic differences between the log export and domestic log markets. Much of the log export activity originates in Washington, yet some of the more impacted regions are in southern Oregon and northern California. Finally, there is apt to be a substitution of mill jobs for longshore jobs (in an already troubled coastal economy), and the net effect upon jobs is uncertain.

Sliding-scale tariffs in Japan serve to provide strong, effective rates of protection for Japanese wood products manufacturers and provide additional impetus for exporting lesser-manufactured products. These tariffs inhibit the ability of U.S. wood products manufacturers (particularly high value added manufacturers) to compete within the Japanese markets. A re-assessment of barriers to trade in the Pacific Rim countries may aid in increasing the vitality of the region's producers and redirecting the flow of raw materials.

Wood products imports are becoming increasingly important to wood products manufacturers in the region – particularly secondary wood products manufacturers. Attempts should be made to investigate how the region's Pacific Rim location can be

exploited on an import basis. Logs, lumber, and cutstock from New Zealand, Australia, Chile, and other Pacific Rim countries are valuable raw materials to the mills in the region. Policies that could channel more of these materials into this distressed region for further manufacturing would serve to buffer impacts from domestic harvest reductions.

Technology could also help to extend the utilization of raw material in the mills and create new forms of products that are less old-growth dependent. New generation composite wood products include a variety of structural and nonstructural wood products that can be made from smaller trees and combinations of lumber, veneer, particles, fibers, and plastics. The region has not moved aggressively into adoption of these composite technologies partly because of the uncertainty over the timber supply outlook.

Such product technologies require substantial capital investment. Overcoming the barriers to capital markets in this time of great uncertainty in the region is of great importance. Many of the composite products can serve as inputs to secondary wood products firms and assist in the difficult transitions that these industries must make.

Currently, a large secondary wood products industry exists in the region (over 25,000 employees). Many people are looking to secondary manufacturing of wood products as a source of "mitigating" employment opportunities, yet many existing manufacturers are at risk because, in addition to wood quantity changing, wood quality will as well. The secondary manufacturers of the region have focused on the production of high quality molding and millwork for door and window components. This industry will see a large change and restructuring in the years ahead.

The industry will be seeing greater proportions of construction grades of lumber and less of the type of lumber suitable for the current types of secondary manufacturing. A key to increasing the use of construction grades of wood products is increasing the adoption of manufactured housing and panelized housing. These technologies substitute factory labor for site-based construction labor. The technologies may result in lower wood use per house and may be more economical, particularly as wood prices rise. But the adoption of panelized housing and alternatives to conventional U.S. frame ("stick") housing is slowed by building codes, contractor knowledge, and tradition. Intensive public education programs along with research and development in the area of alternative building technologies could pay long-term dividends to the region and the utilization of forest resources.

One place to start public education would be with smaller manufacturers in the region. Industrial extension activities carried out by the region's universities and community colleges could augment technology transfer to these small manufacturers and provide some impetus for growth and diversification in the forest products sector. Manufacturing technology centers could speed the development and implementation of new technologies that could simultaneously increase raw material recovery and business success. Establishment and promotion of manufacturing and marketing networks provide synergism among the region's various forest products firms.

Recreation and Tourism Considerations

Policies that provide more recreation opportunities that are deemed in short-supply could bolster the region's tourism. This primarily means offering more opportunities for primitive and semiprimitive nonmotorized activities. Retirement of road systems within some Key Watersheds as part of watershed restoration activities could thus provide side benefits for recreation and tourism.

Because currently we fail to fully charge for recreational use of the forest, we tend to understate the value of recreation outputs. Recreation fees, while contentious with much of the public, could provide a source of replacement revenues to the agencies and the local governments. Traditionally, much of the recreation improvement had been funded out of timber receipts. With declining receipts, charges may be required to guarantee a continual offering of public recreation opportunities.

Commercial Fisheries Considerations

A key concern in the commercial fishing industry is the failure to institute adequate limits on the offshore catch and processing of Pacific whiting. The potential job losses to the coastal communities from this resource "drain" are apt to be substantial. While this is not a policy directly related to the management issues at hand, it is a confounding factor in the coastal communities that will be simultaneously impacted by the changes in federal forest management.

Special Forest Products Considerations

This is a rapidly expanding industry in the region. To adequately capture the economic value of products such as mushrooms, boughs and ferns, and to guarantee that the inherent productivity of the resources is not adversely impacted by harvesting of timber, the agencies will need to take a more active role. Standards and guidelines for harvesting special products could be established, and appropriate fee structures could be investigated. Once sustainable supplies need to be established, and then the appropriate role of these products in the region's economy can be fully considered.

Summary

The economics of the alternatives can be viewed at three scales: national, regional, and local. From a national perspective the assessment of the options indicates that the financial costs are apt to be fairly negligible when one views the aggregate markets. There are gainers and losers among the region's forest products producers, and the consumer costs appear low. The national intrinsic values placed upon the forests of the Pacific Northwest also must be considered and can serve to offset the national costs incurred.

At the regional level, the economy has been rapidly expanding for more than two decades and appears poised for continued growth. The changes in federal forest management appear to have modest impacts on this overall rate of growth in the regional economy. In the longer term, maintenance of a high quality environment may be a factor in allowing economic growth to continue in the region.

Much of this regional economic growth is apt to be centered within the more metropolitan areas of the region, and hence these statistics mask much of the hardship that individuals and communities may be confronted with in the decade ahead. Employment in the timber industries will be down 15 - 22 percent from the level of 1990, and much of this reduction will be centered in the nonmetropolitan areas. Many communities are currently distressed, as market conditions and legal circumstances have already created many of the anticipated job losses. The changes in federal forest management does represent a severe impact to many of the individuals, firms, and communities within the region. In addition to job losses, disruptions in local government funding are inevitable without compensating legislation. These local economic costs are real and represent a major policy issue in the region.

Social Assessment of the Options

Not all is well in the forests and communities of the Pacific Northwest.

On April 2, 1993, President Clinton held a Forest Conference in Portland, Oregon. At this Conference, speaker after speaker talked of how in many forest-dependent rural communities, unemployment is high, hope is low, and despair common. People, living in communities long dependent on the forests near them, are reeling under the effects of the changes that are sweeping across the region. As Robert Lee explained to the President at the Forest Conference:

> *We're moving into a process which looks an awful lot like what happened to the inner city. We're seeing the collapse of families, disintegration of families, disintegration of communities, loss of morale, homelessness, stranded elderly people, people whose lives are in disarray because of substance abuse; it's a very difficult situation.*

As Chuck Meslow said to President Clinton:

> *At the time of settlement...the Northwest was blanketed with forests...perhaps 60 to 70 percent was old growth...over 200 years old. Those stands are mostly gone now. Essentially all old forest has been cut on the private lands....on national forest or BLM lands [only] 10 to perhaps...50 percent [remains and]...what remains has been highly fragmented.*

It is the clash of values, institutions, organizations, and policy commitments that define this complex policy issue. To break the gridlock of inaction will require moving beyond the politics of division. One wonders – in a country with our wealth, ingenuity, resources, and capacity – how could this have happened?

The Purpose of the Social Assessment

The purpose of the social assessment is to provide policy makers with an understanding of how potential policy options might affect constituents and stakeholders and an analysis of potential effects on important social values and activities. Our instructions directed that both economic and social consequences, costs and benefits be assessed, and thus social and economic assessments should be jointly considered. In addition to analyzing the consequences of changes in federal forest policy across the options, we suggest strategies for dealing with expected consequences as well as unanticipated ones. We also identify opportunities for collaboration among resource management agencies and citizens, and opportunities for rural citizens to participate in self-assessments leading to effective new strategies for sustaining rural forest communities. As part of our evaluation, we examine the limits of current research and education and suggest ways to enhance both. In sum, our social assessment covers a wide range of the elements related to the questions and concerns associated with the development of policy options for a conservation and management plan for the federal lands in the Pacific Northwest within the range of the northern spotted owl.

Forest Values in Conflict

All forest values represent social valuations of the worth and importance of aspects of the forest. The paradox is that **those social values for which our ability to define and**

measure is poorest, are the very ones that appear to be of increasing importance in our society. For example, the value of old growth as a source of timber can be established in the marketplace; the high quality, clear grade lumber it provides commands premium monetary returns. When other values of old growth, such as the repository of scientific knowledge about forest ecosystems or for the spiritual rejuvenation it brings us, are recognized, it is possible to move beyond the market place and easy ways to express, much less measure, these important social values.

A key point – this conflict in values is not a new problem, there is no technical solution, and current institutional arrangements sustain it. A forest's value is what society perceives it to be; hence, as social values change so do the meaning and value of forests. To successfully develop and implement a conservation and management plan for the federal lands in the Pacific Northwest, it must be recognized that forest management is inherently a political process. Science and analysis can clarify the tradeoffs of alternative policy options but cannot make choices. Current institutional structures often impede our ability to resolve forest management conflicts. An enhanced organizational capacity to respond to changing social, economic, and political conditions is essential to avoiding gridlock. Trust must be recreated. Agencies that act with openness and honesty, in ways that meet the letter and spirit of the law, and that enter into collaborative decisionmaking with citizens are an essential part in moving toward trustworthy institutions.

Effects of the Options on Rural Communities

Forest-based communities in the region are more complex than previous analyses suggest. Rural communities, rather than a unitary homogeneous phenomena, are highly differentiated, composed of a variety of groups, each with different needs, often within the same geographic locality. Understanding effects from federal timber harvest policy requires knowledge about details of the local situation in terms of community demography and infrastructure, the age class and spatial distribution of forests on proposed Matrix lands, and the capacity or age of local mills. Changes in federal forest management must be seen in the context of a variety of factors such as management of other public, industrial, and holdings of nonindustrial private forest lands, technological changes in wood processing, and the dynamics of international trade.

Workshops involving rural community experts revealed a range of possible effects flowing from changes in federal forest policy. These include the degree to which forest management influences the ability of local residents to have their needs and expectations satisfied by community conditions and opportunities; effects on basic income and sustenance needs; the relative adequacy of facilities, services, and infrastructure (both public and private sector); the needs for association, affiliation, and social integration (e.g., the presence of an array of organizations and institutions for expression of interests, provision of emotional support), and employment and income generation opportunities.

Most negative community effects will be concentrated in rural areas, but some urban areas also will be affected, notably those with substantial forest products employment. Communities dependent upon recreation, amenity, or other environmental quality resources may be positively affected by the proposed changes in federal forest management.

Community Consequences Vary

Consequences are the outcomes – positive, negative, or mixed – that result from forest management policies.

Experts on rural communities reported different levels of consequences from the options for each state (figs. II-24-27) (see chapter VII). On the basis of expert ratings from two workshops, the negative effects of federal harvest reductions appear to be most dramatic at the state level in Washington. The effects for Oregon communities, although significant, appear most variable across the options. The outlook for the California communities assessed is not much more optimistic, but not particularly as a result of federal land management. Experts from California indicated that communities surrounded by federal lands, which were typically smaller and in isolated mountainous areas, were likely to have more negative consequences regardless of option.

Groups Within Communities are Affected Differently by Options

In addition to impacts at the community level, groups within communities can be affected differently. If one focuses on groups and individuals most negatively affected, it is apparent that, even in communities near urban centers, some occupational groups and their families will feel serious impacts.

Groups within communities vary in their ability, willingness or both to respond to economic shifts. What might seem like rational adaptation from one perspective might be "out of the question" for others. Social mitigation strategies can backfire if not sensitive to differences among community groups; such strategies might even increase conflicts and frustrations on the part of groups "left behind." These conflicts pose serious questions about the ability of groups in the region to work together to solve common problems.

Community Capacity

Community capacity involves the ability of residents and community institutions, organizations, and leadership to meet local needs and expectations. Community capacity is related to structural and locational characteristics and varies in reasonably predictable patterns. Those communities with the best access to transportation, markets, and raw materials, and that have the greatest economic diversification tend, on balance, to have the greatest capacity. Community capacity is also related to the quality of community leadership (e.g., energetic, active, inclusive, well connected with community assistance). Such leadership varies widely across communities and suffers in communities with divisive politics.

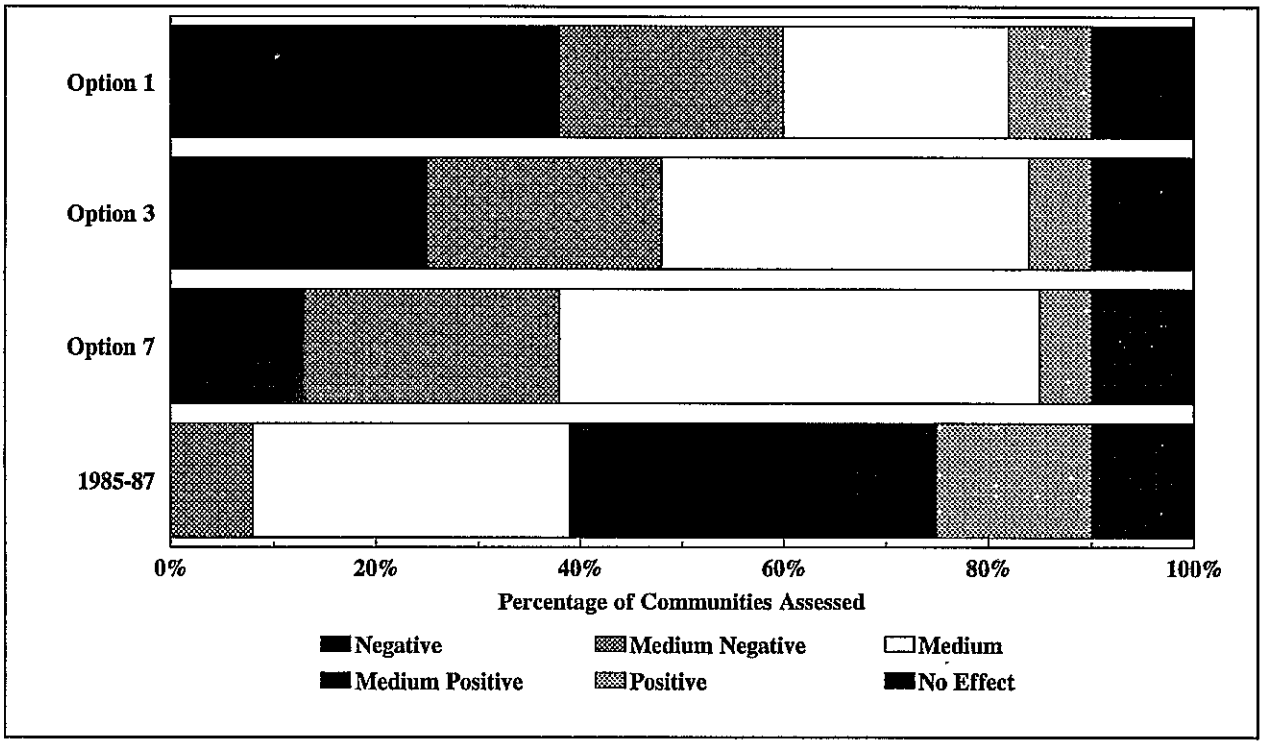


Figure 24. Predicted consequences of four federal land management scenarios on communities in Northern California, Oregon, and Washington.

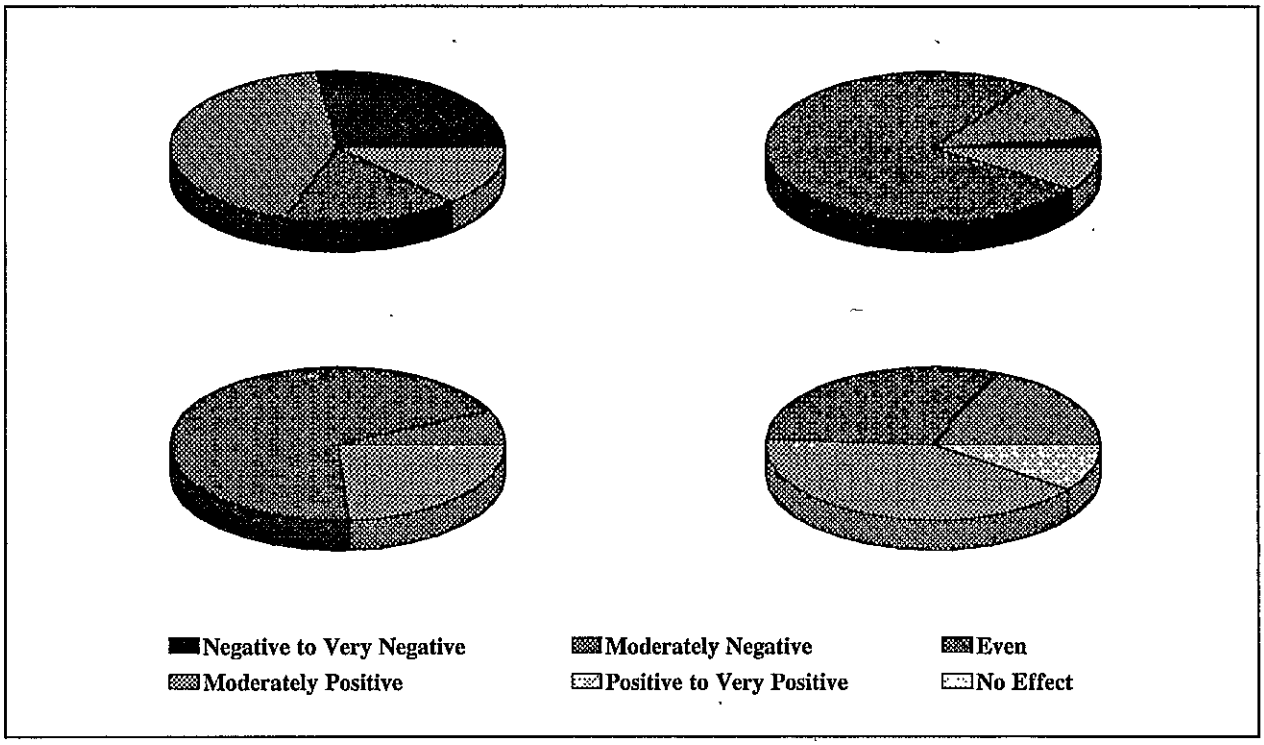


Figure 25. Consequences of Options 1, 3, 7 and the 1985-87 scenario for California.

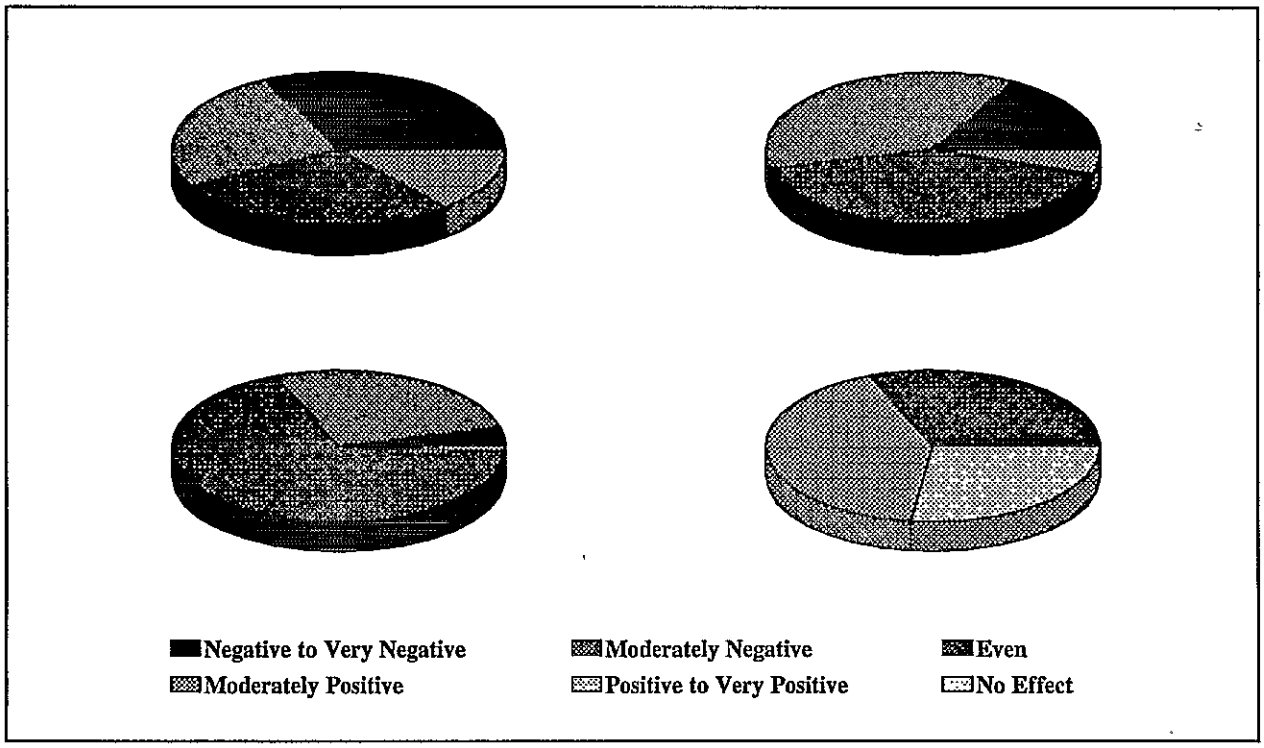


Figure 26. Consequences of Options 1, 3, 7 and the 1985-87 scenario for Oregon.

