Eastern Region Long-Range

Forest Management Plan

October 1995

Oregon Department of Forestry

Eastern Oregon Region

"STEWARDSHIP IN FORESTRY"

List of Acronyms and Abbreviations Used

BLM	Bureau of Land Management
BOF	Board of Forestry
CEQ	Council on Environmental Quality
CFS	Cubic feet/second
CRMP	Coordinated Resource Management Plan
CSFL	Common School Forest Land
DBH	diameter breast height
DEQ	Oregon Department of Environmental Quality
DFSIM	Douglas-fir simulator
DLCD	Department of Land Conservation and Development
DMR	Dwarf mistletoe rating
DOGAMI	Oregon Department of Geology and Mineral Industries
DSL	Division of State Lands
ESA	Endangered Species Act
FPA	Forest Practices Act
FPFO	Forestry Program for Oregon
GIS	Geographic Information System
GWEB	Governor's Watershed Enhancement Board
HCA	Habitat Conservation Area
HCP	Habitat Conservation Plan
IPM	Integrated pest management
LCDC	Land Conservation and Development Commission
LUBA	Land Use Board of Appeals
MBF	thousand board feet
MMBF	million board feet
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
OAR	Oregon Administrative Rules
OCWRU	Oregon Coop Wildlife Research Unit
ODA	Oregon Department of Agriculture
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ONHP	Oregon Natural Heritage Program
ORS	Oregon Revised Statutes
OSCUR	Ownership, Soil-site, Cover, Use, and Rating (state forest inventory system)
ROS	Recreation Opportunity Spectrum
SHPO	State Historic Preservation Office
SLB	State Land Board
SWMG	Strategic Water Management Group
T&E	Threatened and endangered
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

WRD	Oregon Water Resources Department

Foreword

This plan represents an important step in the evolution of Oregon's state forest planning process. To date, the Eastern Region Long-Range Forest Management Plan provides the most comprehensive analysis undertaken on this land base. It thoroughly examines all the resources, from timber to recreation, from fish and wildlife to social and economic resources.

This multi-resource approach toward planning has been adopted for all state lands long-range planning by the Oregon Department of Forestry. It builds on the high quality planning and analysis work we have always done as an agency. And it is accomplished within the legal and policy framework set out by the Oregon Constitution, Oregon Revised Statutes, Board of Forestry and State Land Board.

Like the recent planning efforts on other state forest lands, this plan adds four new concepts:

- Manage land on a larger geographic scale.
- Manage land over a longer time frame.
- Clearly define resource management goals.
- Monitor our actions closely, to assess progress.

We believe these four basic concepts are the heart of what has been popularly called "ecosystem management."

Uneven-aged management of Eastern Region state forest land has become the cornerstone of our overall management approach. An important aspect of this approach is the use of selective harvesting, which is used to maintain or improve uneven-aged stand structure. This has become the preferred silvicultural method in most areas of Eastern Region state forest lands, and we believe that this approach fits in well with ecosystem management concepts.

While recently the spotlight has been on the poor forest health of large areas in eastern Oregon, Eastern Oregon Region state forest land is in relatively good health. Some insect and disease problems do occur though, and are usually related to overstocking and imbalances in species composition. Our approach toward forest health is based upon the belief that certain silvicultural treatments can achieve a diverse, productive, resilient, and sustainable forest ecosystem.

The Klamath-Lake District's uneven-aged management and forest health strategy on these lands is truly unique and a model for similar land bases.

One of the plan's goals is to increase the efficiency and economic feasibility of intensive forest management. In keeping with this goal, this long-range plan addresses management and consolidation of isolated state forest land parcels throughout eastern Oregon.

We must also recognize that it is not possible to predict with complete precision the outcome of management decisions within a given ecosystem. Proper use of adaptive management, and altering actions over the long-term based on valid research and information, will help limit risk. An active monitoring and research program is the key to successfully implementing the forest management plan.

Another fundamental concept about ecosystem management, and a concept you will see in this forest management plan, is that human beings and their activities are an integral part of natural ecosystems. Ecosystem management must consider the full range of human needs.

Underlying all of our actions is the knowledge that healthy ecosystems are essential to the health and sustainability of human societies and the overall quality of life. All human activities, as well as decisions not to act, must maintain or enhance long-term ecosystem health.

We have a responsibility as natural resource managers to use the best information we have on the table today to make sound resource policy decisions that are in the public interest; that is, policies and strategies that are socially acceptable, ecologically sustainable, and commercially viable. We hope you will agree that this Eastern Region Long-Range Forest Management Plan meets these criteria.

James E. Brown
Oregon State Forester

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Klamath-Lake District Forester

Acknowledgments

Developing this plan has truly been a team effort — a team consisting of many talented individuals from agencies, organizations, and the general public. It is through their energy, diligence, and expertise that we have mapped out an effective course for the future.

I extend my sincere thanks and appreciation to all who participated in the planning process. Specifically:

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Executive Summary

❖ Introduction

The state forest lands in eastern Oregon offer many unique qualities and characteristics that stand out among all the state's forest lands. The geology, altitude, climate, and diversity of tree species on these lands provide major contrasts to other state forest lands.

Eastern Region State Forests — The Eastern Region State Forests have a total of 42,020 acres. The Klamath-Lake District has 33,265 acres, or a little over three-fourths, of this total. The remaining 8,755 acres are small pieces of land distributed across 12 eastern Oregon counties. These acres, which are also managed out of the Klamath-Lake District, are referred to as the scattered tracts.

The Klamath-Lake District covers a large part of south central Oregon, an area that stretches from Crater Lake National Park to the California border, and from the crest of the Cascades to Lakeview. South central Oregon includes Upper Klamath Lake, parts of three national forests, wildlife refuges, timber lands, agricultural and grazing lands, the city of Klamath Falls, and many smaller towns. The Klamath-Lake District state forests are concentrated in three areas of the district. The three groups of state forest lands are known as the North Block, East Block, and Southwest Block. Sun Pass State Forest, in the North Block, is the largest state forest in the Eastern Region, with 20,804 acres.