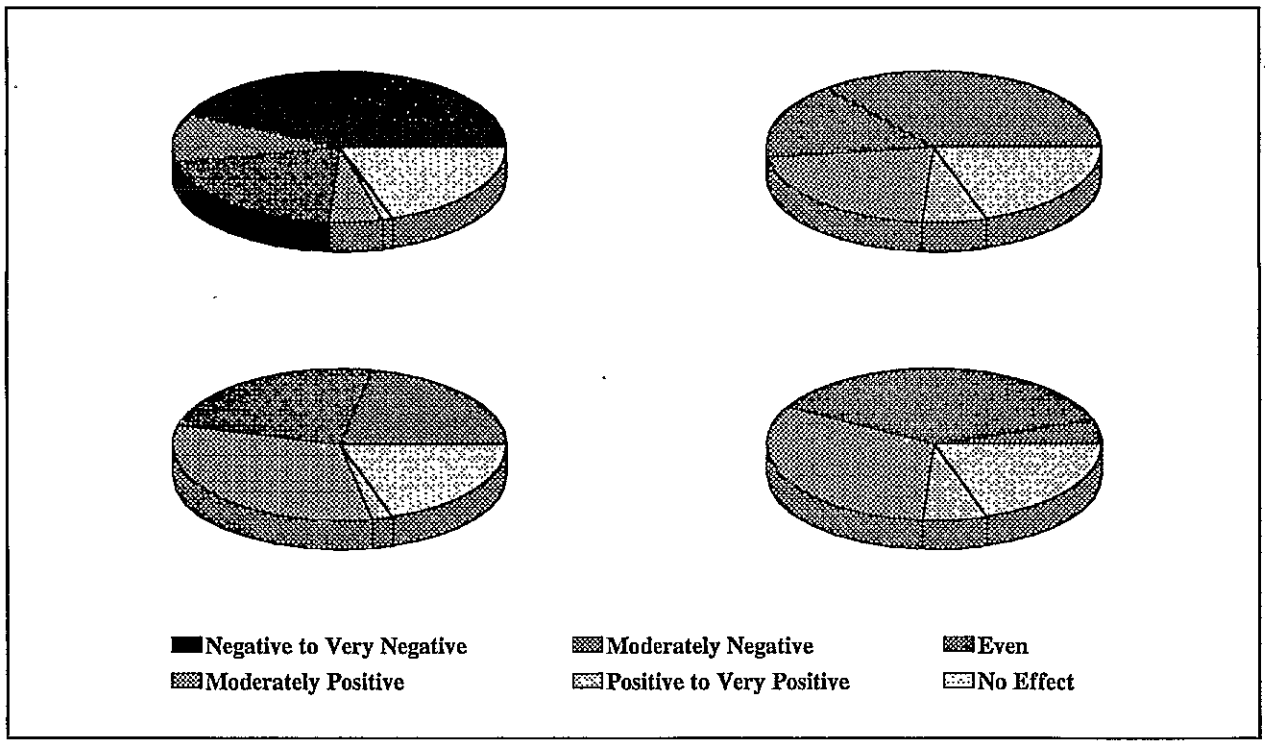


Figure 27. Consequences of Options 1, 3, 7 and the 1985-87 scenario for Washington.

High capacity communities are judged to be less sensitive to variation in consequences across the options. Many coastal communities in all three states are likely to have higher capacities and more positive consequences. Many of these communities have more developed tourist industries and often more diversified economies.

Community capacity varies little across the three-state region (fig. 28). It does, however, vary considerably within subregions of Oregon and Washington (northern California is one subregion).

Policies that focus on improving community capacity cannot be conceived as quick fixes because considerable time is required for people to develop trust needed for cooperative action and skills for new activities. Community capacity can be enhanced by interventions such as sustained technical assistance, leadership training, improved access to capital, and increased genuine involvement in forest planning and management.

Consequence ratings for the options for high capacity communities tend to be close to the mid-point of the scale (even mix of effects) and ratings for each option are close to one another, while ratings for low capacity communities tend to be concentrated more toward the negative end of the consequences scale (see fig. 29). Consequence ratings for low capacity communities also vary among options, reinforcing the notion of these communities' greater reliance on federal timber.

Communities at Risk

The decision as to how to define "acceptable risk" is ultimately a political decision. Perceptions of what constitutes acceptable risk will differ among different stakeholders. Because of these variable conceptions among constituents, any judgment as to what will be considered acceptable risk must involve negotiations among all relevant stakeholders, with scientists and technical experts playing the role of advisors.

To assist policymakers and others concerned with risk, we have defined those communities with low capacity and facing negative consequences from the management options (see the shaded area of table 5) as "most at risk" communities. Under Option 1, one-third of the communities assessed fell into the category of "most at risk." With Option 3, the total fell to 27 percent, and to 22 percent with Option 7.

Not surprisingly, the communities "most at risk" in Options 1, 3, and 7 appear to be those highly dependent on the timber industry. We judge that few of these communities (only 3 percent of all assessed communities) would experience negative consequences with the 1985-1987 forest management scenario (this period was selected as representing a mid-point of federal timber sale levels over the period 1980-1992). Obviously, though, these levels of harvest are not sustainable from public lands under present circumstances of law. Options 1, 3, and 7 likely would lead to additional mill closures and reduced employment from present levels in the forests, and the economic and social infrastructure in these communities would suffer.

As an alternative, "most at risk" communities can be defined as those with medium to very low capacity and even to very negative consequences. With this definition, the proportion of communities defined as "most at risk" increases dramatically (noted the dotted line on table 5); for example, nearly 60 percent of the communities under Option 1 would be so defined.

Some experts in the workshops stated that isolated communities were more likely to experience negative consequences with Options 1, 3, and to a lesser degree Option 7,

because they had few options available locally or in nearby communities and because of limited access to capital and other resources.

Communities that are small, isolated, lack economic diversity, are dependent upon public harvests, and have low leadership capacity are more likely to be "most at risk" than others. These communities are less able to mobilize and respond to changing conditions that may affect a variety of social groups. These communities are likely to suffer unemployment, increased poverty, and social disruption.

Factors other than those associated with the options place these particular communities at risk. Their very structure and location are part of the equation. Policy responses to assist these communities should go beyond timber and jobs. Policies that address limited structural diversity, lack of infrastructure, and coping strategies will be potentially helpful to these communities.

Table 7. Relationship among community capacity, consequences of options, and risk to local communites (expressed as a percentage of communities assessed).

Option 1 Consequences to Community

Capacity	Negative	Moderately Negative	Even	Moderately Positive	Positive
Low	12	3	0	1	0
Medium Low	13	33% 5	3	2	1
Medium	8	8	58% 7	1	0
Medium High	7	4	4	3	0
High	2	4	9	4	0

Option 3 Consequences to Community

Capacity	Negative	Moderately Negative	Even	Moderately Positive	Positive
Low	7	5	1	1	0
Medium Low	9	27% 6	6	2	0
Medium	4	10	58% 10	1	0
Medium High	6	3	9	1	0
High	1	3	12	3	0

Option 7 Consequences to Community

Capacity	Negative	Moderately Negative	Even	Moderately Positive	Positive
Low	4	6	3	1	0
Medium Low	6	22% 6	10	1	0
Medium	2	6	58% 15	2	0
Medium High	1	5	11	1	0
High	1	2	16	1	0

1985-87 Consequences to Community

Capacity	Negative	Moderately Negative	Even	Moderately Positive	Positive
Low	0	2	6	4	4
Medium Low	0	3% 1	12	9	2
Medium	0	0	29% 8	10	6
Medium High	0	1	4	10	3
High	0	2	4	11	2

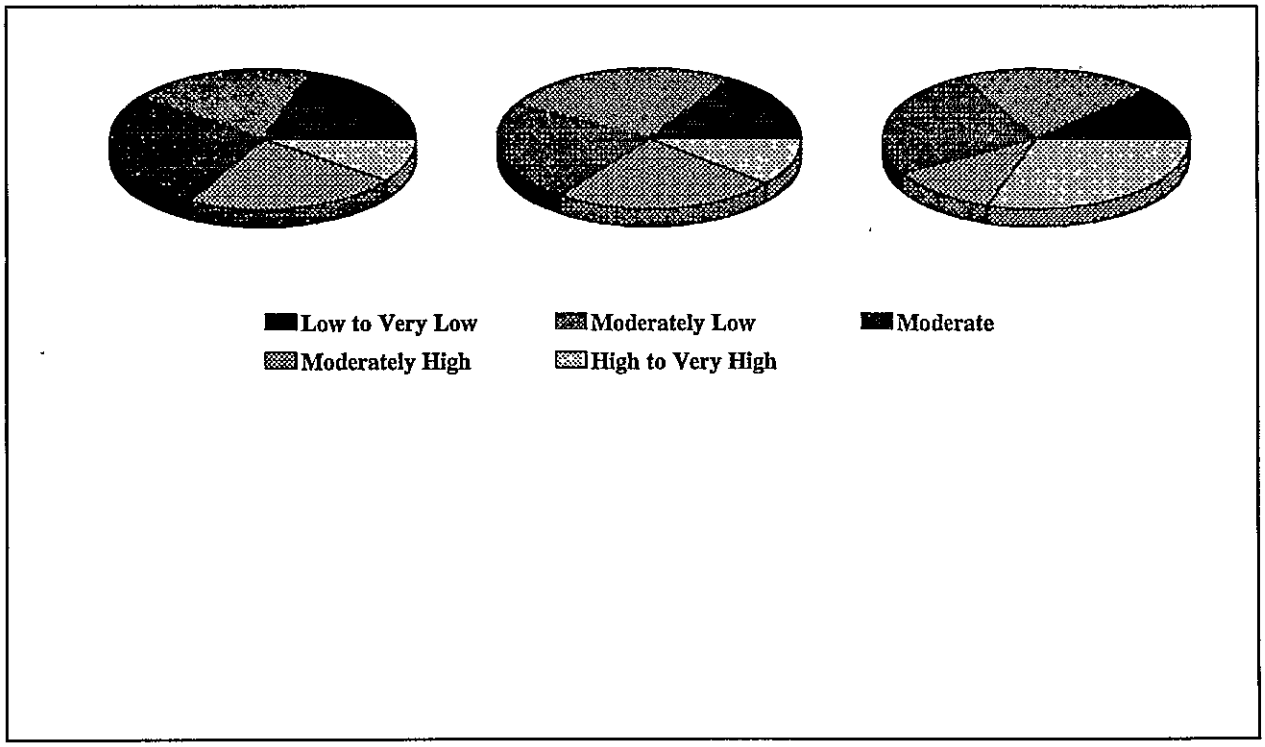


Figure 28. Community capacity in California, Oregon, and Washington.

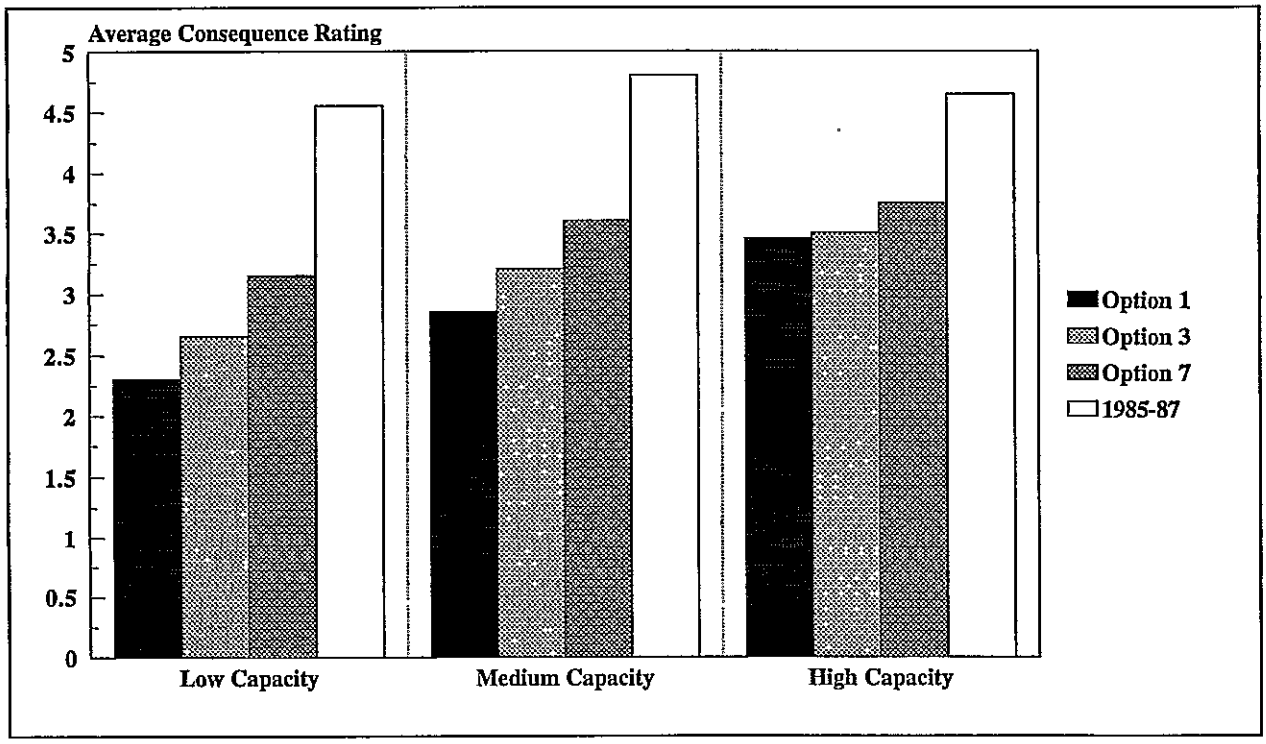


Figure 29. Consequence ratings by option by capacity category.

Risk labels can be a double-edged sword. The perception of risk can mobilize individuals and community leadership into action (e.g., woods 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, the label of "being at risk" can also paralyze and demoralize community members, increase social disruption, and create indirect impacts on communities (e.g., red-lining of communities by banks).

Although poverty in rural forest dependent communities has increased over the past decade for numerous reasons, the current and lengthy gridlock is adding to poverty levels. The increase appears related to a variety of factors that vary by state; in Washington, it appears more directly linked to changes in federal forest management than in California.

Transition in Rural Communities

Some negative consequences can be explained by economic shifts already under way. For example, globalization of the economy and replacement of labor by technology in mills and factories is having a profound effect on the economic well-being of many rural communities.

Even communities undergoing positive economic and social transitions from reductions in federal timber harvests may have only limited options. As these communities make the transition from a commodity-based economy, issues related to economic diversity and isolation may persist. Growth in any one sector – be it tourism, health care, agriculture, or light industry – is not a panacea for all timber-based communities.
Although small communities are noted for their internal ties among community members, they are increasingly linked in significant ways with outside organizations and interests. In the Pacific Northwest, the most significant linkages are federal land management agencies, state fiscal and institutional support services, and private industry headquartered outside the community. Local residents feel that outside support efforts often lack clear goals and integration (e.g., federal retraining programs, state jobs programs, and county jobs corps). Many programs "from above" are perceived as demeaning.

Periods of transition do not always result in severe social disruption, and in many instances, disruptive consequences of instability and rapid change are temporary. However, the circumstances associated with possible changes in management of old-growth forests substantially alter the nature and pace of transitions confronting some rural communities. A decision to reduce timber harvest from federal lands would not only accelerate a downturn in some communities, but might cause a permanent rather than transitory shift in social and economic contexts.

Certainty about harvest levels has never been achieved in the past, nor is it likely to be achieved in the future. Nothing in the options proposed by the Forest Ecosystem Management Assessment Team addresses management of other public and private forest lands. This implies that a measure of harvest uncertainty will persist even if predictability on federal lands is possible. In addition, ecosystem management is a new approach, and we must be cautious when predicting future harvest levels.

Implications for Community Policy

The plight of many rural Pacific Northwest communities is a serious concern. At the root of the problem lies the inability of many communities to respond adequately in the face of significant and rapid changes that characterize forest management.

In our discussions with community experts, a number of key policy issues were raised. We discuss several here. They are elaborated in the chapter Social Assessment of Options.

1. Communities desire stability, predictability, and certainty. Attempts on the part of communities to cope with change are greatly constrained by the recent high levels of uncertainty.

2. Communities need an improved, stable tax base to support basic infrastructure such as schools, social services, and transportation.

3. Communities feel they are not a part of decisions that affect their well-being; they want agencies to be more responsive to their concerns.

4. Some communities feel themselves and their culture under siege from a hostile urban world that neither understands nor cares about them.

5. Additional family and individual stresses result from job loss, declining incomes, and other economic factors.

6. Rural communities often feel at the short end of larger economic and social changes over which they have little or no control.

From these broad policy concerns, we can derive a number of specific strategies and programs.

1. Land management resource policies urgently need to be predictable, unified, and realistic in both the short and long term. This will help reduce uncertainty under which communities find themselves today and will improve their ability to work with managing agencies.

2. Means must be found by which local communities can expand their capacity to help themselves.

3. The need to increase the role of the community in decisionmaking, includes, but is not limited to, the application of local skills and knowledge in the implementation of forest management plans and watershed restoration.

4. Collaborative relations are needed among governmental levels and agencies and between government and citizens.

5. Individuals and communities need to use existing network of programs and expertise at local, state, and federal levels.

6. It is important to distinguish between short- and long-term needs. Short-term responses are designed to mitigate immediate community impacts of harvest reductions, and long-term responses are designed to enhance the communities' capacity so they are less vulnerable to any single external event.

7. Assembling appropriate and comparable information would aid communities, states, and the federal government to develop, implement, and monitor problem-solving programs.

8. Job retraining is the focus of much interest. Community experts confirm its importance but also identified the limitations of retraining. Although it can mitigate some impacts, retraining may also increase others if designed and implemented without adequate attention to broader community issues and individual needs.

Selection of an option should be viewed as a starting point for the involvement of communities in discussions of forest management, not decisions to be imposed from above. As Louise Fortmann noted at the Forest Conference:

> *"We need healthy forest communities ... that can take responsibility for successfully solving their own problems ... we need locally based planning processes that enable local people to develop and implement diverse policy options ... and we need state and federal policies that will facilitate these local processes."*

Under all of the options, involvement of communities and interest groups will come primarily during the implementation phase of the process. This will begin with the opportunity to comment on the draft environmental impact statement that will be issued with an identified preferred alternative. Community involvement should be expected to come most effectively to bear during the implementation phase of reinstituted forest and district planning (i.e., Phase II Planning).

Effects of the Options on Native American Peoples and Culture

Indian tribes and groups are governments and communities that are affected by natural resource policy. Federally recognized tribes possess legal status, and in Washington and Oregon they also possess off-reservation rights held in trust by the U.S. government. Treaty rights have been interpreted to have precedence over subsequent resource uses and must be accommodated by agencies.

The 25 federally recognized tribes in California and the 36 tribes within Oregon and Washington have cultural interest or have reserved treaty rights within the area of study (fig. 30). Of these tribes, 25 have treaties and 10 have Executive Orders that affirm certain rights – both on and off reservations – for water, gathering, hunting, fishing, and other activities and resources.

Access to and use of certain plants (e.g., sedges, cedar), animals (e.g., deer, eagles), and locations (e.g., fishing locations) are vital to the cultural survival of a number of Indian tribes and communities. Plants provide food, medicines, and materials for utilitarian and ceremonial items. Certain plants are essential for items that play key roles in renewal of the earth, becoming an adult in society, and are ultimately critical for "being Indian."

Because individual tribes were not represented in the Forest Ecosystem Management Assessment operations, and information available from the agencies is inadequate, it is difficult to determine all ways tribal concerns may be affected by federal forest policy and practices. Comments from the affected tribes should be solicited during the environmental impact statement review process.

Mixed impacts are associated with various tribes and groups. Oregon and Washington tribes probably would find Option 1 beneficial, but the Hoopa Tribe might drop a proposed land exchange with the Six Rivers National Forest under either Option 1 or 3. Tribal members

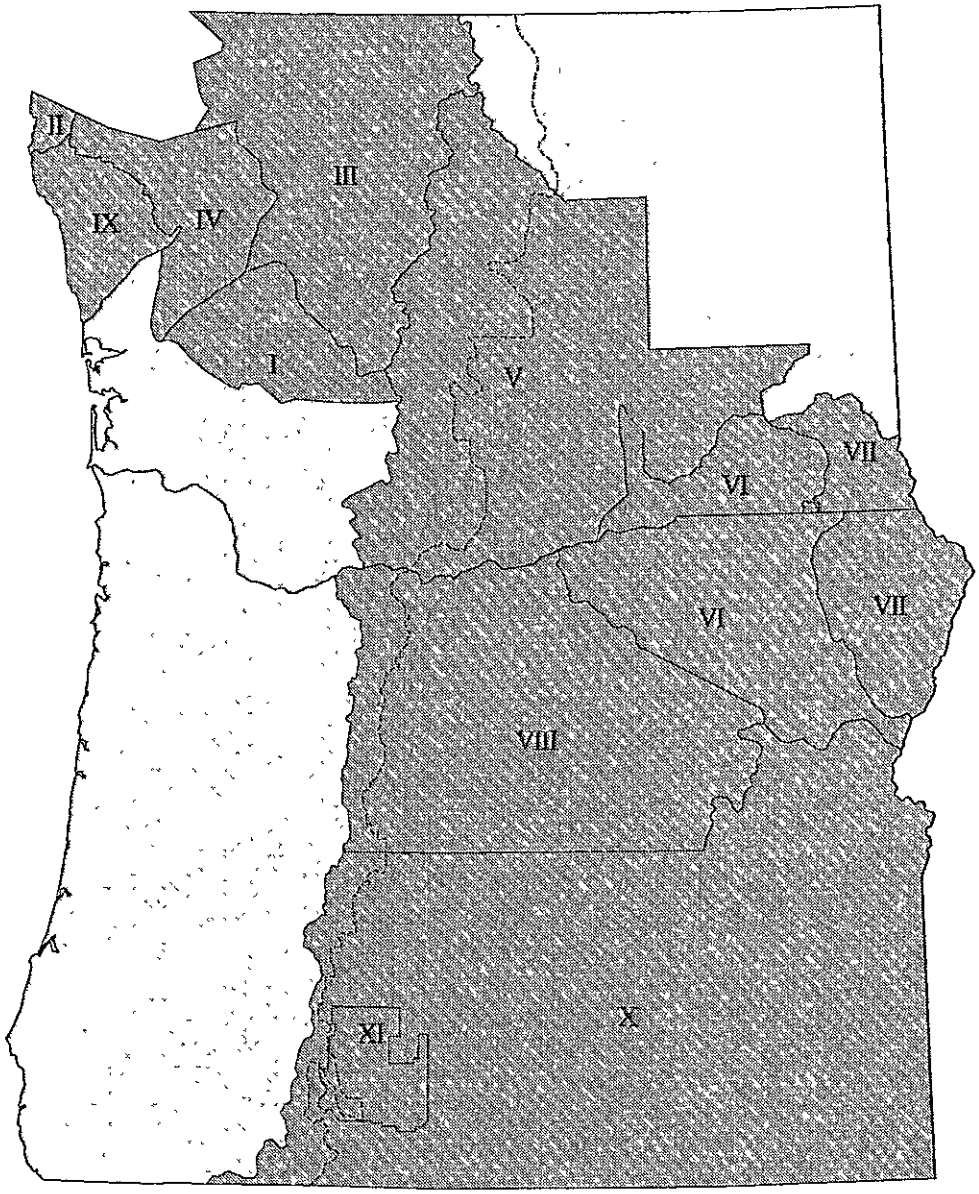
have come to depend on public lands and resources for employment, subsistence, and cultural identity. Restrictions on access and harvesting in Reserves could constrain Native American access to forest materials used to support traditional practices and subsistence activities and to harvest of timber as an employment opportunity. Reduced access in Reserves might, however, help ensure greater privacy to engage in spiritual and cultural practices.

The implementation of standards and guidelines – the specific rules that govern management within different management areas in the forests – have the potential to either constrain or facilitate many of the practices and activities undertaken by Native Americans. For example, standards and guidelines that prohibit or discourage the collection of certain plant materials could affect tribal rights and cultural subsistence practices. Habitat protection measures, such as controls on use of fire, could also have substantial effects if these controls occur within traditional gathering areas (e.g., for grasses) that need to be burned. Prohibitions on removal of Port Orford cedar in old growth on the Klamath National Forest would adversely affect Karuk Tribe members engaged in "rites of passage" ceremonies.

As with many rural residents (tribal and nontribal), there was concern with constraints imposed on timber harvesting in all options; specific areas that the Karuk and Klamath Tribes have requested be managed for "full yield" would be located in Reserves in both Options 1 and 3, and there generally appears to be little difference in consequences associated with Options 1 and 3.

TREATY BOUNDARIES

Oregon and Washington



I MEDICINE CREEK TREATY
II MAKAH TREATY
III POINT ELLIOT TREATY
IV POINT NO POINT TREATY
V YAKIMA TREATY
VI WALLA WALLA, CAYUSE TREATY
VII NEZ PERCE TREATY
VIII MIDDLE OREGON TREATY
IX QUINAULT TREATY
X KLAMATH TREATY
XI FORMER KLAMATH RESERVATION

Spotted Owl Range Line

July 1993 1:4041000

Figure 30. Treaty boundaries for Oregon and Washington.

Effects of the Options on Recreation, Scenery, Amenities, and Subsistence

Recreation, scenic, and related amenity values of forests have been central to both the popularity of forests and the concern expressed in public involvement. Indeed, it was the burgeoning recreational use on National Forests and other public lands in the 1950's that foreshadowed much of the public awareness and concern regarding forest management that arose in the 1960's. Subsistence activities on forest lands embrace many levels of effort, ranging from casual collection of firewood to significant economic enterprises such as harvesting mushrooms, floral materials, and other forest products. Collectively, these activities represent a major source of values that people derive from forests.

Recreation

Both the Bureau of Land Management and Forest Service have made broad recreation management allocations on lands under their jurisdiction. The allocations are based on the recreation opportunity spectrum with six basic categories: primitive, semiprimitive nonmotorized, semiprimitive motorized, roaded natural, rural, and urban.

We were particularly interested how the options would affect the current allocations of primitive and semiprimitive nonmotorized recreation. To what extent would these allocations be located in the Matrix as opposed to one of the Reserve classifications? The basis for this particular concern is that recreation-demand information, reported in both the Oregon and Washington State Comprehensive Outdoor Recreation Plans, indicates a high and increasing demand for recreation settings featuring low levels of development and management activity, with relatively low levels of use, and where motorized access is not permitted. Thus, it is clear that settings catering to these forms of recreation are especially valuable to the public. Decisions that might affect these areas by making them more accessible or subject to modification (e.g., road building, timber harvesting) need to be carefully considered in light of this information.

We examined the way in which current primitive and semiprimitive nonmotorized acres would end up in the Matrix in Options 1 and 7. As table 6 indicates, over half of the primitive and semiprimitive nonmotorized acreage in each state will lie within the Matrix, in both Option 1 and 7; nearly two-thirds of the acreage in California and Washington would be in the Matrix in Option 1. In Washington, Option 7 actually would result in slightly less acreage being located in the Matrix than would Option 1. Although the range between Option 1 and 7 in Oregon is only 6 percent, this represents over 100,000 acres. Combined with distributional effects of the different options (which we were unable to fully capture in our analysis), the effects of the two options could be quite different.

It remains problematic as to what the implications of these effects will be because options vary significantly lending to uncertainty about how and what specific management actions will be prescribed for either the Matrix or Reserves. The fact that areas currently allocated to primitive or semiprimitive nonmotorized recreation are located in the Matrix does not automatically mean they would become roaded or otherwise developed. Conversely, the fact that they are located within a Reserve does not automatically preclude the possibility of some developmental activity. However, given the conservation objectives and species viability concerns associated with Reserves, it is likely their overlap with these types of recreation areas will result in additional protection, as well as an opportunity to provide a desired and demanded recreational setting.

Scenery

Negative effects on scenery from extensive timber harvesting are a major public concern. We examined the extent to which areas currently managed for the most natural appearance (either for retention or preservation visual quality objectives) would be located in the Matrix. The preservation visual quality objectives permits only ecological changes in the landscape; retention objectives require that management activities are not visually evident. As table 7 indicates, over half of these visual quality objective areas would lie within the Matrix in each state in Option 1. There are not large differences among the three states. In Option 7, the percentage rises in all three states, but especially in California.

Option 1 would result in between 35 and 60 percent of the modification and maximum modification landscapes falling within Reserves as table 8 shows. When Option 7 is considered, the figures drop sharply; only in Washington would a significant proportion of these areas be located within Reserves.

Locating areas managed for these visual quality objectives in the Reserves again does not necessarily imply that changes in the visual quality objectives would occur (e.g., from modification to retention). However, it does provide an opportunity to re-examine the objectives and to undertake steps to create a more naturally appearing landscape.

For both recreation and scenic values, the options present opportunities to meet important public concerns and interests. The provision of primitive, nonmotorized recreational opportunities and creation of more naturally appearing landscapes are consistent in many ways with conservation objectives associated with Reserves. Specific management of both the Matrix and Reserves will be guided by standards and guidelines developed for these areas. The opportunity to increase the flow of human benefits to the community that this discussion reveals should be an important influence upon the standards and guidelines.

Roadless Areas

A contentious issue in forest management is the status of roadless areas. Despite efforts to resolve the roadless question (Roadless Area Review and Evaluation I and II and land management planning), those areas where road development has yet to occur remain a major public concern. Many remaining roadless areas will be included within the Reserves in the options but are open to logging after watershed analysis in some options. However, some key areas will be in the Matrix and this will lead to public concerns about potential development and roading of these areas particularly where Riparian Reserves are concerned.

For example, on the Siskiyou National Forest, under Option 1, about 20 percent of the nearly one-quarter million acres of unroaded lands will remain outside reserved areas and within partial- or full-yield timber management areas. This includes the North and South Kalmiopsis and Shasta Costa, areas of regional and national debate since the early 1970's. Under Option 7, 37 percent of this roadless acreage would be outside the Reserves.

Table 8. Percentage of retention and preservation visual quality objective lands located in Matrix in Option 1 and 7 (by state).

	Current Acreage	*Option 1*	*Option 7*
California	1,575,770	58	79
Oregon	1,837,338	54	64
Washington	3,207,015	58	63

Table 9. Percentage of modification and maximum modification visual quality objective lands located in the Reserves in Option 1 and 9.

	Current Acreage	*Option 1*	*Option 7*
California	2,517,272	35	13
Oregon	4,858,015	40	28
Washington	1,903,733	61	45

Special Forest Products

A large and expanding range of products are gathered for both commercial and personal use from the region's forests. Products include mushrooms, firewood, and floral materials such as salal and ferns. Several participants at the Forest Conference also addressed this issue, arguing that in some cases the monetary value of these alternative products exceeded that associated with timber harvesting as Louise Fortmann commented, *"Let me stress that forest dependence is not synonymous with timber dependence. There are diverse forest-based livelihoods."*

Information on which to judge effects of the options on special forest products is largely absent. The availability of special forest products might be constrained in Reserves to protect plant and animal species and habitat, although the sustainability of these products also deserves consideration. Effects would be particularly felt by commercial collectors who represent a growing cottage industry in rural communities. Migration of Asian and Hispanic populations into rural communities has increased demand for many of these products, both for commercial purposes and to support their way of life.

Barriers and Solutions to Interagency Collaboration

At the Forest Conference, President Clinton stated a vision wherein there will be "one government" focused on public service with respect to management of the federal forests. There seems wide concurrence that federal agencies are not working together, at least not as they might or should. Our workshop participants agree. We found that:

1. A strong consensus exists among participants about the nature of the problems and needed solutions.

2. This group of workshop participants showed a capacity to engage in collaborative, self-critical thinking. As Jack Ward Thomas commented to the President at the Forest Conference, *"You command incredibly talented people...they are highly skilled. They are incredibly motivated. They can do marvelous things..."* Within the organizations is a rich body of creative, energetic, and innovative people capable of bringing about significant change.

3. There is wide recognition of the need for fundamental change, and there is an appreciation that marginal changes will not suffice.

4. A rich mix of ideas and suggestions exists, ranging from the relatively simple (e.g., detailing personnel between agencies) to the fundamental and complex (e.g., consolidating agencies, drafting new legislation).

5. Ideas this group identified are consistent with many of the findings we discovered in the course of this social assessment. There is strong support for collaborative decisionmaking processes involving local communities and the full range of interests; there is concern with the inadequate databases from which critical decisions must be made; there is a recognition that the loss of trust must be overcome; there is a concern about the failure of leadership within the land management agencies.

Agency and Citizen Collaboration

Criticizing government agencies often seems to be a national sport. But there are a variety of examples of successful collaboration between land management agencies and citizens. Such efforts are characterized by motivated individuals, agency incentives, and support from agency superiors. Conversely, barriers to successful collaboration include tradition-bound superiors, lack of time, money, and energy; and lack of experience, skills, and confidence.

Various opportunities could increase the quantity and quality of interactions among agencies and citizens: (1) deal with the nonagency world honestly, effectively, and durably; (2) provide incentives to encourage innovation, creativity, and risk taking; (3) legitimize, sanction, and reward efforts to build effective linkages to the nonagency world; (4) make it easier for nonagency groups and individuals to interact with the agencies; and (5) encourage management agencies to see communities and interested citizens as equal partners in management of public lands.

Lessons Learned

Some key lessons emerged from the social assessment. Several of the more important lessons include the following:

The current situation (gridlock) is a legacy of many failures.

Fragmented land ownership patterns, unresponsive forest management policies and practices, inadequate monitoring and evaluation of the conditions of both federal and nonfederal lands, fears (often well-founded) about effects of changes on community health and stability, and lack of a shared vision about the future all contribute to gridlock. Skepticism and cynical views mean that actions will be evaluated, not slogans or labels. Observers will quickly determine if pronouncements are real, or mere window dressing for business as usual. Clarity of vision, inclusion of all potentially affected interests, and consistency of action are fundamental to successfully resolving the situation.

Information about diverse societal values is inadequate.

Our assessment was severely hampered by inadequate information. Critical knowledge was either unavailable or not in a readily useful form. We documented how ill-equipped the agencies are to deal with issues such as Native American values, recreation, scenery, special forest products, and subsistence. Information is collected and stored in different forms, even in neighboring units of the same agency. Relatively little information is readily accessible in the geographic information system. Consequently, it was not possible in an easy way to compare the options to some of the values of concern to society. How can we make informed, sensitive, responsible decisions when we lack essential information?

The negative effects of polarization of political agendas impedes effective communications, coordination, and collaboration.

Valid concerns exist on all sides of the issues at stake in the ongoing debate over natural resources in the United States. However, the shrillness of the dialogue and the vilification of people of opposing values are disturbing. Loggers, foresters, urbanites, scientists, bureaucrats, politicians, and environmentalists have all been painted as villains by each other. Such a tactic makes hollow the claim by the same people that a middle ground or common ground is needed. Processes must be developed that contribute to understanding all the values at stake regardless of who holds them. This also means examining the extent to which current institutions and agency programs and processes exacerbate, rather than alleviate, conflict and polarization. Decisionmaking processes need to fairly consider all values of concern. Failure to choose an appropriate course of action will leave the same polarized extremes at the table, making further gridlock inevitable.

Distrust is a symptom of underlying problems.

The lack of trust underlies forest management conflicts. It exists for many reasons and at a variety of levels: between agencies (regulatory versus management), within agencies (line managers versus professional staff, management versus research), between agencies and citizens, and among various citizen groups. Distrust undermines the best laid plans and often leads to restrictive laws, policies, and practices that compound rather than solve problems. One strategy to build trust is to work together to solve common problems.

Clear definition of the roles of scientists and policy makers is needed.

Social and political factors are at the root of the problems facing forest policy makers and managers. The role of science is to inform those who are in the business of making social choices. Scientists, politicians, and policy makers together need to clearly define the role of science to avoid inappropriate or incomplete solutions and further gridlock. Failure to make the roles clear might result in scientists being viewed as scapegoats for failed policy.

A clear demarcation between the roles of policy makers and scientists must be made to ensure that controversial decisions are founded upon the best and most objective knowledge available, not on how articulate advocates on both sides of the issues may be. As a nation that must make controversial decisions about natural resources, we need advocates who champion important causes and we need scientists who inform and clarify what we do and do not know. But we must know who is in what role.

Credible scientists affirm weaknesses as well as strengths in alternatives and will facilitate policy makers' and the public's understanding of the implications of choosing one management approach over another. They will not argue for a particular choice. The scientist who espouses a personal position under the mantle of objective science is not serving that process whereby decisions are made that have profound consequences for the natural resources and on the people whose livelihoods and lifestyles may be in jeopardy.

Paralysis and myopia can be avoided by looking across institutional and geographic boundaries.

The issues under consideration cannot be solved within any one institution or within the federal forests. Appropriate boundaries must account for both physical and biological resources and other considerations that society believes are important. It became clear

during this assessment that a complete solution (or even an adequate understanding of the issues) cannot occur without including nonfederal lands (e.g., state, tribal, and private).

People will not support what they do not understand and cannot understand that in which they are not involved.

Many professionals bemoan the seeming lack of understanding the public has for natural resource issues. In many respects this is probably true. But professionals do not understand the public well either. The situation will change when public and agency education and involvement processes become truly participatory, with the public an active partner. Scientists, managers, and citizens all have knowledge important to understanding and resolving issues. Having mutual respect for the people who have information, and creating an environment for mutual learning, are critical for success. Not doing so will likely lead to further polarization.

The process must be open, fair, and inclusive.

We must focus on the process as well as the endpoint. For example, the process of planning is often more important than the plan itself, and the process we use to make decisions can be the key to whether the decision is understood and accepted. The success of any new approach to forest management will require development, use, and careful monitoring of an open process that fairly considers all points of view and that fosters mutual learning and adaptive management. Solutions must be founded on the principles of inclusion, leadership, and vision. Top-down social engineering, particularly targeted at the community level, is a thing of the past. Leadership – both within the agencies and at various levels within the broader society – is essential to breaking gridlock and finding innovative solutions.

Major Recommendations

Based on our assessment, a wide range of specific recommendations are possible. These are described in the chapter Social Assessment of Options. In this overview, we focus on recommendations central to resolving key concerns documented in the chapter.

Recognize that ecosystem management will require collaboration by all people across all forests. The President stated a vision at the Forest Conference wherein all the federal agencies would act in concert to serve the American people. Our findings validate this need. But there is more. We recommend that the federal agencies be encouraged to provide leadership by moving beyond the limits of federal jurisdictions to engage states, tribes, forest industry, and other private forest managers as equal and essential partners in discussing their relative roles in sustaining the region's forests and communities. A common vision, a shared framework for action, and an interactive process for creating both are central to successful resolution of the political gridlock. To continue to bow to those interested in delay and inaction will inevitably put our forests and communities at further risk and more people out of work.

Fundamentally change federal land management planning processes to provide the leadership for effective collaboration. Preoccupation with the technical aspects of federal land management planning processes has led to little attention to the fundamental reasons society is concerned about federal land management. Federal land and resource management plans are now inadequate in large measure due to the reluctance of the agencies to recognize the public issues that lead to the current gridlock. In our judgment, **marginal changes in the current plans are not sufficient.** There must be fundamental reform in the land

management planning process. Land and resource management plans must begin from a regional perspective and place all the federal lands into a landscape of forest lands, including both urban centers and rural communities. As part of the planning process, a new way of incorporating the wide array of societal values is required. Considerable attention must be paid to the relationship among local, regional, and national values. Which takes precedence, where, and why? And the relationship between the agencies and citizens in reaching decisions must be clearly defined.

Immediately develop a comprehensive, regionwide understanding of the effects of the selected option for federal land management on communities, tribal rights and values, recreational opportunities, and amenity values. This social assessment is just a beginning. Crisis-oriented policy analysis is not a substitute for comprehensive assessment and adequate research. A full assessment of effects on communities, important resource values, future opportunities, and economic costs and benefits is essential to implementation of new federal direction for land and resource management.