Purpose and scope of the management plan — The Eastern Region Long-Range Forest Management Plan (this document) provides direction for all Board of Forestry Lands and Common School Forest Lands in the Eastern Oregon Region. Of the region's 42,020 acres, 64% are owned by the Board of Forestry and 36% by the State Land Board. This plan supersedes the Timber Resource Inventory, Analysis, and Plan for the Eastern Oregon Area State Forests (Oregon Department of Forestry 1978).

The plan has a much more comprehensive approach toward forest planning than previous plans. It includes an assessment of the current condition of each resource, applicable laws and policies, and current management programs. The resource management strategies are intended to achieve the stated goals and address any underlying conflicts or problems. For example, the plan articulates the role of the state forests in providing wildlife habitat, while also addressing forest health concerns and allowing timber to be harvested.

Executive summary — The executive summary provides a "road map" of the plan. On pages S-2 through S-9, the summary explains briefly what is covered in each section of the plan. On pages S-10 through S-13, information is summarized for some key resources: cultural resources; forest health; land base; threatened, endangered, and state candidate plants; timber; and wildlife and fish. This part of the summary is synthesized from information in Sections III, IV, and V of the plan, and provides an overview of how these resources will be managed under the plan.

❖ Section I. Background and Planning Process

Location — This subsection provides additional information about the location of the Eastern Region State Forests.

History — This subsection provides a general history of the Klamath-Lake District area and past uses of the area's natural resources, as well as a history of the state forests. The State of Oregon acquired most of the Klamath-Lake District state forest lands in the 1940s and 1950s. Early forest planning dealt mainly with timber harvest schedules and silviculture. The 1978 long-range plan was the first formal plan for the Eastern Oregon state forests (Oregon Department of Forestry 1978). Both forest managers and the public have become increasingly aware of the many values associated with forests. The current planning effort for the Klamath-Lake District state forests (this document) recognizes the need to integrate a wide range of forest values into forest management, while recognizing that the state forests are intended to be an important contributor to timber supply for present and future generations.

Forest management planning for state forests — In the Eastern Oregon Region, the forest management planning system consists of the following elements: long-range plans (such as this document); annual operations plans; and budgets. This subsection includes more information on these elements. It also includes a detailed description of the planning process for the current long-range plan (this document). This description includes information on the planning team, the technical planning process, public involvement, and plan approval.

Alternatives — The draft long-range plan does not include alternatives to the listed strategies. This decision was made with the concurrence of the planning team's advisory committee and key resource specialists.

During the planning process, a variety of approaches were considered for each forest resource. These were narrowed to the final set of draft strategies, based upon the criteria of achieving the planning goals and providing balance among forest resources. During the public comment period, the planning team received feedback as to whether the draft strategies met these criteria.

Decision-makers and the public may expect a long-range plan to offer a range of alternatives for them to comment and act upon. This expectation may arise from experience with the federal planning processes. In particular, any plan that requires a federal action must go through the NEPA (National Environmental Policy Act) process. This federal process requires a wide spectrum of alternatives that have been fully developed and analyzed.

The planning team believed that the Eastern Region's role in providing wildlife habitat could be accomplished without going through the NEPA process. If the plan depended upon a federal action, then the team would have had to develop and analyze a wide spectrum of alternatives in order to satisfy NEPA requirements.

❖ Section II. The Guiding Principles

The guiding principles were developed by the planning team to guide the plan's development. The management goals in Section IV and the management strategies in Section V must be consistent with the guiding principles. The guiding principles are discussed in detail in Section II.

1. The plan will be a comprehensive, integrated forest management plan taking into account a wide range of forest values.
2. The plan will be developed within the context of State Forest Lands in the Klamath-Lake District as managed forest lands. The remaining 53 smaller parcels of Common School Lands, which are distributed across 12 Eastern Oregon counties ("scattered tracts"), will be managed to maintain their "asset value."
3. The plan will recognize that the forest is intended to be an important contributor to timber supply for present and future generations.
4. The primary standard of management of all resources on the Eastern Region State Forests is maximization of income for the Common School Fund and production of income for local governments over the long-term, consistent with cost-effective and ecologically sound forest resource management.
5. Lands will be identified and managed to optimize long-term revenue, biological capability, and social values. The plan will recognize that there will be trade-offs between revenue-producing activities and other activities that do not produce revenue.
6. The plan will examine opportunities to cooperate with other agencies, user groups, or organizations.
7. Diverse input from a variety of interested parties, including user groups, business interests, adjacent landowners, and the general public will be a high priority throughout the planning process.
8. The plan will be goal-driven.
9. The plan will manage the forest as a sustainable ecosystem, and maintain the forest's ecological processes and biodiversity in order to provide long-term sustainability.
10. The forest will be managed to meet state and federal Endangered Species Acts while fulfilling the State Land Board's responsibilities under the Oregon Constitution and the Board of Forestry's statutory responsibilities. Management plans for threatened or endangered species will seek to complement or supplement habitat provided by other landowners.
11. Adaptive management will be used to incorporate new information as it becomes available.

❖ Section III. Resource Description

The Eastern Region State Forests have a wealth of resources. This chapter is divided into four main subsections.

- **The land base —** This subsection describes the Eastern Region's land ownership. Additional information about land location and names is provided in Section I.
- **The landscape —** This category includes abiotic resources, such as the climate, geology, soils, topography, water resources, and air quality.
- **The ecosystem —** This category includes all biological resources, such as trees, other vegetation, wildlife, and fish. This part of the chapter begins with a general description of the forest ecosystems and biodiversity in eastern Oregon, and concludes with a discussion of forest health.
- **The human context —** This category includes the many ways that people use the state forests in the Eastern Oregon Region, as well as how management of their resources affects nearby communities and local economies.

For each resource, the description covers two main items.

- **Resource description —** The information that is currently known about the resource is summarized. Information may include quantitative data, such as the miles of streams. It also includes qualitative discussion of the resource's status.
- **Current programs —** Laws, policies, and programs that affect the resource and its management are described.

Section III includes detailed descriptions of the following resources.