Attend to the short-term consequences from shifts in federal policy. While information is gathered, effects are analyzed, and collaborative relationships are built, some communities are being immediately impacted by loss of federal timber supply and some jobs will be eliminated. These short-term effects can be mitigated by public policy programs. These communities can be identified, and jobs immediately dependent on near-term federal timber sales can also be identified. One alternative may be to accelerate timber harvest levels consistent with species viability considerations in early years of a planning period (say 5 to 10 years) and reduce them in subsequent years. The "ramp down" would provide additional time for woodsworkers, communities, and businesses to adjust to significantly reduced tree harvest from federal lands. Trust would seem to be the major obstacle to this approach.

Specific policy relief can be accorded to both communities and occupational groups. Federal programs might first seek opportunities to enhance and augment local and state programs focused on communities and workers. Sometimes the limiting resource will be access to finances, other times it may be access to technical expertise in effectively competing for existing programs.

Declining federal timber harvest will, however, immediately impact particular communities and specific jobs. In some instances, new federal programs may be appropriate. State and local government should be included in deciding how and where scarce resources are allocated. Above all, our assessment indicates that strategies must fit the needs of the community in question. One size will not fit all. Citizens and communities must be included in the process of evaluation and self-determination of their future.

Future Forests For Society: Where To Next?

Some may ask, why bother to respond to threats confronting endangered species such as the owl ("species go extinct all the time") or to rural communities at risk because of changes in forest policy ("communities will adapt to change")? Is not change inevitable and any effort to intervene through policy pointless and futile?

One response to such questions is that the **forest management issue is fundamentally a moral question.** This would suggest that a society that fails to take care of its environment or its people risks collapse; history is replete with examples. The focus upon the survival of a particular species (the northern spotted owl) has deflected attention from the more fundamental concern: the declining status of the owl reflects an overall decline in the health

of the environment upon which we humans all depend, whether for economic or psychic sustenance. Likewise, denigration and dismissal of a sector of our society (e.g., timber workers) as not worthy of concern and support has the familiar ring of intolerance, prejudice, and arrogance. To dismiss one group of citizenry raises the possibility of being dismissive of others.

Unfortunately, the range of options for responding to the many demands on our natural resources is increasingly becoming limited. This shrinking decision space provides little latitude for choice, if the requirements of current legislation (e.g., National Forest Management Act, Federal Land Policy and Management Act, Endangered Species Act) are to be met. Our shrinking latitude is a legacy of the failure to come to grips adequately with a range of problems – social, economic, and ecological – over the past decades. The legacy includes the inability of resource management institutions to be responsive to change and, as a result, the courtroom has become the forum for debate and resolution about forest management.

Responsive administrative decisionmaking structures are required, with a central element of participative management. Natural resource professionals from multiple jurisdictions need to take the lead collectively in interacting with members of the public to address complex problems.

Shared decisionmaking is critical if people are to be part of the solutions rather than adding to or becoming the problem. Tapping into the rich body of knowledge held by the citizenry, working in collaboration with citizens to formulate alternative conceptions of the future, helping people understand the consequences of alternatives, enhancing our awareness of the distribution of costs and benefits associated with alternative management – all these represent features of participatory management. Ultimately, the institutions of government serve only at the sufferance of the governed. If these institutions are perceived as dysfunctional, they will be replaced. New ways of doing business will need to be undertaken if we hope to achieve the idea of "one government." As Ted Strong noted at the Forest Conference, "*Status quo management is completely unacceptable. We must go on.*"

Research institutions need to focus on the key questions confronting society and on how to make the resulting knowledge available to a wide range of constituents. Scientists and researchers need to focus on an expanded array of questions and with methodologies appropriate for clarifying the complex social choices confronting society. New science is needed and its policy role is waiting as it helps define the range of possibilities, expected consequences, costs, and benefits associated with choices, and the means by which these choices might be achieved. Society is the ultimate beneficiary and consumer of research. The incapacity of research institutions to be responsive to the major concerns of society will diminish their long-term support and relevance.

Educational institutions need to refocus and become responsive to changing public perceptions and values of forests and forestry. Natural resource professionals need to be educated as citizens, as individuals who have a capacity to teach as well as to learn, and as people who can foster a sense of understanding, awareness, and appreciation among those around them. Above all, they need to be adept at asking the right questions and being critical thinkers. Like the institutions of management and research, educational institutions must help us understand today's problems while anticipating for changes in what will be relevant in the future. Concern is growing that educational programs and curricula are not preparing future professionals to deal with the priority issues facing society. The educational institutions must be more aggressive in demonstrating their responsibility and

responsiveness to the wider society; failure to do so will diminish their value to, and therefore their support from, society.

Toward Breaking the Gridlock

In the face of intense conflict and acrimony surrounding the forest management issue, it is tempting to not make any decision to avoid offending some interest. It is not possible, however, to do nothing; "no decision" is a decision. The failure to act proactively defaults to a decision to act passively. Events overtake us and outcomes unfold without deliberation and thought. In such an event, consequences will fall without reflection and without the possibility of appropriate mitigative action. Moreover, failure to act will only further shrink the range of choice before us; the status quo will prevail, with all its acrimony.

There is nothing permanent except change.

Hereaclitus (540-475 BC)

Implementation and Adaptive Management

Implementation of a Pacific Northwest forest management strategy requires several actions by the relevant resource agencies. These actions include developing a common vision, implementing an adaptive management process, developing new monitoring and information systems, increasing research, modifying planning methods, and following an implementation strategy. Greatly increased multiagency collaboration will be required, as well as increased coordination with state and local governments and landowners to improve agency planning processes by increasing local participation and ensuring that potential regulatory conflicts are identified and resolved early in the planning process.

Introduction

The desired future condition of federal forest and riverine ecosystems of the Pacific Northwest will involve levels of biotic diversity, ecological processes and functions, including habitats, that sustain viable populations of native species as well as the productive capacity of the ecosystems. All lands, public and private, are important to supporting and maintaining healthy, functioning ecosystems. This requires close collaboration among federal agencies, nonfederal landowners, and the public.

Conservation strategies and adaptive management could result in quite different future landscapes, ranging from a series of fixed reserves growing into old-growth, nested within managed Matrix lands, to a landscape without visible reserves where management activities occur throughout with varying degrees of alteration of natural processes. In the long term, the landscape may behave as a dynamic mosaic of old and young forests shifting through time and space. The processes of monitoring, adaptive management, and implementation described here is intended to help us move in the appropriate direction of achieving the common vision.

Ecosystem Management

The concept of ecosystem management directs the attention of land managers and others to understanding ecosystems and developing appropriate site-specific management to achieve overarching ecosystem management objectives. However, our understanding of the underpinnings (supporting science, ecological constructs, legal interpretation, and societal acceptance) of natural resource management is in rapid flux and deals with imprecise concepts such as "ecosystem management" itself and sustainable development as a means of achieving ecosystem management.

Given current laws, ecosystem oriented management begins with strategies that involve layering relatively independent management schemes to accommodate northern spotted owls, old-growth ecosystems, marbled murrelets, and selected fish stocks. The next step toward ecosystem management is to assign multiple roles to the individual land allocations in an overall conservation strategy. This step leads to development of a single conservation strategy with multiple phases to accommodate the various species and ecosystems (e.g., riparian and old-growth) of concern. Including ecosystem concerns will require adaptive management actions that will accelerate the transition from conservation strategies for individual species to ecosystem management (fig. 31).

A critical element of managing the future landscape of the Pacific Northwest will be an understanding of and appreciation for the fact that ecosystems extend across ownerships –

federal, state, and private. Streamflow and species of fish, wildlife, and other organisms know no jurisdictional or ownership boundaries. Consequently, increased ecological knowledge, concern with environmental protection, and an ecosystem approach to management must foster interownership cooperation and improved efficiency in balancing ecological and economic objectives.

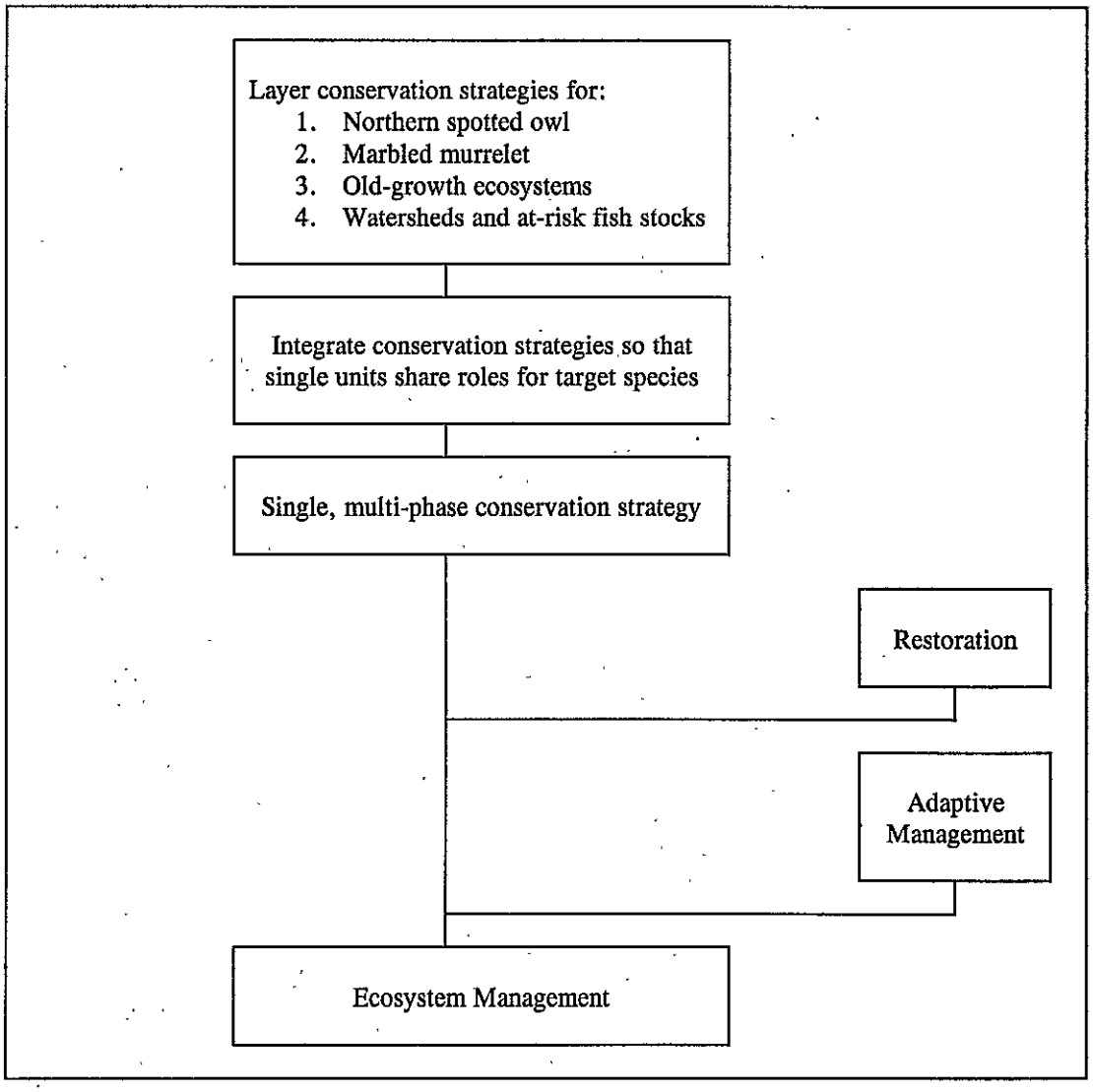


Figure 31. Conceptual diagram of the transition from our current "layering" approach using largely species-specific conservation strategies, through a single, multi-phase strategy, to an ecosystem-based, rather than species-based, system of management.

Watersheds as Basis for Management

Watersheds represent a physically and ecologically relevant and socially meaningful scale for managing forest resources. Watersheds link regional and provincial conservation strategies and objectives for terrestrial and riparian species with project implementation,

providing a rational and effective spatial scale for citizens to participate in natural resource decisionmaking.

Ecosystem planning may need to be conducted at four spatial scales: regional, province/river-basin, watershed, and site. At each scale, analyses describe human needs, environmental values, and important watershed and ecosystem functions. Information collected at the broader spatial scales (regional and provincial) guides analysis and development of management options at the finer scales (watershed and site). Conversely, information collected at the finer scales provides feedback on cumulative effects at the larger scales. These concepts are more fully developed in chapter V.

Adaptive Management

The Process

Adaptive management is a continuing process of planning, monitoring, researching, evaluating, and adjusting management approaches (fig. 32). A formal process of adaptive management would maximize the benefits of any option described in this report and achieve the long-term objective of ecosystem management.

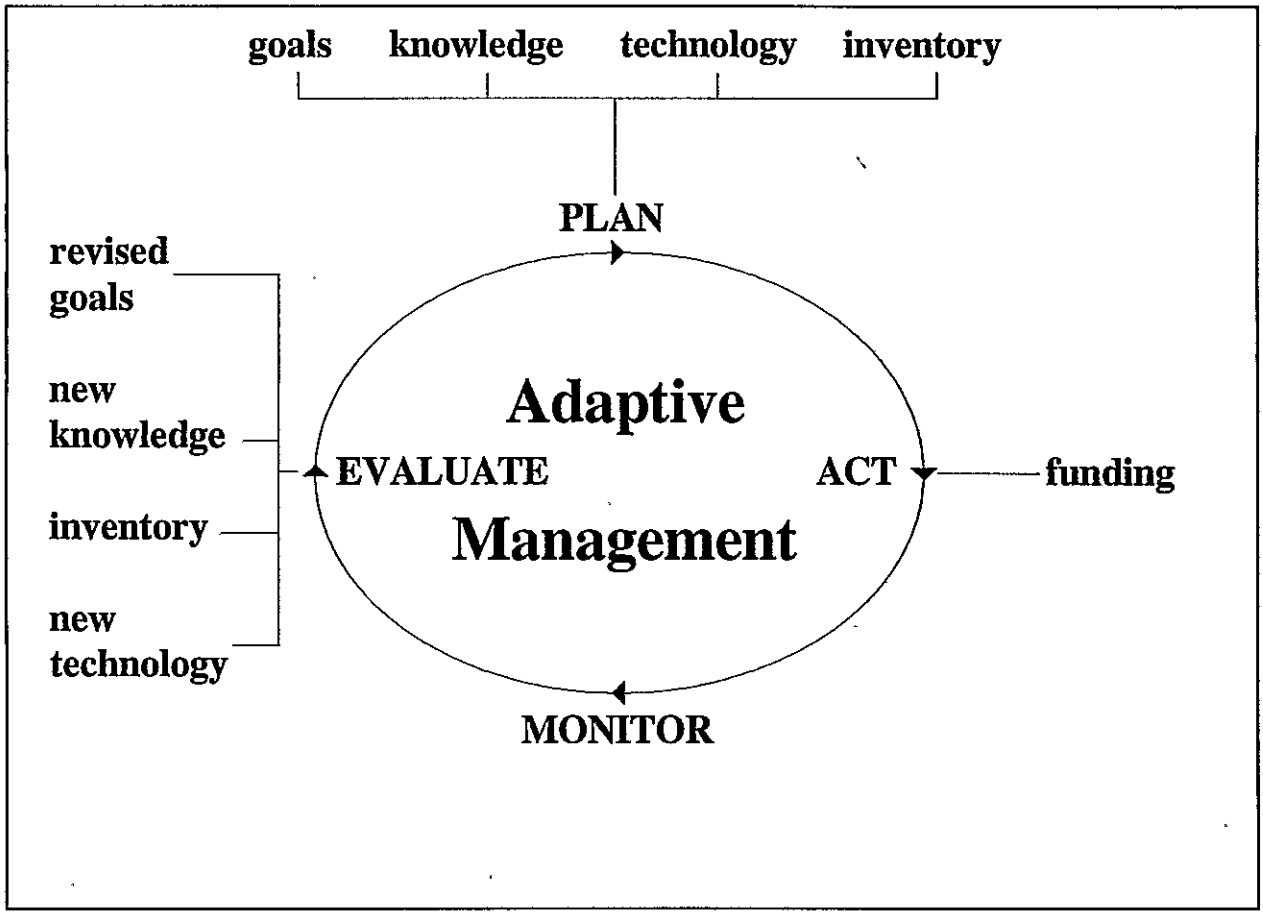


Figure 32. Adaptive management process.

Planning

Planning processes executed by federal land management agencies have not consistently produced legally, scientifically, or socially defensible products. A new or greatly modified planning process is needed to implement the options and objectives described in this report. Recommendations for this process are described in chapter VIII and in the report of the Agency Coordination Working Group.

Monitoring

Monitoring is a critical component of adaptive management and a required activity for ecosystem management. It is also necessary to ensure compliance with forest management laws and policy. The current shortage of "science" makes monitoring critical because of the uncertainty of our predictions. Though currently required, this activity, up to now, has not been well designed, effectively implemented, or adequately funded.

Monitoring should be sufficiently sensitive to detect changes of ecological importance at all resource scales – region, province, watershed, and project levels. The monitoring system should have sufficient independence and quality control to provide an acceptable basis for natural resource policy decisions. Because monitoring can be costly, the system should be designed specifically to serve the policy needs. Additionally, it should strive to achieve the greatest degree of collective efficiency such as using common guidelines and standards for integration of data from individual projects into a common regional data base.

Evaluation and Adjustment

"Managing to learn – learn to manage" is a phrase used to characterize organizations whose culture is committed to experimentation, learning, and improvement over time. It is an important extension of the concept of adaptive management. It increases societal participation and the role of science and diversifies management practices to provide an opportunity to test a variety of techniques. Managing to learn entails implementing an array of practices, then taking a scientific approach in describing anticipated outcomes and comparing them to actual outcomes. These comparisons are part of the foundation of knowledge of ecosystem management.

Scientists, managers, and members of society would help evaluate the effects of the different treatments. Together, these groups would gain the information needed to design the next experiment and to ensure that the information gained would be shared with managers of nonexperimental landscapes. Managers, for their part, must take the evaluation process seriously because it will probably lead to changes in the way they do business – the whole point of adaptive management.

Research

Our evaluations of the use, management, and conservation of Pacific Northwest forests have identified major gaps in our knowledge and understanding of these resources. In addition to the need for basic information on ecosystem function and processes, research is needed to develop and refine the analytical tools critical to ecosystem management and to help expand the resource productivity options within Pacific Northwest forests.

However, society is demanding an increased sophistication and refinement of management strategies as well as programs that address specific organisms or components of ecosystems

that have had limited previous study. The inability to respond to these needs leads to serious gaps in knowledge and uncertainty that restrict the total benefits to society from any conservation strategy implemented. Due largely to funding limitations since the late 1970's, the natural resource research organizations in the Northwest have fallen behind in their ability to provide the science required to effectively address many of the evermore rapidly emerging issues and conflicts.

Strategic Information Resources

A key element for accommodating ecosystem management is the need for consistent, accurate, and current information about basic physical and biological resources and their distribution across the landscape. As all forest resources become limited and their use more intensely debated, it is essential that a substantially more accurate accounting of the amount, condition, and trends become available.

A multiorganizational, multivalue inventory system will be important for effective implementation, appropriate modification, and meaningful evaluation of management and protection strategies in Pacific Northwest forests. Even the more traditional commodity based inventories such as timber volume are not standardized across ownerships and are not reliably aggregative at the various scales needed for decisionmaking. To implement the several interagency recommendations in this report it will be necessary that a multivalue inventory be accessible to all concerned parties. This will require common protocols, database management, quality control, and a centralized delivery mechanism.

Implementation Strategy

The current status of the late-successional and old-growth forests and associated forest species, and the concerns of local communities and the public, require prompt decisions about implementation of a forest ecosystem management strategy in the Pacific Northwest. However, no set of options could be constructed to avoid or minimize every potential ecological problem or societal concern. The solution is to establish a workable process where potential problems can be identified and resolved *before* they become major conflicts.

Current planning and regulatory processes provide the basis for implementing a conservation strategy, but ecosystem planning on federal lands will drastically change the way that agencies conduct business. It will require an unprecedented level of interagency cooperation, involving the coordinated efforts of all federal agencies involved in planning and regulating of forest and forest-related activities in the Pacific Northwest and northern California. The land management and regulatory agencies, through the Agency Coordination Working Group, have been working together to develop more specific guidance based upon the following concepts.