The Land Base

The Landscape

- Climate
- Geology, topography, and soils
- Water resources
- Air quality

The Ecosystem

- Biodiversity
- Vegetation
- Wildlife and fish
- Forest health

The Human Context

- Land use classifications
- Forest products: timber
- Special forest products
- Recreation and scenic resources
- Cultural resources
- Fire management
- Grazing
- Subsurface resources
- Social and economic resources

❖ Section IV. Management Goals

This section describes the management goals for each resource on the Klamath-Lake District forests that will be actively managed. Goals are general, non-quantifiable statements of direction. The goals describe what we would like to achieve with respect to the resources of the Klamath-Lake District forests. The goals were used to guide the development of the management strategies in Section V. The strategies describe how we will attempt to achieve the goals. Compliance with all applicable laws will be ensured through the goals and strategies. If the laws change, then the goals and strategies will be modified to ensure consistency with the new laws. This section has goals for the following resources. The resources are listed in alphabetical order.

- Air quality
- Cultural resources
- Fire management
- Forest health
- Grazing
- Land base
- Recreation and scenic resources
- Social and economic resources
- Soils
- Special forest products
- Subsurface resources
- Threatened, endangered, and state candidate plants
- Timber
- Water resources
- Wildlife and fish

❖ Section V. Management Strategies

Management strategies are specific actions that will be taken to achieve the management goals described in Section IV. The forest plan is implemented by carrying out management strategies. The plan's success can be measured in part by the degree to which the management strategies are successfully implemented. The plan will be implemented using an adaptive management approach. This approach is described in Section VIII. A detailed explanation of how the goals and strategies were developed is given in Section I under the heading "The Eastern Region Planning Process."

Strategies are given for the resources listed above for Section IV, "Management Goals", with the exception of social and economic resources. The goals for social and economic considerations will be met through implementation of the strategies for the other resources. Section V also includes a short analysis of each strategy. The analysis provides a short explanation of why the strategy is needed, how it will contribute to achieving the goals, and a brief description of the effects and outcomes that are expected to occur when the strategy is implemented.

❖ Section VI. Asset Management

The Eastern Region State Forest Lands are a tangible asset of the people of the State of Oregon. In particular, they are an asset of the counties, local taxing districts (mostly schools), and the Common School Fund. By statutory mandates and constitutional requirement, these lands are, and will remain, a long-term revenue-generating asset. Prudent and careful management of this asset is a central theme to the overall planning for and management of the forest. Each major decision and implementing action must recognize this imperative.

Management of the asset includes investment of time, dollars, and resources to perpetuate the forest's ability to generate revenue long-term. These investments include direct expenses for the annual production of commodities such as timber, as well as indirect expenses for overall planning and long-term management, such as resource monitoring or studies. Most revenue-generating resources on these forests are renewable, and therefore the forest's revenue-generating potential is very long-term.

Organization and management — The Eastern Region State Forests are managed by the Klamath-Lake District of the Oregon Department of Forestry. Section VI describes the district's organization, district responsibilities, responsibilities of the Salem headquarters staff, and support provided by the Oregon Department of Fish and Wildlife. This section also describes the financial management of the forest management program.

Resource revenues and expenses — This subsection summarizes revenues and expenses for each resource. Not all resources are associated with direct revenues and/or expenses. Also, some immediate resource expenses are in fact investments in the health and sustainability of the forest, and therefore contribute to the forest's overall ability to generate future income. The table on the next page summarizes revenues, expenses, and net income (in 1994 dollars) for the timber resource over the next ten years.

Table S-1. Revenues, Expenses, and Net Income for Eastern Region State Forests — Timber Only			
Land Ownership	**Revenue [1] Ten-Year Total 1995-2004**	**Expenses [2] Ten-Year Total 1995-2004**	**Net Income [3]**
Board of Forestry Lands	$18,572,000 to $34,676,000	$8,122,000	$26,554,000
Common School Forest Lands	$3,798,692 to $6,697,000	$1,764,000	$ 4,933,000
Totals	$22,370,692 to $41,373,000	$9,886,000	$31,487,000

1. The high value in the revenue range assumes stumpage prices based on recent experience. The low value assumes stumpage prices experienced in the late 1980s. As stumpage prices change, actual revenue will change accordingly.
2. The district expenses for timber management include all associated management costs for the forest not included in other resource descriptions. These expenses include Eastern Oregon Area and Salem headquarters staff costs.
3. Net revenue was derived using the high end of the revenue range minus the anticipated expenses.

The following table summarizes the anticipated total revenues, expenses, and net income (in 1994 dollars) for all resources for the next ten years.

Table S-2. Revenues, Expenses, and Net Income for Eastern Region State Forests — Total for All Resources			
Land Ownership	**Revenue [1] (Ten-Year Total) 1995-2004**	**Expenses [2] (Ten-Year Total) 1995-2004**	**Net Income**
Board of Forestry Lands	$18,575,000 to 34,679,000	$8,294,000	$26,385,000
Common School Forest Lands	$3,802,000 to $6,700,000	$1,867,000	$4,833,000
Totals	$22,377,000 to $41,379,000	$10,161,000	$31,218,000

1. Includes estimated revenues from the timber and grazing resource sections of the asset management analysis. The timber revenues include a revenue range with high and low values. See Table S-1 for the timber revenue range.
2. This is a total of the estimated costs discussed in the cultural, fire, land base, recreation, threatened and endangered plants, timber, and wildlife and fish resource sections of the asset management analysis.

❖ Section VII. Implementation

This section describes who is responsible for implementing the plan, and how implementation will be carried out.

Responsibilities — The Klamath-Lake District Forester has the overall responsibility for implementing the Eastern Region Long-Range Forest Management Plan. Implementation of the plan consists of the four primary responsibilities listed below.

- Implement the management strategies listed in Section V, "Management Strategies."
- Monitor those activities as described in Section VIII, "Monitoring and Adaptive Management."
- Conduct periodic reviews of plan implementation as described in Section VIII, "Monitoring, Research, and Adaptive Management." Determine when changes are needed.
- Amend the plan as needed.

Plan scope — For the Eastern Region State Forests, this Forest Management Plan supersedes the Timber Resource Inventory, Analysis, and Plan for the Eastern Oregon Area State Forests (Oregon Department of Forestry, 1978).

Plan duration and amendments, implementation levels, and implementation through other plans — Section VII includes discussion of these items also.

❖ Section VIII. Monitoring, Research, and Adaptive Management

Monitoring — Monitoring is a key to successfully implementing the forest management plan. The Department of Forestry is committed to carry out the monitoring activities described in this section. In the context of the Eastern Region state forests, monitoring is a process of measuring key characteristics of forest resources, in order to determine the effects of carrying out management strategies. Monitoring helps us answer the question: "Are the management strategies we have implemented achieving our management goals for resource development and protection?"

This subsection summarizes information on monitoring plans and the types of information that will be collected for each resource. Together with ongoing research, monitoring provides the information needed to support an adaptive management approach to forest management.

Research — The Oregon Department of Forestry will sponsor research to better understand managed forest conditions that support healthy pileated woodpecker and goshawk populations. (See Wildlife and Fish Strategies in Section V for details.) The research objective is to develop and implement habitat standards (for example, snags and

woody debris) and refine silvicultural prescriptions for the Forest Connectivity Areas. These standards should ensure the maintenance over time of at least two nesting pairs of pileated woodpeckers and one nesting pair of goshawks. The study plan will be developed.

Adaptive management — A commitment to adaptive management is one of the guiding principles driving the Eastern Region planning process. Adaptive management involves collecting new data, analyzing it, and adjusting management if necessary. Specifically, it involves taking input from monitoring activities and research, and incorporating this information into ongoing planning and implementation. It may also involve partnerships with other landowners to share information, collaborate on research, and implement joint or complementary management activities.

Adaptive management is based on sound, verifiable science that is peer-reviewed. It involves a regular assessment of current management practices. This occurs through ongoing implementation and also through the yearly sale planning and budget cycles. For the Eastern Region State Forests, it will involve a partnership approach between district personnel and staff specialists at the Salem headquarters. This subsection lists some of the information sources that will be used to support adaptive management, and gives some examples of how adaptive management will be implemented on Eastern Region State Forests.

The Klamath-Lake District plans to hold an annual review of plan implementation. This review may include a field tour, and will be an opportunity to collect input from resource specialists and the general public.

❖ Appendices

Supplemental information is included in a number of appendices. The appendices include a glossary; references; information on legal and policy mandates; plant associations; species lists for plants and animals; biographies of planning team members, staff, and technical advisors; the scattered tracts plan; a seven-year history of timber harvest; and information on special forest products.

❖ Summaries for Key Resources

On the next several pages, information from Sections III, IV, and V of the plan is summarized for several key resources. Please refer to the appropriate sections of the plan for detailed information about these resources and the other resources on Klamath-Lake District state forests.

Cultural Resources

Cultural resources are a significant consideration in the management of the Klamath-Lake District state forests. Some Klamath-Lake District state forest lands are located on former Klamath Indian Reservation lands and on lands ceded by the three treaty groups — Klamath, Modoc, and Yahooskin Paiute — in 1864. American Indian cultural resources in the vicinity of state forest lands include villages, camps, rock shelters, cremation piles and burials, obsidian quarries, stone tool making sites, peeled trees, petroglyphs, pictographs and vision quest sites. Two American Indian sites are known to be located on state forest lands. Klamath tribal members are concerned that these sites be protected.

Historic sites known to be present or that may be found on state lands include early explorers' trails, wagon roads, features and artifacts relating to Fort Klamath, early land survey markers, and railroad logging grades, camps, features, and artifacts.

The Eastern Region Long-Range Forest Management Plan includes several strategies designed to protect American Indian sites and objects, and historic non-Indian cultural resources. The Winema National Forest archaeologist and the Klamath Tribes were consulted during the initial assessment of cultural resources, and in the development of goals and strategies.

Forest Health

The Klamath-Lake District state forests are in relatively good health compared to other eastern Oregon forests that have been experiencing insect and disease epidemics. Nevertheless, pest problems do occur and are particularly related to overstocking and imbalances in species composition.

The approach toward forest health is based upon the premise that a diverse, productive, resilient, and sustainable forest ecosystem can be achieved through silvicultural treatments. Human intervention is needed to mitigate undesirable forest conditions that tend to result from excluding natural fires. The silvicultural approaches for timber, soils, wildlife and fish, and fire management are closely related. Most treatments are done in conjunction with timber harvesting and post-harvest activities.

Land Base

The Eastern Oregon Region state forests total 42,020 acres. Of this total, 26,862 acres are Board of Forestry lands, and 15,158 acres are Common School Forest Lands. Three-fourths of the total, or 33,265 acres, are in the Klamath-Lake District. The Sun Pass State Forest contains 20,804 acres. All of the Eastern Region's state forests are managed by personnel in the Klamath-Lake District office.

One of the plan's goals is to increase the efficiency and economic feasibility of intensive forest management. The Eastern Oregon Region includes 8,755 acres of Common School Forest Lands, in 53 separate parcels, that are spread across 12 counties outside Klamath County. These lands are known as the "Eastern Region Scattered Tracts." The Eastern Region Long-Range Forest Management Plan contains a Scattered Tracts Plan (see Appendix L) that considers land exchanges and/or removing these lands from the Common School Forest Land list. The Asset Management Plan that is currently being developed by the Division of State Lands will provide further policy guidance for determining retention, sales, and exchange strategies.

Within the Klamath-Lake District, some of the lands are satellite parcels that are isolated from the state forest core areas. These include both Board of Forestry and Common School Forest Lands. The Eastern Region Long-Range Forest Management Plan addresses the need to exchange these parcels in order to consolidate ownerships.

Threatened, Endangered, and State Candidate Plants

The Oregon Department of Agriculture has approved a base list of species that have a strong possibility of occurring within the planning area. The list consists of two plants, *Astragalus peckii* (Peck's milkvetch) and *Botrychium pumicola* (pumice grape-fern), that are state candidates currently proposed for threatened or endangered status. The plan addresses the development of appropriate assessment methodology to allow the Oregon Department of Forestry to screen specific activities in specific locations for potential conflicts with listed species. For these two species, assessments would probably be limited to about 4,000 acres within the lodgepole pine forest zone.

Timber

Most of the Klamath-Lake District state forests have an uneven-aged structure with trees of many species, sizes and ages. In limited areas where clearcutting or seed tree harvesting has occurred, the trees are mostly the same age, or even-aged.