Planning Levels

Implementation of the selected option will rely on general recommendations (standards and guidelines) that will need to be refined at increasingly more site-specific levels:

- *A regionwide conservation strategy* that provides general guidance to be considered at lower planning levels. This guidance should not set quantitative goals for goods and services as should emerge from land capability assessments.

- *A physiographic province (or river basin) conservation strategy* that provides more specific guidance for land managers to consider as they develop site-specific planning strategies for watersheds or other units of analysis and planning.

- *A watershed level analysis* for individual watersheds that takes into consideration site-specific information and needs, and which provides the basis for refinement of provincial conservation strategies as well as project-level decisions.

Although the regionwide plan provides a method for standardizing processes across provinces, the physiographic province is intended to become the focal point for ecosystem planning and is expected, ultimately, to replace the current National Forest and Bureau of Land Management District plans.

Watershed analysis is proposed as a key component of the general framework for identifying and assessing appropriate actions at the local level. Watershed analysis would be the foundation for revising province-level plans as information is collected and assessed through the adaptive management process. Watershed analysis would provide a method to assess the current situation and relationships between species and mechanisms that should be considered as a whole.

Considerable effort will be needed through interagency planning teams to make a smooth transition from the current to the proposed planning scenario (fig. 33). The intent during this transition is three-fold: (1) to refine the preferred options and accompanying standards and guidelines in the initial phases of implementation so that local differences and needs can be more thoroughly addressed through the planning process; (2) to initiate an adaptive management process where approaches can be developed and integrated through a phased approach into a more ecosystem-oriented approach to land use planning; and (3) to identify and resolve potential regulatory conflicts (e.g., endangered species concerns) early in agencies' planning process so delays and negative impacts can be avoided or successfully mitigated.

Components of the Strategy

There are four similar components in all the options that will need to be considered in implementation as we move through the planning levels noted above:

1. Late-Successional Reserves and Riparian Reserves with specific boundaries delineating the areas.

2. Standards and guidelines for managing the reserves.

3. Standards and guidelines for managing the forest Matrix (between reserves) and Key Watersheds.

4. Watershed analysis procedures.

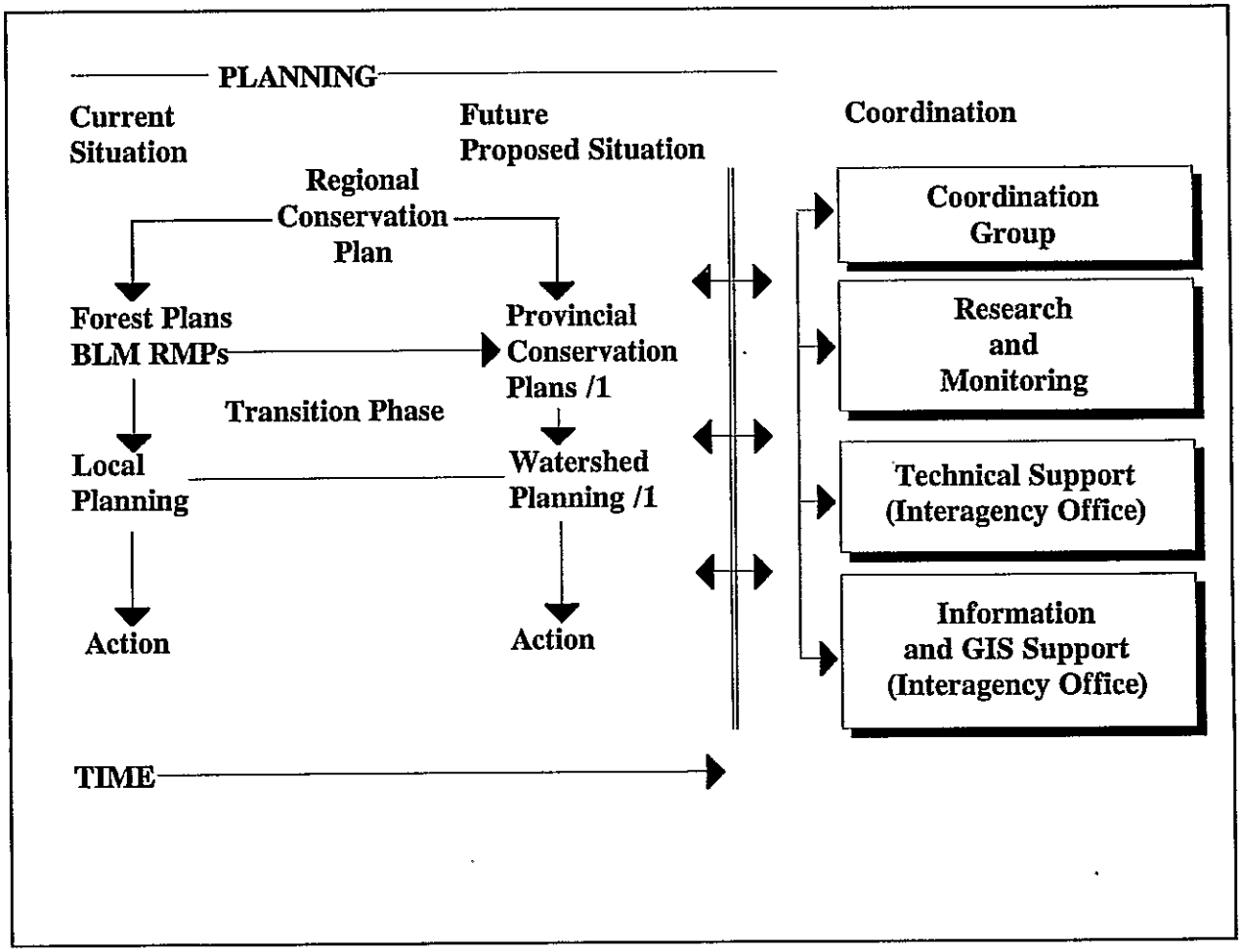


Figure 33. Relationship between current and proposed planning, and interagency coordination efforts.

Refinement of these components will occur through a series of steps in agency planning. Through these steps information will be integrated and aggregated at different planning levels and adjustments made in the regional as well as more locally based plans, as appropriate. This will require an interim phase during which time the current plans will need to be revised and actions taken to meet specific timeframes, and will require an extensive training and education program for professional staff.

Phases of Implementation

Implementation should occur in three phases. Some of the actions identified here should be implemented *immediately* and *concurrently* to reduce the time involved in making the transition from current operations to a focus on the watershed and provincial levels.

Phase I: Develop options (this effort).

- Select preferred alternative.

- Process required environmental impact statements.

Phase II: Identify and carry out actions that need to be completed in the immediate future (e.g., within the first year).

- Refine regionwide components (reserve boundaries, standards and guidelines).
- Complete development of the watershed analysis approach.
- Initiate training, education, and public information programs.
- Proceed with harvesting timber sales.

Phase III: Identify and carry out actions that need to be completed in the short term (e.g., 4 years).

- Refine the components described in the regionwide strategy at the province level (e.g., boundaries and standards and guidelines applicable to each of the physiographic provinces) and begin development of provincial conservation plans.
- Refine the watershed analysis process and initiate high priority watershed analysis and restoration activities.
- Continue with the short-term timber sale program.

Phase IV: Identify and carry out actions that need to be completed to implement a selected (and refined) option over the planning period (e.g., 1-10 years).

- Refine the provincial guidelines at the watershed level for each watershed identified within the planning process.
- Refine National Forest/District or provincial level plans as necessary to meet the goals and objectives resulting from the watershed planning process.

Actions in the Transition Phase

An orderly transition is needed as we move toward implementation of a preferred option for future forest management. A major issue is continuation of ongoing programs (e.g., timber sale programs) and, specifically, decisions on existing timber sales that were planned under previous agency management plans. An evaluation of these sales has been initiated by the Forest Service and Bureau of Land Management. Over 1,300 timber sales currently exist, including sales developed under Section 318 of Public Law 101-121, sales that are currently enjoined, and new sales that have been planned. Most sales have already passed through the regulatory and planning requirements of applicable laws and policies. Steps should be taken to provide for completion of the review for remaining planned sales. Evaluation of these sales will require careful consideration of the effects these sales may have on the ability of the options to meet the specified objectives. Priority should be given to existing sales that have the least impact on the described options. Emphasis should be on sales outside of Key Watersheds, roadless areas, marbled murrelet habitat, and spotted owl critical habitat.

Planning and Regulatory Mechanisms

One aspect of the Forest Ecosystem Management Assessment Team's analysis rated the sufficiency, quality, distribution, and abundance of habitat to allow the species populations to stabilize across federal lands. This viability of federal habitat does not directly correspond to viability of the affected species. Furthermore, regulatory statutes for the Endangered Species Act and the National Forest Management Act contain different standards. As a result, it is not possible to construct an option for forest management that obviates the need for continued regulatory review of the impacts of actions that may affect (1) species listed under the Endangered Species Act, (2) water quality, or (3) other laws.

For example, the Team did not attempt to determine whether implementation of any of the options, or actions under any option, would result in jeopardy or destruction or adverse modification of critical habitat or offset listing under the Endangered Species Act. The Fish and Wildlife Service and the National Marine Fisheries Service are the agencies authorized to make such decisions. Appropriate regulatory processes (e.g., through Section 7 of the Endangered Species Act or Environmental Protection Agency water quality programs) could profitably be integrated with the applicable planning processes at an early stage in planning to avoid delays or future conflicts. If this occurs, it would result in a shift in regulatory review from later in the planning process to an earlier phase to help identify potential regulatory conflicts (e.g., actions that may impact listed or candidate species) so that actions can be taken to avoid or reduce those conflicts before irretrievable commitments of resources have been made. Regulatory processes can be coordinated with ongoing planning without causing problems in regulatory review, although it may require a need to increase the size of regulatory staff to accommodate their increased involvement in planning.

Interagency Coordination

The achievement of ecosystem management goals will involve a much greater level of coordination and cooperation than has ever existed. Improved coordination will include the establishment of regional/provincial coordinating groups, which includes representatives of the primary participants in land management planning (fig. 33). These groups should be responsible for such tasks as ensuring adequate participation and timeliness in planning, monitoring, guiding, analyzing new information, and providing a forum for deliberating questions. Tasks would include:

- Review and refinement of options (from the regionwide to the local level, including refinement of boundaries and standards and guidelines).
- Information and education to appropriate parties.
- Agency guidance on key issues.
- Response to problems and concerns – including biological, human/social, and legal.
- Future adjustments to plans and activities.
- Coordination of monitoring activities, data information management, and sharing of information.

Planning teams would assist in coordinating the appropriate planning and regulatory processes at the local level (e.g., province and watershed) to help respond to problems and

concerns and to provide technical support to agencies as those agencies carry out planning. The number and types of groups involved in coordination will depend on the type of planning being undertaken. Both regional and local efforts should include close coordination with the appropriate state agencies, tribes, interest groups, and local communities.

To assist in the immediate transition from development of the set of options described through the selection, refinement, and implementation of a preferred option over the next year may require establishment of an interagency working group to continue analysis of the issues raised through the initial planning process described herein, address questions raised by the planning and regulatory agencies as they move toward implementation, expand the selected option into a more detailed plan, and assist in developing concepts of watershed and adaptive management processes.

Relationships to Nonfederal Lands

The majority of species inhabiting late-successional forests in the Pacific Northwest are not restricted to habitat on federal lands. Nonfederal lands are an integral part of any strategy that seeks to address the overall landscape as an ecosystem. Therefore, this interrelationship will require close cooperation between state agencies, tribes, private landowners, and federal agencies. This is particularly important for threatened and endangered species or other at risk species.

Because of the importance of the watershed scale for successful ecosystem management, planning activities for mixed ownership areas should be coordinated with nonfederal agencies or landowners wherever appropriate. Coordination of activities will play an integral part of ecosystem management at the regional, provincial, and watershed scales, regardless of the landowner or manager. The states should be actively involved by taking the lead in developing conservation ecosystem management objectives applicable to nonfederal lands.

Mechanisms for providing incentives to nonfederal landowners should be explored to encourage cooperative and coordinated efforts. Participation of nonfederal interests in planning for ecosystem management can identify opportunities to provide these incentives. A proactive approach to reduce potential conflicts, such as reducing the need for future listings, should be emphasized here. In these types of planning processes, priority should be given to finding ways of gaining maximum benefit from conservation activities to account for multiple species (e.g., the spotted owl, anadromous fish, marbled murrelet).

Partnerships between local, state, and federal parties offer unique opportunities to share information on these practices and to test different management techniques (e.g., Applegate Project in Oregon). These cooperative projects are intended to integrate the applicable authorities and techniques into a multiorganizational action to address the ecosystem problem.

Administrative, Budget, and Staffing Needs

The interagency approach requires that past methods of operation must be altered to accommodate a more interactive and up front approach to planning along with opportunities for others (e.g., states, interest groups) to participate. The current budget process may not be compatible with integrated resource management and may require a change in the way budgets are allocated, particularly for the land managing agencies that previously received funds based on an assessment of commodity and other resource-based output.

Considerations, such as funding to support habitat restoration projects and, in particular, funding to support a strong monitoring program, will be important.

Regulatory agencies should also change the focus of their involvement from a reactive to a more proactive and cooperative role. This will entail not only a change in the way they carry out their mandates but also a shift in workload from pure regulatory review to a more planning-oriented process, which will result in a heavier involvement in land planning efforts.

The Forest Ecosystem Management Assessment Team did not examine the potential costs to the federal government of implementation of the options described in this report. However, considerable effort will be needed to carry out the expected planning, monitoring, research, and associated projects that are important to the success of this effort. This includes a recognition that roles and needs for current staff do not disappear, but evolve as we implement new ways of conducting business are implemented.

Pending additional analysis, we emphasize that, regardless of the option selected, it is likely incorrect to conclude that reductions in funding and personnel are possible because of the possibly inaccurate assumption that ecosystem management will be somehow cheaper than management with more emphasis on traditional revenue-generating activities.

Policy Conclusions

Managing Risk: Recognizing the Implicit Tradeoffs

The Forest Ecosystem Management Assessment Team analyzed the ecological, social, and economic implications of 10 management options for the federal forests in the range of the northern spotted owl. The Team worked to integrate assessments of biophysical processes with assessments of community capacity and economic factors.

This report presents the analysis of the implications of satisfying the biophysical requirements of protecting wildlife and fish species, providing adequate distribution of late successional/old growth forests, and protecting riparian and watershed systems in the context of a social and economic system dependent upon a wide range of forest values and resources. Figure 34 presents some of our findings in graphic terms.

Figure 34 demonstrates, by option, the effect on the Probable Sale Quantity of timber on tradeoffs between acres of late-successional forest in the Matrix (open to timber management for commercial purposes) and acres in Reserves. Figure 35 shows the tradeoffs as they affect the number of species (plants and animals) that the panels of experts rated as 60 percent or more likelihood of having habitat on federal lands capable of supporting a viable population well-distributed in the planning area.

It can be seen in figure 34 that nearly all the difference in the Probable Sale Quantity expected from each Option is accounted for by the amount of late-successional forest in the Matrix that is subject to timber harvest ($R^2 = .90$). This is not surprising as most of the anticipated timber harvest from the federal lands over the next decade will come from late-successional forest stands.

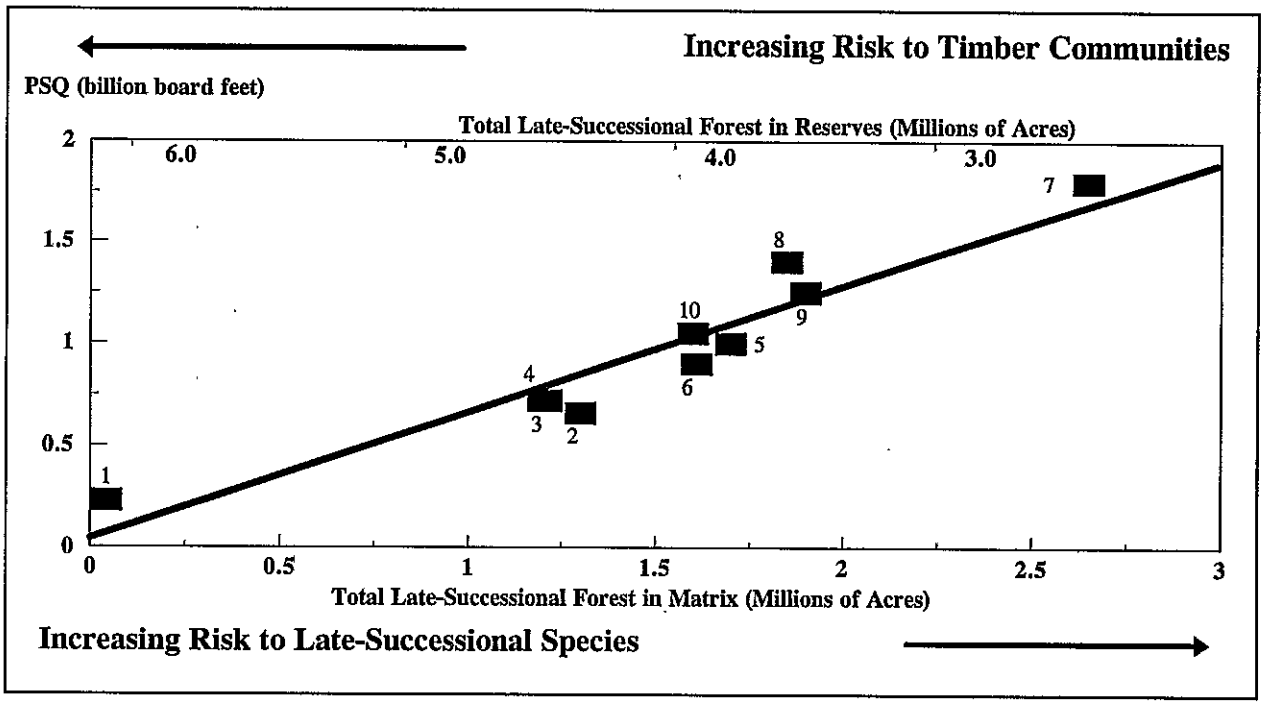


Figure 34. Area of late-successional forest in Reserves and Matrix for each option. Reserves include Late-Successional and Riparian Reserves; additional late-successional forest occurs within Congressionally and Administratively Withdrawn Areas. (Read up from an option point to derive the acres in Reserves. Read down to derive the acres in the Matrix. Read left to derive probable sale quantity, PSQ.)

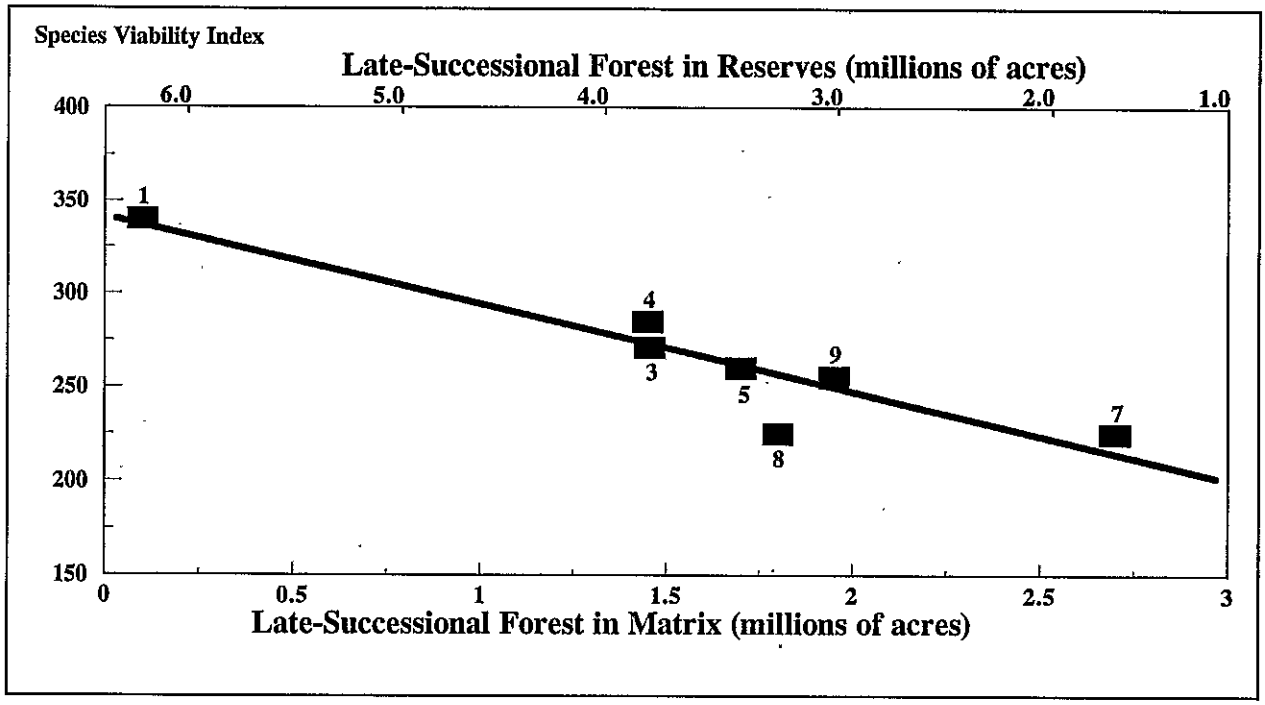


Figure 35. Expected number of viable species in relation to acres in Reserve and in the Matrix. (Read up from an option to determine acres in Reserve. Read down to determine acres in Matrix. Read left to derive the number of viable species.)