Selective harvesting, which is used to maintain or improve uneven-aged stand structure, has become the preferred silvicultural method in most areas of the Klamath-Lake District state forests. Earlier timber harvesting practices left a stand structure that is easily adapted to uneven-aged management. The gentle terrain makes selective harvesting economical with ground-based equipment. The advantages of uneven-aged management include: (a) higher timber production with the site continuously occupied by trees; (b) better forest

health; (c) low reforestation costs and good success with reforesting; (d) increased biodiversity and wildlife habitat.

Under the strategies of the Eastern Region Long-Range Forest Management Plan, uneven-aged management will be practiced in the ponderosa pine and white fir forest zones, and even-aged management in the lodgepole pine forest zone. Even-aged management may also be used occasionally in circumstances where ecological conditions, insects, or disease make selective harvesting less attractive.

Sustained yield harvest will be regulated on an acreage, rather than volume, basis. The plan estimates that during the first decade of plan implementation, a total of 11,887 acres will be harvested in the Klamath-Lake District state forests. Of this total, 9,813 acres will be on Board of Forestry lands, and 2,074 acres on Common School Forest Lands. The estimated volume for these acreages is 90.07 MMBF (million board-feet). Of the total volume, 74.04 MMBF will be from Board of Forestry lands, and 16.03 MMBF will be from Common School Forest Lands. See Table S-1 on page S-7 for timber revenues, expenses, and net income expected from the timber harvest.

Wildlife and Fish

Many wildlife species are known or expected to occur on Klamath-Lake District state forests. The Eastern Region Long-Range Forest Management Plan includes a number of strategies that will provide the foundation for protecting biodiversity on Klamath-Lake District state forests, and will meet the habitat needs of most wildlife species. These strategies include maintaining the current set of Conservancy — Critical Wildlife Habitat Areas; retaining snags, large trees, and cover areas; and participating in the Sun Creek Cooperative Road Closure.

ODFW (Oregon Department of Fish and Wildlife) biologists have recommended that Sun Pass State Forest has a special role in the region. This role is to provide connectivity between the four late successional reserves that surround Sun Pass on the Winema National Forest and the late successional habitat in Crater Lake National Park. To help fulfill this role, the Eastern Region Long-Range Forest Management Plan provides for designating approximately 2,000 acres of Sun Pass as Forest Connectivity Areas. These areas will be managed to provide forest stands with higher density, greater crown closure, and larger trees.

Four listed threatened and endangered (T&E) species are known or likely to be found on Klamath-Lake District state forest lands: American bald eagle, northern spotted owl, peregrine falcon, and California wolverine. Currently, these species do not appear to be highly dependent upon the state forests for habitat. Therefore, management strategies that deal with T&E species are not expected to have a large impact on timber or other forest resources.

Spotted owl surveys have been conducted annually at Sun Pass State Forest since 1992. Three owl pair activity centers have been located within 1.5 miles of Sun Pass State Forest on Crater Lake National Park and Winema National Forest. Based on the survey results, the Department of Forestry has made the following findings: (a) spotted owls do not use Sun Pass State Forest, and (b) spotted owls nesting adjacent to Sun Pass appear to avoid the state forest.

Three years of spotted owl surveys have been conducted in the Bear Valley Tract. There is evidence that this area has importance as a travel corridor. Outside the Bear Valley core area, surveys by Weyerhaeuser Co. and the BLM (Bureau of Land Management) have located an owl pair activity center within 1.2 miles of an isolated state forest parcel on Buck Mountain.

Bald eagles are common year-round residents in the Klamath Basin, with both a significant nesting population and a large wintering population. State forest lands adjacent to the U.S. Fish and Wildlife Service Bear Valley Wildlife Refuge do not provide winter roost habitat, but are probably important as a forest land buffer to prevent the encroachment of human disturbance such as subdivisions.

A pair of peregrine falcons nests in the cliffs above Crater Lake. Sun Pass State Forest lies in a direct line between Crater Lake and foraging areas in the Fort Klamath valley. It is almost certain that the birds fly over the state forest, but they do not likely fly below the canopy.

Wolverines are not known to occur on Klamath-Lake District state forest lands. They are wide-ranging animals with large home ranges. There have been two recent sightings within two miles of state forest lands.

The pileated woodpecker, a state critical sensitive species, and the northern goshawk, a federal Category 2 and state critical sensitive species, were selected as indicator species to monitor the effectiveness of the Forest Connectivity Areas in achieving Sun Pass's connectivity role. The plan includes strategies to collect information on the status of these species on Eastern Region state forests, and if necessary, to develop additional standards for Forest Connectivity Areas.

The endangered shortnose and Lost River suckers were not identified as being known or likely to occur in waters within state forests. However, state forests could impact these species through the quality or quantity of water flowing from state forest lands. The water resource strategies in Section V address water quality and quantity.