Increasing the Probable Sale Quantity by increasing the acres of late-successional forest in the Matrix (and decreasing that in reserve status) reduces the risk to the welfare of timber dependent communities and increases the risk to species associated with late-successional forest habitats. The inverse relationship, obviously, holds.

Examination of Figure 35 indicates that there is a significant relationship ($R^2 = .92$) between the amount of late-successional forest in the Matrix and the probability of maintaining habitat for species associated with late-successional forests in a condition where viable populations exist in a well-distributed state within the planning area. While this measure is qualitative in nature and based on the evaluation of panels of experts, the relationship seems clear.

Being in compliance with laws and regulations while maintaining the maximum Probable Sale Quantity under those conditions requires the decisionmaker to weigh these competing trends and choose an option. Inherent in that choice is the weighing of risk to species and the benefits associated with increased timber sale levels. That is a policy call for those in authority - not for scientists or technical experts. What is the appropriate balance?

Providing information useful to decision makers in this regard was exacerbated for scientists by the maddening process of trying to make biological reality fit into an analysis framework defined by the regulations issued pursuant to the National Forest Management Act related to viability and distribution of species on the National Forests. The intent of the regulation seemed clear and in keeping with the thrust of the Endangered Species Act and the newly adopted policy of ecosystem management.

However, it was in the details of the regulation that difficult, perhaps essentially unresolvable, technical problems arise. Following the letter of that regulation produces a situation in which any broadscale ecosystem management strategy that involves significant manipulation of forest habitats will cause some change, ranging from minor to significant, in distribution (certainly) and viability (perhaps) of every associated species. These species vary greatly in distribution (contiguous or fragmented – on and off federal lands), numbers (to the extent that numbers can be estimated), viability (which can be quantitatively determined for only a fraction of the species), occurrence across federal/nonfederal ownerships, and the fact that the land management agencies may control only a portion of the habitat and that factors beyond their control may be the primary factors influencing viability.

It may be time to reconsider the regulations promulgated under the National Forest Management Act regarding the "viability" of species on National Forests in order to make the specifics of those regulations better fit the "real world" situation while preserving the spirit of those regulations.

Meeting the Law – A Policy Dilemma

The Forest Ecosystem Management Assessment Team has undertaken probably the most extensive evaluation of biological risk ever attempted in an effort to help decisionmakers evaluate the degree to which the array of options might meet legal requirements. To conduct this assessment, the Team reviewed the National Forest Management Act and the Endangered Species Act to highlight the key phrases that might guide the analysis. This was not an easy task.

Which species count? At one level, the National Forest Management Act might be interpreted to apply only to vertebrates ("...habitat shall be managed to maintain viable

populations of existing native and desired non-native vertebrate species in the planning area."). But the Act also speaks to "diversity of plant and animal communities," and this phrase clearly implies a broader mandate. How much broader? Should the phrase "plant and animal" include all life forms, including invertebrates and nonvascular plants? Certainly the Endangered Species Act applies to all species. Arguably, the National Forest Management Act could be interpreted as a protective measure to avoid conditions that would lead to threatened or endangered status for any species within the federal lands. The Endangered Species Act would provide support for those species that would need further protection. As we did not know the answers to these questions, we assessed the consequences of the options for all species and leave to others to interpret the statute and regulations.

What does "ensure" mean? Our viabilility assessments resulted in estimates of the likelihood, under each of the options, that habitat conditions might result in each of four outcomes (A = viable, well distributed; B = viable, but with gaps in distribution; C = restricted to small patches or refugia; D = extirpated from the planning area). The Team was charged with analyzing and displaying the consequences of a set of land management options. Would an 80 percent likelihood of outcome A ensure viability? What about 60 percent, or 90 percent? The Forest Ecosystem Management Assessment Team cannot interpret the legal standard for viability. Is the consideration of the combined likelihood of Outcome A and B appropriate when dealing with species that currently have gaps in their distribution? It is for others to translate these results into legal standards.

What is well distributed? Our viability outcomes were meant to specifically address the distributional aspect of species viability. As we discuss in chapter IV, the concept of "well distributed" is difficult to assess and is not clearly specified in the law. The National Forest Management Act states 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 dispersal or movement capabilities of particular species, but we have no policy guidance as to the degree to which movement would be legally acceptable. Is it sufficient to provide for only occasional contact between reproductive individuals? Some species, especially those associated with specialized habitats, occur naturally in small, relatively isolated patches. For such species, well distributed means something entirely different from what it does for widely distributed, habitat generalists. We tried to adjust our assessments to the expected distributions of each species and to assess whether a given option might cause further restriction of a species' distribution. This was a difficult task given the paucity of scientific knowledge on many species and the less than optimal environmental conditions from past forest management activities.

The evaluation of a species distribution is also contingent on defining a suitable benchmark. Should the species' distribution be evaluated relative to its current or its historic distribution? Past land management activities and other factors have clearly caused changes in species distributions. For example, the American marten and fisher both occur in a much smaller area than they once occupied, due to a combination of habitat loss and overharvest. Should the land management objective be to restore the animals to their former range or to maintain the status quo in terms of distribution?

Regional strategies versus local responses. The options were designed as broad, 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. But 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 we assessed, such as total amount and distribution of Late-

Successional Reserves, distribution of Riparian Reserves, and general guidelines for the management of Matrix lands, were not specific enough or not described at a fine enough spatial resolution to fully address the microhabitat requirements of these smaller organisms. These plants and animals respond to local conditions, but the options were designed around regional objectives. How will these different scales be resolved? Presumably, the viability of some species will be affected as much by the site-specific management decisions that are made in implementing the strategy as by the regional strategy itself.

Every action has an effect. 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 habitat for, say, a canopy-dwelling lichen. The species may survive, but in reduced numbers. Viability assessment is meant to help determine when the cumulative effects of such incremental losses of habitat might result in unacceptable risk to the species' survival. But as discussed above, this determination is problematic. We do not have the knowledge, in many cases, about the exact habitat requirements of many organisms, nor can we predict the exact consequences of each potential land management activity for all species. So we are left with more 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. How do we address site-specific needs for every species in light of the potential influence of an array of actions many of which may occur off-site on a significantly difference scale?

Change happens. 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. How can viability assessments fully account for the level of change that can be tolerated by species? We attempted to account for change in our assessment by thinking about the capacity of species to recover from catastrophic events, but our ability to fully evaluate such responses is limited by lack of knowledge and uncertainty in predicting the severity and frequency of such events. We cannot expect a static forest ecosystem. What is an acceptable level of variability in species populations over time, given the range of variability these species have experienced in their evolutionary history?

Alternative Approaches To Assessments of Species and Ecosystems

Two Complementary Methods to Conservation: Species and Ecosystems

We used two complementary methods to assessing options: evaluation of species and evaluation of ecosystems. In the first method, we assessed the viability of a suite of plant and animal species as influenced by habitat management on federal lands. In the second method, we assessed the fate of entire late-successional forest ecosystems on federal lands. In both cases the focus was on habitat. The two methods are complementary in that evaluating and prescribing for viability of individual species does not necessarily address the range of all factors pertinent to sustaining ecosystems and maintaining ecosystem attributes does not necessarily entail ensuring high viability of every associated species.

Species viability. Species viability was defined as the likelihood of a species persisting well distributed throughout its range for a specified period, in this case for a century or longer, on federally administered lands within the range of the northern spotted owl. Essentially, population persistence is measured as the size and trend of the population over time and is

influenced by habitat, biology, and environment. Depending on the range of the species, habitat can be contributed from both federal and nonfederal lands. Biological factors are effects of other species including disease and parasites. Environmental factors include changes in regional or local climate, air and water quality, and catastrophic events such as fires and storms.

Each of these factors can affect population persistence and viability. Populations respond to these conditions by their internal demography (patterns of survival and reproduction), how they occupy habitats across the landscape (metapopulation dynamics), their genetic diversity, and other aspects of their life history, principally dispersal capability, movement patterns, and types of breeding and social structures.

All of these factors should be addressed to conduct a full population viability analysis. That analysis has as its goal an evaluation of the potential persistence of populations under one or more management scenarios. The assessments conducted for this report, however, centered on understanding how provision of habitat on federal lands under each option could contribute to population persistence and distribution over a century. Although the effects of demography, metapopulation dynamics, genetics, and life history of each species on population persistence were considered to the extent possible, the primary emphasis was on how the amount, quality, and distribution of habitat on federal lands could influence persistence and viability of plant and animal populations.

Ecosystem persistence. Ecosystem persistence was defined as the resilience and persistence of late-successional forests for a specified period, in this case for a century or longer. Ecosystem persistence was measured in terms of the amount, composition, and diversity of its ecological elements; the range of natural conditions; the representation of critical processes and functions; and the capacity of the system to respond to changes and perturbations, including catastrophic events. Each of these components is in turn affected by land allocations and conditions, as influenced by each option over time. Ecosystem persistence is modified by ecological processes, functions, and composition (chapter V). All of these factors would be analyzed in an ecosystem-based assessment of ecosystem persistence.

Interpreting Viability for Threatened and Endangered Species

Security of a population is related to population size and distribution. At very low population numbers and poor distributions, significant increases in these parameters need to be made to significantly increase security. At very high numbers and distributions, increases do not significantly raise an already-high level of security. At intermediate levels the contribution to population security per unit increase of population size or distribution is greatest.

There is some general level – which likely differs by species and context – at which security is low enough to warrant listing as threatened or endangered under the Endangered Species Act. There is a higher level – again, which likely differs by species and context – at which National Forest Management Act regulations for ensuring viability are met. Between these levels is a range of conditions, up to the level specified in the Act, in which recovery of a listed species should be met, although this may vary in accordance to a number of factors, such as endemism, land ownership, or other factors beside habitat.

Complicating this depiction is the contribution of nonfederal lands to the geographic range of the species. Significant declines in population or habitat over all or a significant portion of a species range would warrant species protection under the Endangered Species Act. A

species distributed over multiple ownerships may be stable and well distributed on one ownership (for example, federal forest lands), but be listed due to declines and poor distribution on other ownerships (for example, state or private lands). The survival of a population on one ownership would not necessarily ensure that populations located on other ownerships remain extant. In addition, small or narrowly distributed populations are susceptible to demographic, genetic, and stochastic events that may result in extirpation even with intense proactive management and conservation, as on federal forest lands. Thus, it is critical to determine the extent to which conservation management on federal lands must "take the brunt" of viability effects felt from other lands, particularly for species whose range is largely in nonfederal lands. Policy for management of federal forest lands should reflect this.

Which Approach Best Meets Existing Policy Mandates?

Population viability assessments – including use of professional judgment and qualitative evaluations of the contribution of habitat on federal lands to population persistence – can help to meet the National Forest Management Act regulations dealing with population viability. Further, the mandates for evaluating species status and for deriving recovery objectives and standards, as found in the Endangered Species Act, can also be addressed by such an approach. The enormous number of plant and nonvertebrate species, however, makes this approach rather intractable to use in common forest planning activities for all such species on a species-by-species basis. We simply do not have sufficient scientific knowledge to apply this approach to every species.

How can regulations be met that deal with conservation of the entirety of biological diversity – including all plant and animal species and communities and late-successional forest ecosystems? Clearly, conducting indepth, quantitative population viability analyses for each plant and animal species (vertebrate and invertebrate) is not a likely approach. The ecological indicator approach has also failed, primarily because a small set of species will not serve to represent the habitat requirements and population responses of all species.

Even conducting qualitative expert opinion assessments, as used in this report, is an enormous task when applied to all species of a particular ecosystem. Such assessments are wrought with difficulties of interpreting the relative contribution of habitat conservation on federal lands, as teased out from the array of other factors that can affect species viability. Confounding such interpretations is the fact that some species are naturally scarce and distributed in patches. Also, in a sense, we are now inheriting the results and problems of past forest management objectives and activities. How should assessments of current management options address naturally scarce species, and how should they be accountable for or respond to past actions? Ensuring that each and every species is provided for is of importance. And due credit should be given to forest management options that do much to provide for scarce species or species currently at risk, even if their prognosis is not good.

It seems to us that a combination of approaches to evaluating species and ecosystems is necessary to answer existing policy direction and legal mandates. The approaches, however, must remain tractable and understandable. They should allocate finite resources of talent and funding to identify and assess higher priority questions of species viability and ecosystem conservation. They must result in clear statements of likelihoods of various outcomes, to best inform publics and to aid decisionmakers in establishing a course of action. They also should help identify and give credit to management options that conserve habitat for at-risk, rare, or locally endemic species, even if the overall viability of such species remains low to moderate for the long term because of factors beyond the scope of habitat management.

Which Approach Should Be Used for Policy Direction?

We feel that we have helped refine the scope and bounds of such an assessment. Further work is needed, however, to definitively specify which approaches to risk analysis of species and ecosystems should become standard. We recommend that our methods be reviewed and that advice be given for analysis standards by a specially assigned technical panel comprising expert forest analysts and conservation biologists.

Prescribing Management and Planning Goals for Species Viability, Ecosystems, and Long-term Conservation Objectives

The lessons we learned from this assessment can help in interpreting existing laws, regulations, and agency policies dealing with management for species viability and ecosystems. In particular, the following criteria should be considered:

Management for Habitat and Species Viability

- Population viability remains a legitimate concern for management of forests on federal lands. Conserving or restoring population viability should remain a strong component of the regulations implementing the National Forest Management Act. Such regulations should also apply to management of forests on all other federal lands.

- Population viability should continue to be defined as the likelihood of continued existence of well-distributed populations over the long term, on the order of a century or longer.

- Assessment of population viability should be part of a regional planning program, although there should not be a requirement to conduct quantitative, indepth population viability analyses for each and every species of plant and animal. Rather, assessments can include a range of methods for (1) screening species for viability concern, (2) devising management guidelines to ensure that currently secure species remain secure and do not become listed, (3) conducting qualitative, expert-opinion evaluations of species status and responses to management options, and (4) conducting quantitative population viability analyses for selected species of special viability concern. In addition, some species can be evaluated in a broader sense of their functional role in ecosystems and might not need to be assessed on a species-specific basis. Still other species cannot be evaluated on a species-specific basis because of lack of scientific knowledge. Allocating available expertise, funding, and time for evaluating species viability and for devising and testing appropriate forest management activities needs to be made in a reasonable way.

- The desirable likelihood of population viability is not merely a biological question. The simple biological answer is to maintain a high likelihood; at least 95 percent likelihood over a century or longer is an often-touted objective, regardless of effects on local communities and economies. But in a more realistic context, it is a question of balance between the fate of plant and animal populations, social desires, economic ramifications, and other factors of managing public lands. Defining the "best" likelihood remains a problem-specific, difficult decision best relegated to decisionmakers, politicians, courts, and other authorities as appropriate, whose charge it is to balance environmental protection with the public good. The best science can

significantly contribute to this decisionmaking process by evaluating risks to species and by helping to devise innovative programs to better meet concurrent goals of conservation and production.

- A clear recognition needs to be made, in management policy for federal agencies, between (1) providing habitat that contributes to species viability and (2) prescribing and conducting other management activities that influence species viability and persistence per se.

  The first recognition deals only with conservation of habitats and sites as a necessary (but likely insufficient) component in ensuring long-term viability of species. This is pertinent to management of National Forests and Bureau of Land Management Districts where habitat conservation is the primary charge. We should account for the degree to which habitat conservation on these lands can contribute to overall viability of the species, given effects from management of other lands and particularly for species ranging onto nonfederal lands.

  The second recognition deals with actions that affect biology, environment, demography, genetic, and other nonhabitat aspects of providing for viable populations of plant and animal species. This is pertinent to evaluating listing, jeopardy, and recovery activities under the Endangered Species Act.

- Management of habitat for viable populations should address (1) long-term conservation objectives for the target species and (2) appropriate spatial scales of habitats and forests that match the environmental conditions to which the species respond.

- Information needs, including inventory and monitoring of habitats and populations, should be clearly identified in evaluations and management programs, programmed into funding requirements, and conducted in interagency and/or interdisciplinary teams as appropriate. Conducting monitoring and research, however, should not be used as excuses for poor management decisions with unacceptably high risk.

Ensuring Healthy and Diverse Ecosystems

- Management of healthy and diverse ecological systems and protection of overall biological diversity should be goals complementary to population viability goals for management of federally administered public forest lands, and should be developed in concert with other goals for forest management such as timber production.

- Population viability evaluations can help determine management effects and requirements for ensuring healthy and diverse ecosystems. However, every species does not have to analyzed for devising and implementing ecosystem management guidelines.

- Managing for healthy and diverse ecosystems on multiple-use, federally administered public lands must account for disturbances likely to result from acceptable human activities. It is unreasonable to assume that all effects and evidence of human presence can be erased from such lands. At the same time, however, ecosystem conservation objectives cannot be compromised by

allowing undue changes to natural ecosystems. As with defining acceptable levels of population viability likelihoods, it is a matter of decisionmaking that defines acceptable levels of change to ecosystems and their processes, functions, and composition. Such decisions could be aided by consulting with technical experts who could map out the range of conditions and responses to management options and who could recommend new ways to meet simultaneous objectives for ecosystem conservation and human use of natural resources.

There is No Technological Fix: Moving From Analysis to Action

Beginning in 1970's, consecutive panels of scientists and technical experts have been convened to address the consequences of meeting the requirements of protecting species adversely influenced by loss or alteration of forest habitat. Each consecutive panel has reached the same conclusion: a conservation strategy that will stand the test of time and evolving knowledge should include ecosystem protection. In response to requirements to develop conservation strategies for wildlife species listed as threatened, a conservation strategy was developed for the northern spotted owl (Thomas et al. 1990).

Within a year, concern with the status of late-successional, old-growth forests prompted several committees of the House of Representatives to sponsor the "Gang of Four" (Johnson et al. 1991) assessment of amounts and distribution of late-successional forests and to develop an array of alternatives of how the issue might be addressed in a management strategy. The Gang of Four developed 14 options for management with assessment of the effects on northern spotted owls, marbled murrelets, anadromous fish, other vertebrate species of species associated with late-successional/old-growth ecosystems, and the viability of the ecosystem itself. Concern with spawning and rearing habitat for fish species considered to be "at-risk" of listing as threatened emerged in this study and emerged as a full-blown issue in the management of forest lands.

The Northern Spotted Owl Recovery Team included an appendix listing a number of species that were likely to be associated with late-successional forest conditions (USDI 1992). The marbled murrelet joined the list of threatened species in 1992. The Scientific Assessment Team performed a detailed assessment using panels of technical experts to qualitatively evaluate the status of species associated with late-successional forest conditions (Thomas et al. 1993). Now the issue has expanded to the late-successional forest ecosystem. On June 4, 1992, the Chief of the Forest Service announced that agency would henceforth adopt a policy of "ecosystem management" on National Forest lands.

Clearly the developing circumstances over the past several decades have combined to produce a situation where the "decision space" for management of federal forests has been dramatically reduced. Among these factors are:

1. The continued effort to meet allowable sale quantity levels derived from planning models while accumulating experience with "real life" caused the estimates of allowable sale quantity to be revised downward.

2. Keeping roadless areas and other sensitive areas in the timber base while it became increasingly obvious that these areas would not likely be subject to timber harvest –at

least in the foreseeable future. This resulted in the concentration of timber cutting in those watersheds open to timber harvest.

3. Refusal or inability to comply with the requirements of environmental laws leading to the present "train wreck" of myriad court injunctions on management actions.

4. Inadequate actions to prevent the listing of species as threatened or endangered when such listings appeared imminent. Delays, for example, in effectively addressing the impending listings of the northern spotted owl, the marbled murrelet (and the now impending listing of some species of anadromous fishes) produced significant loss of management flexibility in addressing these issues. Then, when the species were listed, even more serious erosions of decision space resulted.

5. Delays in response to the increasingly obvious conclusion that, in some cases, allowable sale quantity targets could not be met while meeting other objectives of the forest plans (i.e. adherence to standards and guides) reduced flexibility to address evolving environmental concerns.

The situation seems to have reached a point where satisfaction of the requirements of the Endangered Species Act and the National Forest Management Act and other applicable laws requires a course of action that will produce an allowable sale quantity level of approximately 0.2 to 1.7 billion board feet (depending on the option chosen) over the next two decades from federal forests in the owl region. The consequences of such a level of harvest are apt to be debilitating to relatively isolated rural communities - many of which are already in difficulty. However, it is likewise increasingly clear that the only solutions available that seem likely will satisfy the law will still create hardship in some communities at least in the short term.

Facing Facts

In our last Team meeting the question was asked, "What did we learn?" The sub-team leader that had dealt with the work on terrestrial ecosystems replied. "Ecosystem management won't be easy. It won't be cheap. And, we probably can't save every species."

Hand-Off

We struggled to find the tightest possible fit between adherence to requirements of law and our charge to maximize the potential economic and social contribution of the federal lands given that adherence . We have done our best to fulfill the charge given to us. We believe the assessment of the situation and of the options is adequate to support a decision. Our work as scientists, economists, and analysts is complete. The decisions that may emerge from this work is now, most appropriately, in the hands of elected leaders.

OPTION DEVELOPMENT AND DESCRIPTION
Excerpts Relating to Option 9

Description of Option 9

Option 9 consists of elements from the Scientific Panel on Late-Successional Forest Ecosystems (Johnson et al. 1991), the Scientific Analysis Team Report (Thomas et al. 1993), the Final Draft Recovery Plan for the Northern Spotted Owl (USDA 1992), and Key Watersheds as described in this study.

Late-Successional Reserves

Under Option 9, Late-Successional Reserves are based on boundaries that represent an integration of previous efforts (Johnson et al. 1991; USDI 1992c). They incorporate some portion of the reserves from each of those previous efforts, and include new areas designated to protect Key Watersheds. Thinning or silvicultural treatments inside Reserves require review by an interagency oversight team to ensure that they are beneficial to the creation of late-successional forest conditions. Activities that would be permitted in the western and eastern portions of the range are described separately below. Salvage of dead trees would be based on guidelines adapted from the Final Draft Recovery Plan for the Northern Spotted Owl (USDI 1992c) and would be limited to areas where catastrophic loss exceeded 10 acres.

West of the Cascades

There is no entry allowed in stands older than 80 years of age. Thinnings (pre-commercial and commercial) may occur in stands up to 80 years of age regardless of the origin of the stands (plantations planted after logging or stands naturally regenerated after fire or blow down). The purpose of these silvicultural treatments is to be neutral or beneficial to the creation and maintenance of late-successional forest conditions.

East of the Cascades and the Eastern Portion of the Klamath Province

Given the increased risk of fire in these areas due to more xeric conditions and the rapid accumulation of fuels as the aftermath of insect outbreaks and drought, there are additional management activities allowed in Late-Successional Reserves. Guidelines to reduce risks to large-scale disturbance are adapted from the Final Draft Recovery Plan for the Northern Spotted Owl (USDI 1992c). These guidelines can be found at the end of the chapter.

Other Late-Successional Reserves result from:

1. Protection of all forest **sites occupied by marbled murrelets** found outside the larger reserves. See Option 1 for details.

2. The application of some of the **protection buffers for other species** associated with old-growth forests based on the provisions for such species. See Thomas et al. (1993) for details.

Managed Late-Successional Areas:

Under Option 9 these result from:

1. The application of some **protection buffers for other species** associated with old-growth forests based on the provisions for such species. See Thomas et al. (1993) for the description of the standards and guidelines for other species associated with old-growth forests.

Riparian Reserves

Under Option 9, Riparian Reserve strategy 2 applies. Prescribed widths on both sides of streams are:

1. Fish-bearing streams in all watersheds - the combined average height of two site potential trees or 300 feet (whichever is greater).

2. Permanently flowing nonfish-bearing streams in all watersheds - the average height of one site-potential tree or 150 feet (whichever is greater).

3. Intermittent streams in aquatic conservation emphasis Key Watersheds: - the average height of one site-potential tree or 100 feet (whichever is greater).

4. Intermittent streams in all other watersheds - one-half the average height of a site-potential tree or 50 feet (whichever is greater).

The Matrix

For the Oregon Coast Physiographic Province, the Olympic National Forest, and the Mount Baker-Snoqualmie National Forest (areas with high stream density):

Management of the Matrix is based on provisions of the forest plans for the retention of snags and logs in cutting units. No other retention provision is prescribed.

For other National Forests in Oregon and Washington within the range of the northern spotted owl:

Management of the Matrix under Option 9 consists of the retention of 15 percent of the volume of each cutting unit. This can be individual green trees, but one-half the amount must include some small (1/2 to 4 acre) late-successional stands that are intact. If late-successional stands are not available, the next oldest stands shall be retained.

For Bureau of Land Management administered lands in northern Oregon (north of Grant's Pass):

Management is based on providing 640 acre blocks of land (spaced 3 to 5 miles apart) that are managed on 150-year timber harvest rotations. When an area is cut 12 - 18 green trees will be retained. Overall 25 to 30 percent of the block must be in late successional forest at any point of time.

For Bureau of Land Management administered lands in southern Oregon (south of Grant's Pass):

Management consists of selective harvest where 16 to 25 large green trees per acre are left.

For the federal forests in California within the range of the northern spotted owl:

Management of the Matrix provides for retention of 15 percent of the volume of each cutting unit, plus use of 180-year harvest rotations for conifer and mixed evergreen forests and 100 years for hardwood forests.

In all cases, other allocations and standards and guidelines of the federal agency forest plans will be applied in the Matrix where they are more restrictive than the provisions of this option. However, administrative withdrawals that were specified in the forest plans to benefit martens, pileated woodpeckers, and other late-successional species would be returned to the Matrix under this option.

Option 9 incorporates another feature called **Adaptive Management Areas** where broad guidelines are developed for each area to manage forests for a variety of values, including late-successional forests. These areas allow the application of innovative management techniques to integrate ecological, social, and economic objectives. A separate discussion of the Adaptive Management Areas follows the description of the Options.

Adaptive Management Areas

Adaptive Management Areas are landscape units designated to encourage the development and testing of technical and social approaches to achieving desired ecological, economic, and other social objectives. Ten areas containing a range from about 84,000 to nearly 400,000 acres of federal lands have been identified. The areas are well distributed in the physiographic provinces. Most are associated with subregions impacted socially and economically by reduced timber harvest from the federal lands. The areas provide a diversity of biological challenges, intermixed land ownerships, natural resource objectives, and social contexts. In the Applegate Adaptive Management Area in Oregon, community-based activities have already begun from the grassroots.

The Adaptive Management Areas are specifically designated in Option 9, but the concept could be applied within any of the options. Specific boundaries of the areas would have to be modified consistent with particular options, and biological, economic, and social assessments would have to be revised to be consistent with those allocations.

The overarching objective for Adaptive Management Areas is to learn how to do ecosystem management in terms of both technical and social challenges, and in a manner consistent with applicable laws. It is hoped that localized, idiosyncratic approaches that may achieve the conservation objectives of this plan can be pursued. These approaches rely on the experience and ingenuity of resource managers and communities rather than traditionally derived and tightly prescriptive approaches that are generally applied in management of forests.

The Adaptive Management Areas are intended to contribute substantially to the achievement of objectives for Option 9. This includes provision of well-distributed late-successional habitat outside of reserves, retention of key structural elements of late-successional forests

on lands subjected to regeneration harvest, and restoration and protection of riparian zones as well as provision of a stable timber supply.

The Adaptive Management Area concept incorporates the three adaptive management models/objectives discussed elsewhere in this report – technical, administrative, and cultural/social.

Key features of the Adaptive Management Areas:

- The areas are well-distributed geographically and represent a mix of technical and social challenges and are of sufficient size to provide for landscape-level management approaches.
- The areas provide for development and demonstration of monitoring protocols and new approaches to land management that integrate economic and ecological objectives based upon credible development programs and watershed and landscape analysis.
- Opportunities exist for education, including technical training to qualify local community residents for employment in monitoring and other management programs.
- Innovation in community involvement is encouraged, including approaches to implementation of initial management strategies and perhaps, over the longer term, development of new forest policies.
- Innovation is expected in developing adequate and stable funding sources for monitoring, research, retraining, restoration and other activities.
- Local processing (county level) of forest products harvested from the Adaptive Management Areas are encouraged.
- Innovation in integration of multi-ownership watersheds is to be encouraged between federal agencies and is likewise encouraged between state and federal agencies, and private landowners.
- Innovation in agency organization and personnel policies includes tests and modification in recruitment and promotion procedures to encourage local longevity among the federal workforce.

Selection of the Adaptive Management Areas

Adaptive Management Areas were selected to provide opportunities for innovation, to provide examples in major physiographic provinces, and to provide a range of technical challenges, from an emphasis on restoration of late-successional forest conditions and riparian zones to integration of commercial timber harvest with ecological objectives.

The Adaptive Management Areas have been geographically located to minimize risk to the overall conservation strategy. The Adaptive Management Areas were intended to provide a mixture of public and private ownerships. In locating the Adaptive Management Areas, the proximity of communities that were subject to adverse economic impact resulting from reduced federal timber harvest was considered. The social and economic analysis of the

Forest Ecosystem Management Assessment Team (reported elsewhere in this report) was a major source of information that helped guide these decisions.
The Adaptive Management Areas also provide a mixture of ownerships. Six areas include lands administered by the Forest Service and Bureau of Land Management. In two areas (Northern Oregon Coast Ranges and Olympic) there are significant opportunities for the states to participate in a major cooperative adaptive management effort with their forest lands. The majority of areas also have interspersed privately owned forest lands that could be incorporated into an overall plan if landowners so desired.

Establishment of the Adaptive Management Areas is not intended to discourage the development of innovative social and technical approaches to forest resource issues in other locales. These are intended to provide a geographic focus for innovation and experimentation with the intent that such experience will be widely shared. The array of areas provide a balance between having a system of areas that is: (1) so large and diffuse that it lacks focus and adequate resources and has extensive management constraints because of its size and overall impact on regional conservation strategies; and (2) too small to allow for meaningful ecological and social experimentation.

Technical Objectives

The Adaptive Management Areas have scientific and technical innovation and experimentation as objectives. These are difficult to achieve under traditional agency management. The guiding principle is to allow freedom in forest management approaches to encourage innovation in achieving the goals of Option 9. This challenge includes active involvement by the land management and regulatory agencies early in the planning process.

The primary technical objectives of the Adaptive Management Areas are development, demonstration, implementation, and evaluation of monitoring programs and innovative management practices that integrate ecological and economic values. Experiments, including some at quite large-scale, are likely. Demonstrations and pilot projects, while perhaps significant, useful, and encouraged in some circumstances, may not be sufficient to achieve the objectives in and of themselves.

Monitoring is essential to the success of any selected option and to an adaptive management program. Currently, adequate monitoring is essentially nonexistent throughout the federal resource management agencies despite being required by forest plans. Hence, development and demonstration of monitoring and training of the workforce are technical challenges and are suggested for emphasis.

Technical topics requiring demonstration or investigation are a priority for Adaptive Management Areas and cover a wide spectrum, from the welfare of organisms to ecosystems to landscapes. Included are development, demonstration, and testing of techniques for:

- Creation and maintenance of a variety of forest structural conditions including late-successional forest conditions and desired riparian habitat conditions.

- Integration of timber production with maintenance or restoration of fisheries habitat and water quality.

- Restoration of structural complexity and biological diversity in forests and streams that have been degraded by past management activities and natural events.

- Integration of wildlife welfare (particularly of sensitive and threatened species) with timber management.

- Development of logging and transportation systems with low impact on soil stability and water quality.

- Design and testing of effects of forest management activities at the landscape level.

- Restoration and maintenance of forest health using controlled fire and silvicultural approaches.

Each Adaptive Management Area should have an interdisciplinary technical advisory panel, including specialists from outside government agencies, that would provide advice on research, development, and demonstration programs.

Social Objectives

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, land owners, communities, and citizens to work together to develop innovative management approaches. Broadly, Adaptive Management Areas are intended to be prototypes of how forest communities might be sustained.

Innovative approaches include social learning and adaptation, which depend upon local communities having sufficient political capacity, economic resources, and technical expertise to be full participants in ecosystem management. Similarly, management will need to be coordinated with collaboration across political jurisdictions and diverse ownerships. This will require mediating across interests and disciplines, strengthening local political capability, and enhancing access to technical expertise. Adaptive management is, by definition, information dependent. Setting objectives, developing management guidelines, educating and training a workforce, organizing interactive planning and management institutions, and monitoring accomplishments all require reliable, current inventories. New information technologies can be used to provide such information. But a well-trained workforce to collect and assimilate required information is largely lacking. Local persons might be ideally suited to this task if appropriately trained.

Agency Approaches and Management Oversight

Federal agencies are expected to use Adaptive Management Areas to explore alternative ways of doing business internally, with each other, and with other organizations, local and state government, and private landowners. In effect, the areas should be used to "learn to manage" as well as "manage to learn."

Agencies are expected to develop plans (jointly, where multiple agencies are involved) for the Adaptive Management Areas. Development of a broad plan that identifies general objectives and roles, and provides flexibility should be the goal. Such a plan could be used

in competing for financial resources, garnering political support, providing a shared vision, and keeping track of experience.

If the Adaptive Management Areas are to make timely contributions to the regional conservation strategy and to the communities, it is absolutely critical that initiation of activities not be delayed by requirements for comprehensive plans or consensus documents beyond those required to meet existing legal requirements. Development of such documents can proceed simultaneously with other activities; the only area in which detailed planning must precede any activities is the Snoqualmie Pass Adaptive Management Area. Forest plans, as modified by the directions laid down in the selected conservation strategy, can provide the starting point for activities. Initial involvement of user groups and communities would emphasize how the strategy and plans should be implemented.

Initial direction and continuing oversight should be provided by a regional interagency group, possibly working through the Provincial Interagency Team if this concept is adopted from the implementation plan. It is important that the interagency coordination involve both the regulatory and management agencies and that the regulatory agencies participate in planning and regular review processes.

Funding the Adaptive Management Area Program

To achieve its multiple objectives the Adaptive Management Area program will require substantial and stable funding sources. Regular appropriations are one obvious source but are likely to be insufficient in amount and predictability to meet programmatic needs. Hence, developing innovative approaches to financing is an essential element of the Adaptive Management Area strategy.

Possible funding mechanisms for programs associated with Adaptive Management Areas include:

1. Using all or portions of the receipts from Adaptive Management Areas for accelerated monitoring, research, retraining, restoration and other innovative activities within these areas.

2. Authorizing agencies to assess user fees that could be retained for use within Adaptive Management Areas.

3. Using objective-based "end result" budgeting approaches with agency budgets.

4. Agency authorization for experimentation with nontraditional approaches to resource valuation, including market-based approaches to noncommodity resources, the purchasing, selling, and trading resources (e.g., private purchase of commercial timber for retention, rather than harvest).

5. Provision for other kinds of cooperative funding arrangements with other land owners, governmental bodies, organizations, and private individuals. In addition to funds needed for programs on the Adaptive Management Areas there may also be a need for risk capital for community-based efforts and pilot programs in incentive-based management agreements with private landowners.

If receipts are used as a source of funding for programs in Adaptive Management Areas several factors need to be considered. First, development of a common pool should be considered because all areas have the same basic needs – such as in monitoring and

retraining – but differ greatly in their ability to generate revenues. Second, some portion of the funds should probably be reinvested on the same area, but care should be taken to avoid developing a negative feedback whereby resource exploitation is being stimulated by a desire for additional funds.

Development of additional innovative funding sources must not be viewed as a substitute for appropriate funds for management and research. Rapid implementation of programs within Adaptive Management Areas is essential to both their regional function and to the adjacent communities. In at least the short term, this implementation will only be possible through the regular appropriation process. Indeed, the intensity of activity proposed on the Adaptive Management Areas calls for higher levels of appropriated funds in the short term rather than lower levels.

Timber Supply

One reason for locating Adaptive Management Areas adjacent to adversely economically impacted communities is to provide opportunity for social and economic benefits to these areas. Adaptive Management Areas are expected to produce timber as part of their program of activities consistent with their specific direction under Option 9. The rates and methods of harvest will be determined on an area-by-area basis. Each area management team is expected to develop a strategy for ecosystem management to guide implementation, restoration, monitoring, and experimental activities involving timber sales. The strategy should contain a short-term (3 to 5 year) timber sale component and a long-term projection of timber yield.

Local processing of wood products harvested from federal lands within Adaptive Management Areas may be critical to the economic welfare of the associated communities as well as essential to creation of adaptive management approaches. If local processing is not achieved, the potential economic benefits to the local communities may not be realized. Hence, agencies are encouraged to develop approaches which encourage or require processing of a portion of the harvest within the local area, defined here as the county or counties within which the Adaptive Management Area is located. Sufficient legal authorities may already exist in laws such as the Cooperative Sustained Yield Act and the National Forest Dependent Rural Communities Economic Diversity Act (part of the 1990 Farm Bill).

Education

Each Adaptive Management Area was located adjacent to one or more communities with economies and culture long associated with utilization of forest resources. As a result, the people have a sense of place and desire for involvement. Many of these local workers already possess the woods skills and knowledge and sense of place that make them natural participants in ecosystem-based management and monitoring. Here adaptive management can bring indigenous knowledge together with formal studies, the local communities and the land management agencies in a mix that may provide creative common-sense approaches to complicated problems.

Technical and scientific training of a local workforce should be an educational priority of the Adaptive Management Area program. A program of formal schooling and field apprenticeship might provide the workforce needed to help implement ecosystem management, particularly in the area of monitoring. This program might be based on collaborations among local community colleges, state universities, and the agencies.

Descriptions of the Adaptive Management Areas

Adaptive Management Areas are shown on the appendix map for Option 9. Late-Successional Reserves provide for a major element of the Option 9 conservation strategy. Adaptive Management Areas would contribute to accomplishing the objectives of the option, such as protection or enhancement of riparian habitat and provision for distributed late-successional forest habitat. Detailed prescriptions for achieving such objectives are not provided, however, so that managers may develop and test alternative approaches, applicable to their areas and in a manner consistent with existing environmental and other laws.

Riparian protection in Adaptive Management Areas should be comparable to that prescribed for other federal land areas. For example, Key Watersheds with aquatic conservation emphasis within Adaptive Management Areas must have a full watershed analysis and initial buffers comparable to those for Tier 1 Key Watersheds. Riparian objectives (in terms of ecological functions) in other portions of Adaptive Management Areas should have expectations comparable to Tier 2 Key Watersheds. However, flexibility is provided to achieve these conditions, if desired, in a manner different from that prescribed for other areas and to conduct bonafide research projects within riparian zones.

Guidelines for sustaining marbled murrelet habitat necessitates management restrictions for Adaptive Management Areas within the primary murrelet zone if Option 9 is to rate at least an 80 percent likelihood of providing nesting habitat well-distributed in the planning area at 100 years (see Chapters IV and V). In the two Adaptive Management Areas where most late-successional forests have already been harvested (Northern Oregon Coast Ranges and Finney), required mitigation is: (1) survey for and protection of all occupied murrelet sites (see Option 1); (2) retention of LS/OG1s, LS/OG2s, and owl additions (from Johnson et al. 1991) as Late-Successional Reserves within the Adaptive Management Areas. These reserves should be managed as stipulated for such reserves under Option 9. On the Olympic Peninsula, where larger reserves of late-successional forests remain on federal lands, all sites occupied by marbled murrelets will be protected (see Option 1). In all the Adaptive Management Areas, management activities will be conducted to achieve the objectives described for Option 9. Full watershed assessments will be conducted prior to new management activities in identified Key Watersheds with Adaptive Management Areas.

Name: **Applegate Adaptive Management Area, Oregon**

Size:	268,600 acres.
Ownership:	Medford District, Bureau of Land Management; Rogue River and Siskiyou National Forests; potentially state and private lands.
Associated communities:	Grants Pass and Medford, Oregon; Jackson and Josephine Counties, Oregon; and Siskiyou County, California.
Emphasis:	Development and testing of forest management practices, including partial cutting, prescribed burning, and low impact approaches to forest harvest (e.g., aerial systems) that provide for a broad range of forest values, including late-successional forest and high quality riparian habitat. Late-Successional Reserves are included in the Adaptive Management Area boundaries.