Eastern Region Long-Range Forest Management Plan

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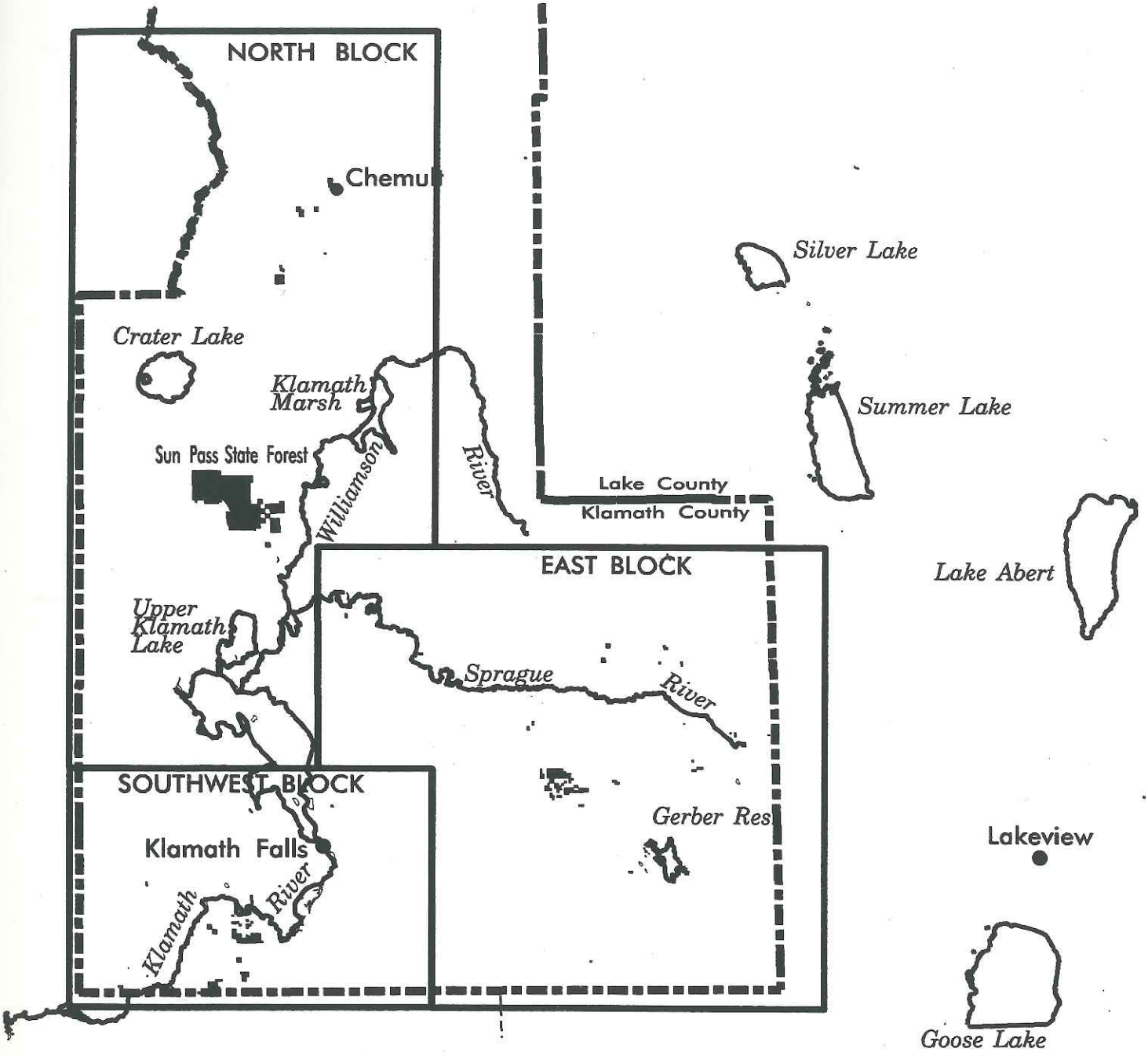
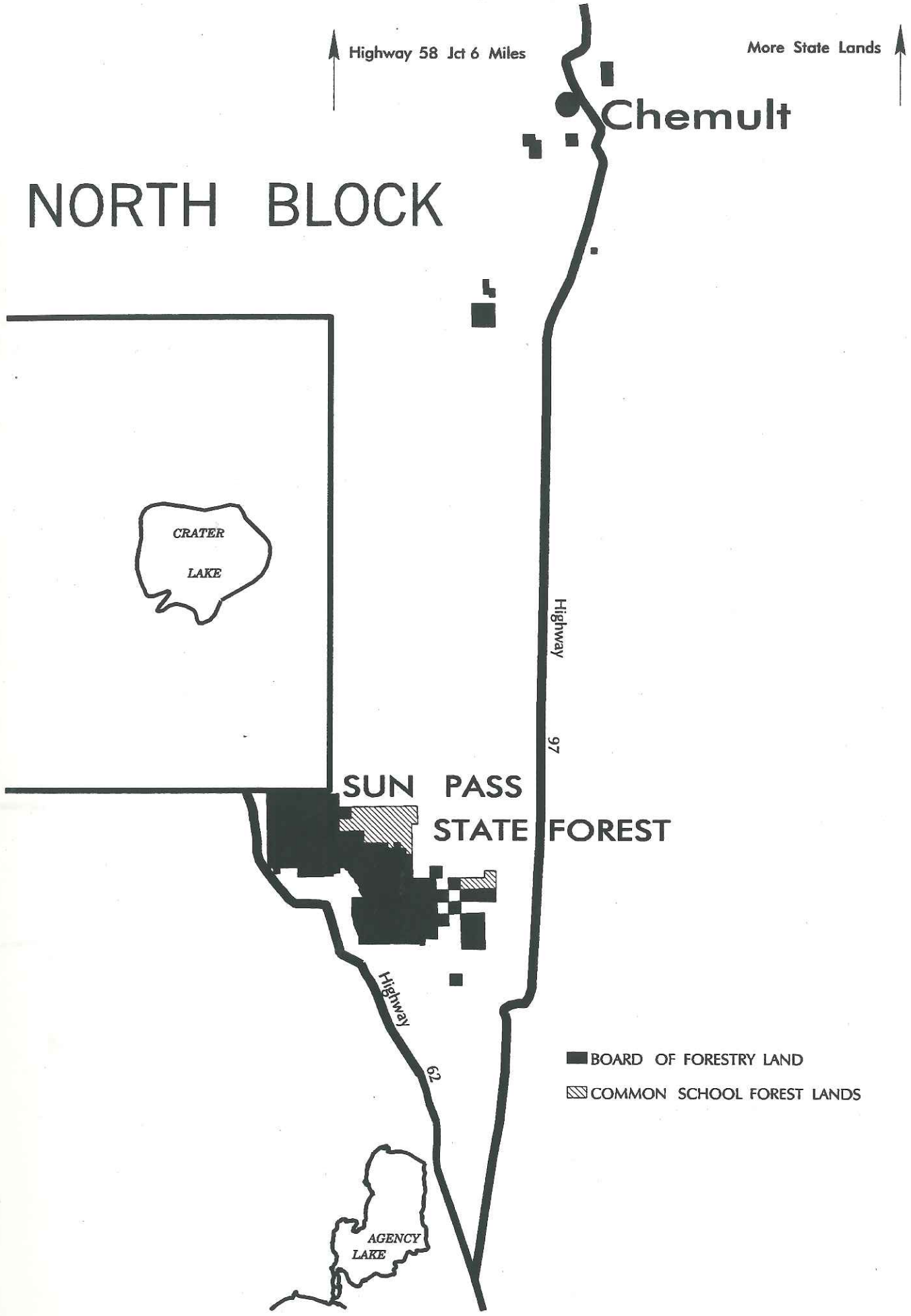
KLAMATH–LAKE DISTRICT