Name: **Blue River Adaptive Management Area, Oregon**

Size:	153,200 acres.
Ownership:	Willamette National Forest; Eugene District Bureau of Land Management; potentially state and private lands.
Associated Communities:	Eugene, Springfield, and Sweet Home, Oregon.
Emphasis:	Intensive research on ecosystem and landscape processes and its application to forest management in experiments and demonstrations at the stand and watershed level; approaches for integrating forest and stream management objectives and on implications of natural disturbance regimes; and management of young and mature stands to accelerate development of late-succession conditions, a specific management objective for the forests within the Moose Lake block as well as in other portions of the Adaptive Management Area to be selected. Current status of the H. J. Andrews Experimental Forest as an Experimental Forest, i.e., maintenance of control areas and full flexibility to conduct experiments is retained. One Late-Successional Reserve is included in the area.

Name: **Cispus Adaptive Management Area, Washington**

Size:	142,900 acres.
Ownership:	Gifford Pinchot National Forest; potentially state and private lands.
Associated Communities:	Randle, Morton, and Packwood, Washington; Lewis and Skamania Counties, Washington.
Emphasis:	Development and testing of innovative approaches at stand, landscape, and watershed level to integration of timber production with maintenance of late-successional forests, healthy riparian zones, and high quality recreational values.

Name: Finney Adaptive Management Area, Washington

Size:	101,100 acres.
Ownership:	Mt. Baker-Snoqualmie National Forest; potentially state and private lands.
Associated Communities:	Darrington, Washington; Skagit and Snohomish Counties, Washington.
Emphasis:	Restoration of late-successional and riparian habitat components and provision of stable timber supply. Retention of habitat consistent with guidelines for marbled murrelet areas as noted at the beginning of this section. Sites occupied by spotted owls (pairs or territorial singles) will be protected by establishing Late-Successional Reserves using procedures to delineate Reserved Pair Areas under the Final Draft Recovery Plan for Northern Spotted Owls (USDI 1992c).

Name: Goosenest Adaptive Management Area, California

Size:	169,600 acres.
Ownership:	Klamath National Forest; potentially private lands.
Associated Communities:	Yreka, Montague, Dorris, Hornibrook; Siskiyou County, California.
Emphasis:	Development of ecosystem management approaches, including use of prescribed burning and other silvicultural techniques, for management of pine forests, including objectives related to forest health, production and maintenance of late-successional forest and riparian habitat, and commercial timber production.

Name: Hayfork Adaptive Management Area, California

Size:	399,500 acres.
Ownership:	Shasta-Trinity and Six Rivers National Forests and Yreka District Bureau of Land Management; potentially private and state lands.
Associated Communities:	Hayfork, California; Trinity and Humboldt Counties, California.
Emphasis:	Development, testing, and application of forest management practices, including partial cutting, prescribed burning, and low-impact approaches to forest harvest, which provide for a broad range of forest values, including commercial timber production and provision of late-successional and high quality riparian habitat. Maintain identified Late-Successional Reserves; conduct full watershed analysis in critical watersheds.

Name: **Little River Adaptive Management Area, Oregon**

Size:	83,900 acres.
Ownership:	Umpqua National Forest and Roseburg District Bureau of Land Management; potentially private and state lands.
Associated Communities:	Roseburg, Myrtle Creek, Oregon; Douglas County, Oregon.
Emphasis:	Development and testing approaches to integration of intensive timber production with restoration and maintenance of high quality riparian habitat.

Name: **Northern Coast Range Adaptive Management Area, Oregon**

Size:	247,000 acres.
Ownership:	Siuslaw National Forest and Salem District Bureau of Land Management; with potential participation by the Oregon Department of Forestry and private landowners.
Associated Communities:	Tillamook, Willamina, Grand Ronde, Oregon; Polk, Yamhill, Tillamook, and Washington Counties, Oregon.
Concept:	Management for restoration and maintenance of late-successional forest habitat, consistent with marbled murrelet guidelines noted at the beginning of this section. Conduct watershed analysis of the Nestucca River drainage. Subsequently, the Oregon Department of Forestry will be invited to collaborate in development of a comprehensive strategy for conservation of the fisheries and other elements of biological diversity in the northern Oregon Coast Ranges. All occupied marbled murrelet (see Option 1) and northern spotted owl sites will be protected by establishing Reserved Pair Areas under the Final Draft Recovery Plan for the Northern Spotted Owl (USDI 1992c).

Name: **Olympic Adaptive Management Area, Washington**

Size:	145,000 acres.
Ownership:	Olympic National Forest and potentially Washington Department of Natural Resources, Indian Reservations, and private lands; Jefferson, Clallam, Grays Harbor, and Mason Counties, Washington.
Emphasis:	Create a partnership with the Olympic State Experimental Forest established by Washington Department of Natural Resources. Develop and test innovative approaches at the stand and landscape level for integration of ecological and economic objectives, including restoration of structural complexity to simplified forests and streams and development of more diverse managed forests through appropriate silvicultural approaches such as long rotations and partial retention. All occupied marbled murrelet sites will be surveyed for and protected (see Option 1).

Name: Snoqualmie Pass Adaptive Management Area, Washington

Size:	261,300 acres
Ownership:	Wenatchee and Mt. Baker-Snoqualmie National Forests; Plum Creek Timber Company and other private land owners; state.
Associated Communities:	Cle Elum and Roslyn, Washington; Kittitas and King Counties, Washington.
Emphasis:	Development and implementation, with the participation of the U.S. Fish and Wildlife Service, of a scientifically credible, comprehensive plan for providing late-successional forest on the "checkerboard" lands. This plan should recognize the area as a critical connective link in north-south movement of organisms in the Cascade Range.

MAP KEY
Federal Allocations Proposed Under Option 9

The land allocations depicted on the following three state maps are intended to display the extent and location of the major features of Option 9, one of ten options described in the report "Forest Ecosystem Management: An Ecological, Economic and Social Assessment". Final boundaries and land allocations are subject to further revision and refinement. All land allocations apply only within the range of the northern spotted owl.

Major features:

CONGRESSIONALLY WITHDRAWN AREAS include National Parks, Wilderness Areas, National Monuments, and other federal lands withdrawn from timber harvests or other vegetation management through Congressional designation.

ADMINISTRATIVELY WITHDRAWN AREAS are federal lands that have been withdrawn from planned or scheduled timber harvest through administrative decisions. These include experimental areas, research areas, recreation areas, areas where regeneration is difficult and timber productivity is low, areas of special concern for individual species, and areas protected administratively for scenic or other reasons.

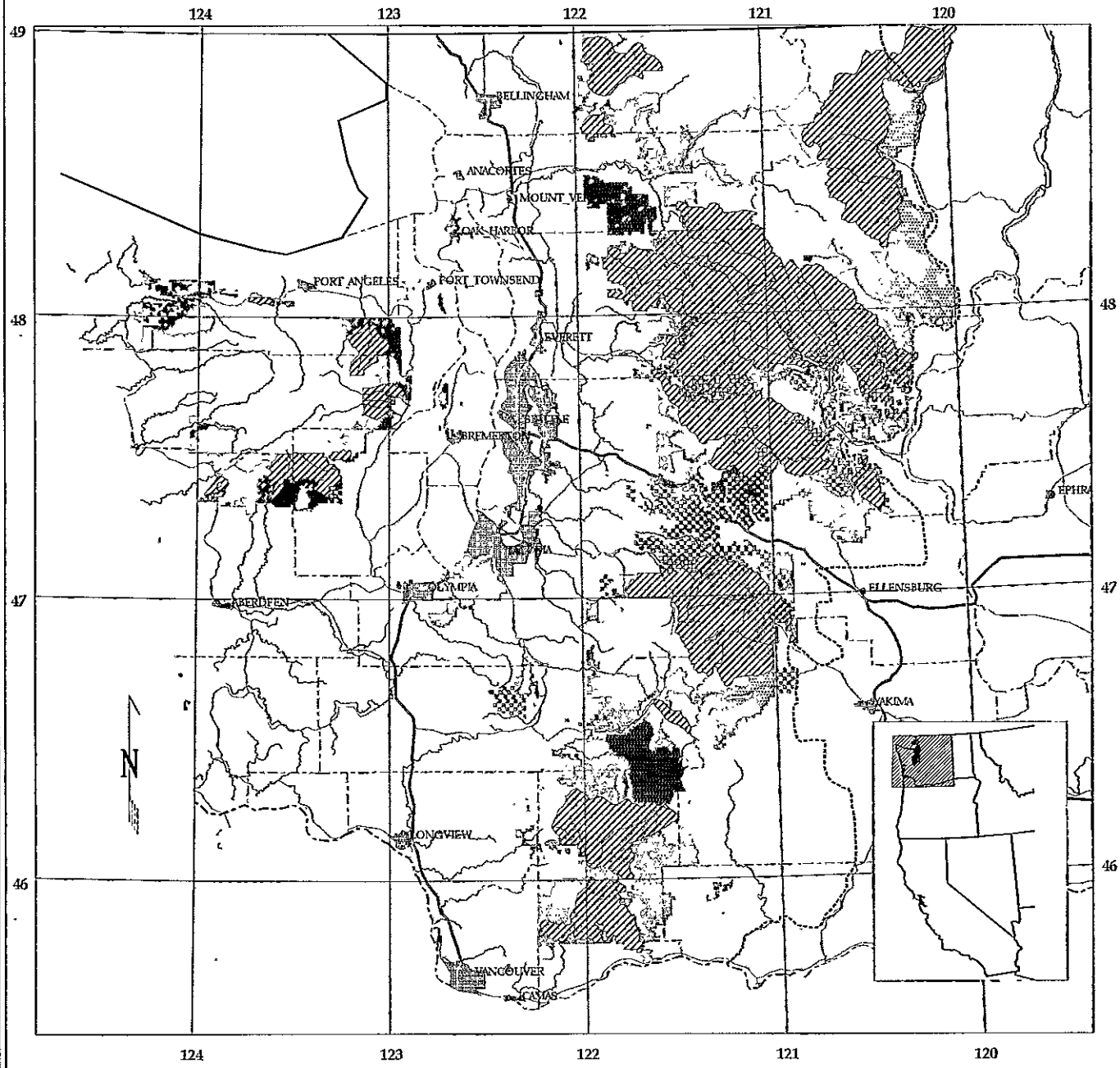
LATE-SUCCESSIONAL RESERVES include all federal lands within a prescribed boundary where cutting of old growth or late-successional stands is prohibited (except for certain salvage) and where treatment of younger forest stands is limited to certain thinning and salvage. Where late-successional reserves overlap administratively withdrawn areas, the overlap is shown on the maps as late-successional reserves.

RIPARIAN RESERVES are areas designated along perennial and intermittent streams and wetlands where cutting of trees is limited to silvicultural treatment of young forest stands with an objective of maintaining suitable habitat conditions for fish and other aquatic organisms. Riparian Reserves are not shown on the maps, as they cannot be depicted accurately as the scale used for the maps. However, even in areas where timber harvest would otherwise be allowed (such as the Matrix), twenty to fifty percent of the landscape could actually fall into Riparian Reserves.

ADAPTIVE MANAGEMENT AREAS are landscape units for development and testing of new approaches for integration and achievement of ecological, economic, and social objectives.

MATRIX is all the remaining federal land outside of reserves and withdrawn areas, that is available for timber harvest at varying levels.

Federal Land Allocations for Washington Proposed Under Option 9



Projection UTM-10

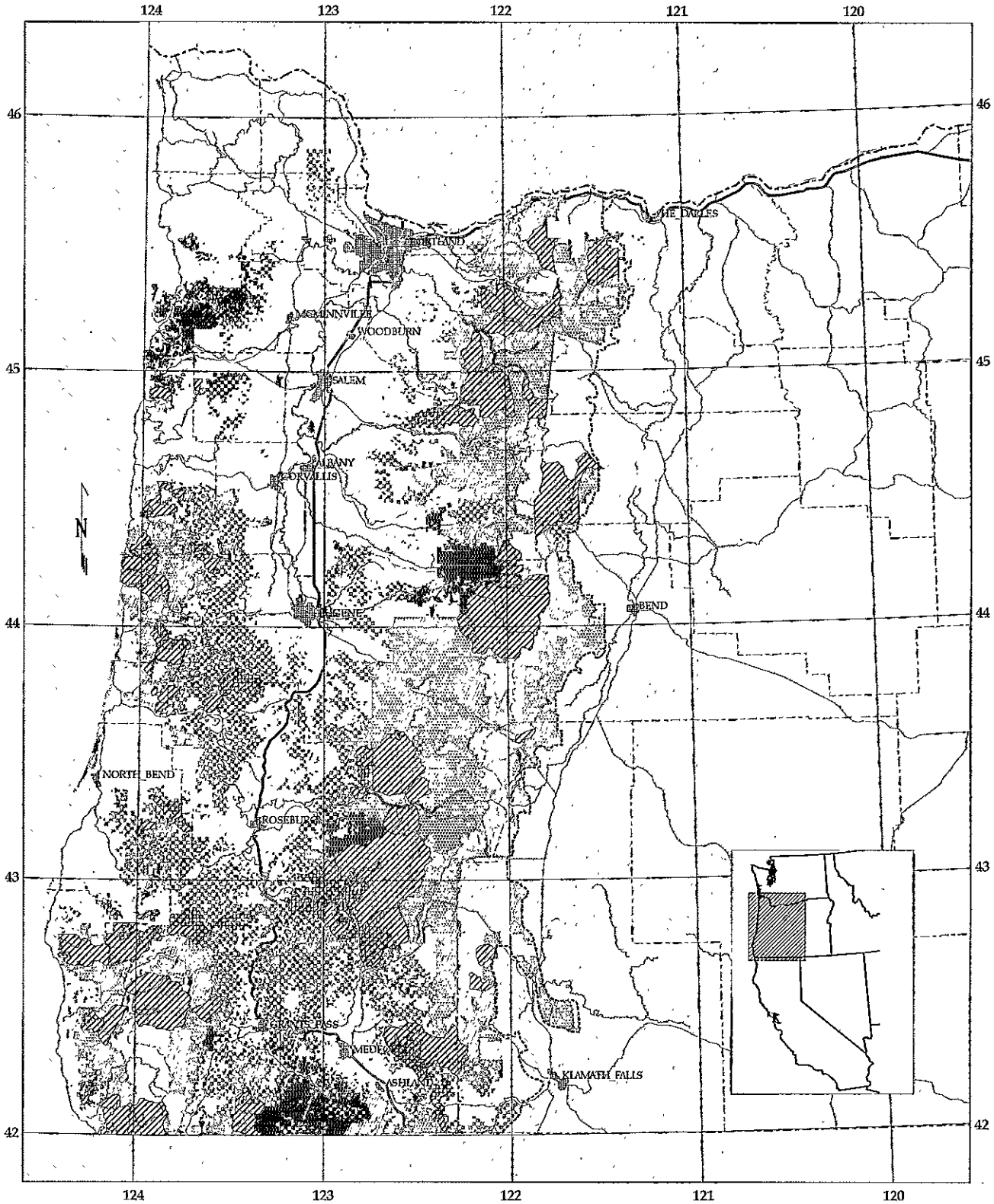
10 0 10 20 30 40 50 60
miles

July 1993

- Congressionally Withdrawn Areas
- Late-Successional Reserves
- Administratively Withdrawn Areas
- Adaptive Management Areas
- Matrix
- Key Watersheds (Tier 1)
- International Border
- State Border
- County Border
- Owl Range
- Interstate Hwy
- Federal and State Hwys.
- Cities
- Rivers
- Water

No warranty is made for the use of these data beyond the purpose intended by the Forest Ecosystem Management Assessment Team

Federal Land Allocations for Oregon Proposed Under Option 9



Projection UTM-10

10 0 10 20 30 40 50 60
miles

July 1993

Congressionally Withdrawn Areas

Adaptive Management Areas

Late-Successional Reserves

Matrix

Administratively Withdrawn Areas

Key Watersheds (Tier 1)

International Border

State Border

County Border

Owl Range

Interstate Hwy.

Federal and State Hwys.

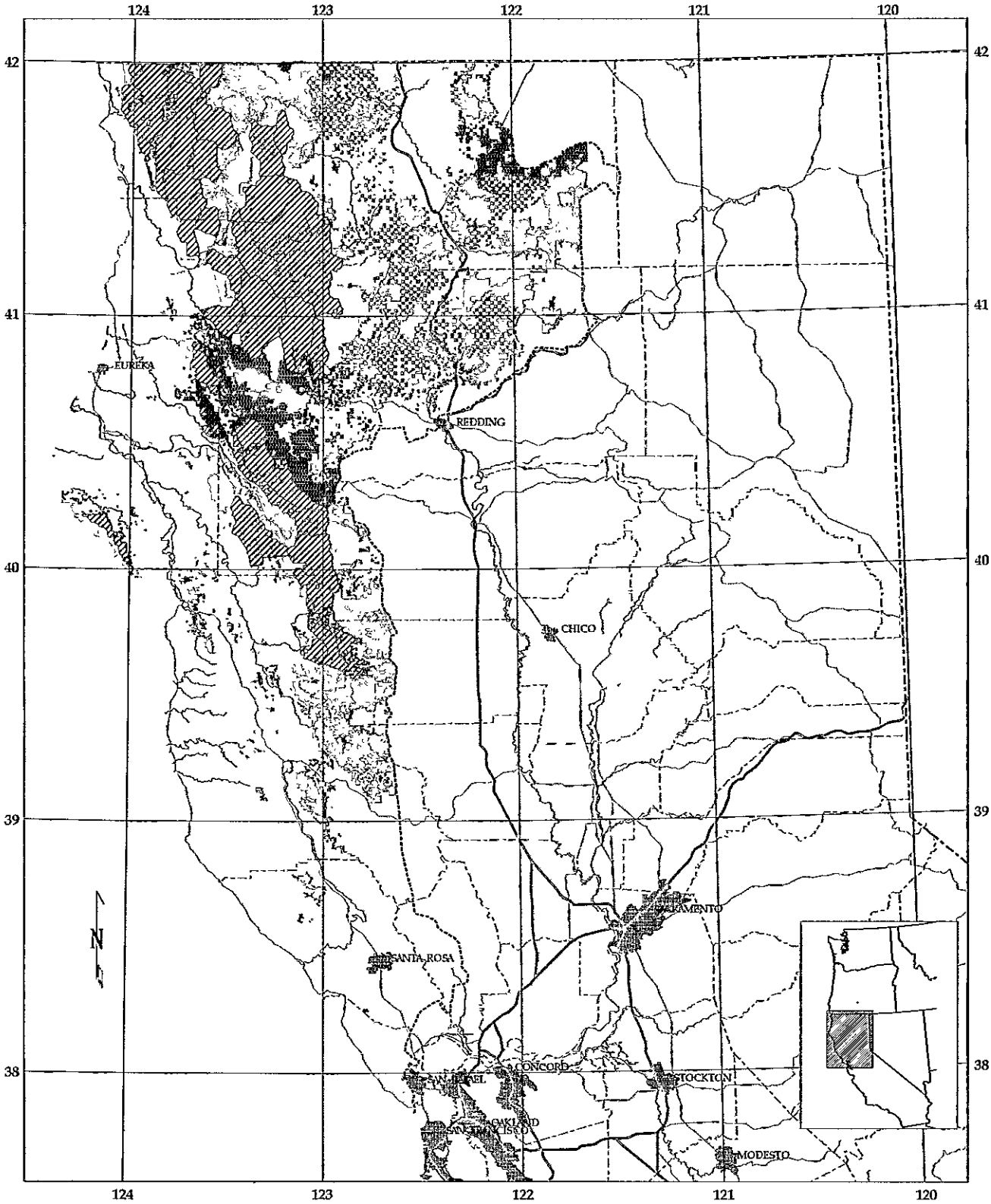
Cities

Rivers

Water

No warranty is made for the use of these data beyond the purpose intended by the Forest Ecosystem Management Assessment Team

Federal Land Allocations for California Proposed Under Option 9



Projection UTM-10

miles

July 1993

Congressionally Withdrawn Areas

Late-Successional Reserves

Administratively Withdrawn Areas

Adaptive Management Areas

Matrix

Key Watersheds (Tier 1)

International Border

State Border

County Border

Owl Range

Interstate Hwy.

Federal and State Hwys.

Cities

Rivers

Water

No warranty is made for the use of these data beyond the purpose intended by the Forest Ecosystem Management Assessment Team

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