Highway 58 Jct 6 Miles
More State Lands
Chemult
NORTH BLOCK
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SUN PASS
STATE FOREST
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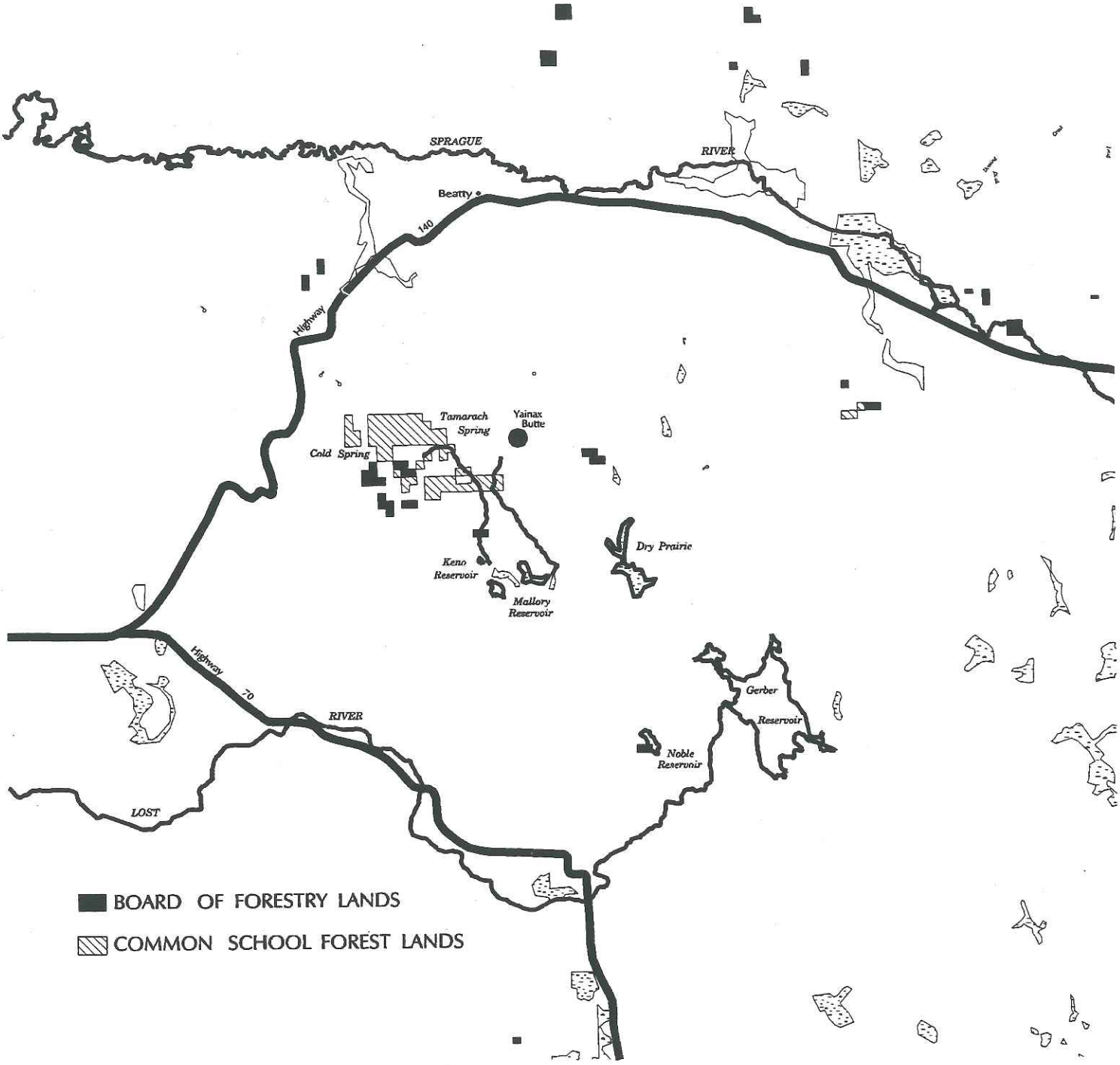
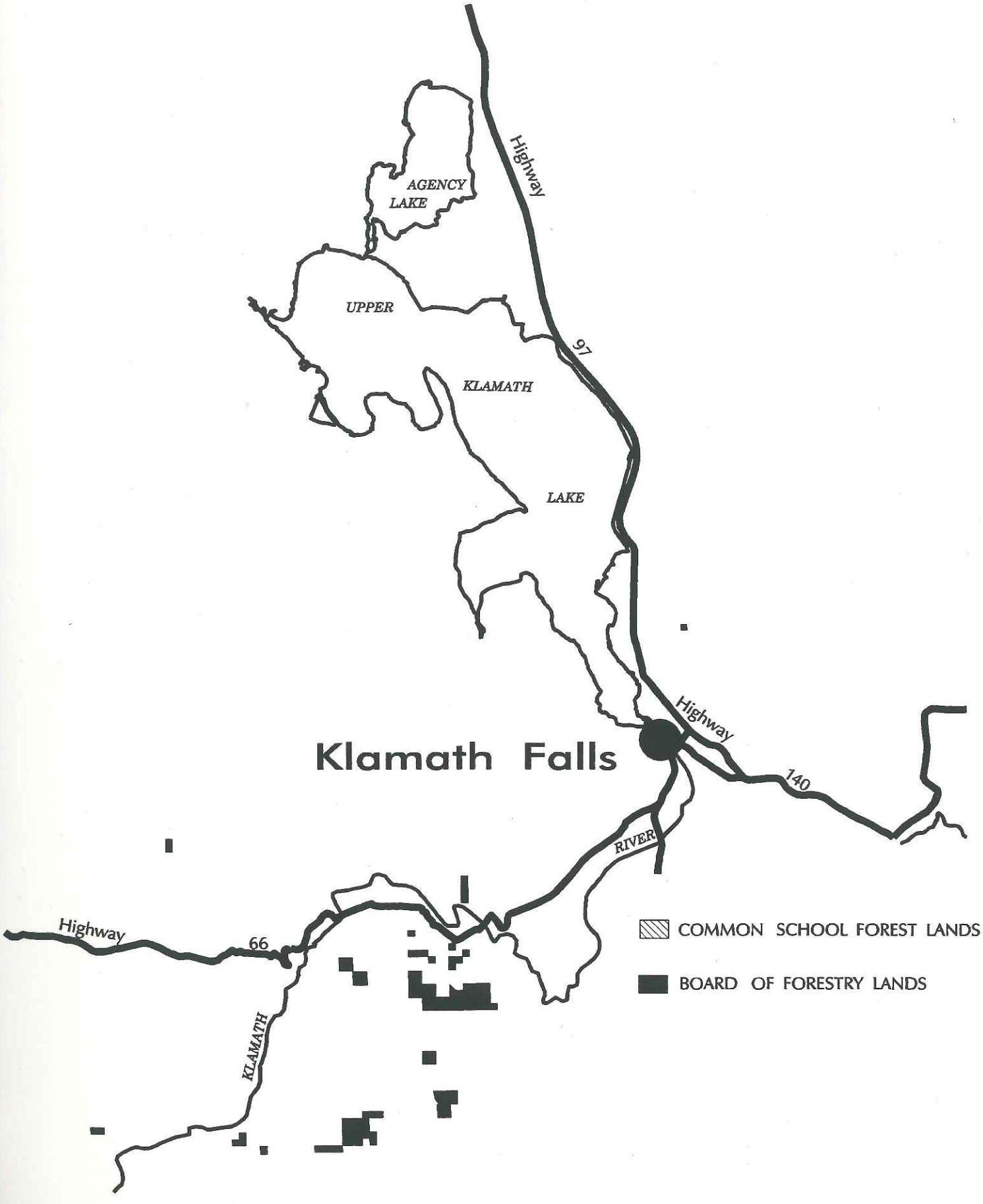
BOARD OF FORESTRY LAND
COMMON SCHOOL FOREST LANDS

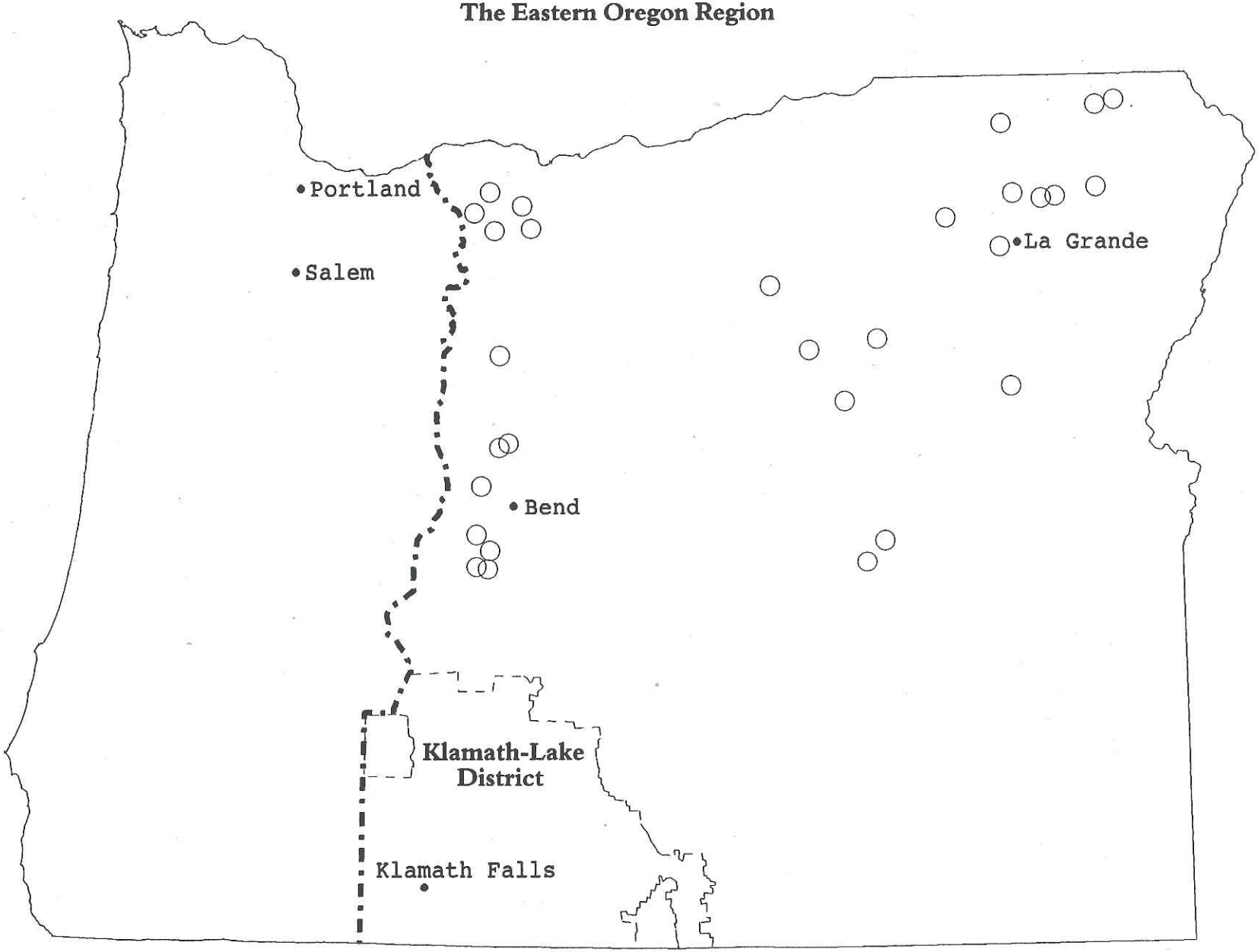
EAST BLOCK


SPRAGUE
RIVER
Beatty
140
Highway
Tamarach Spring
Yainax Butte
Cold Spring
Dry Prairie
Keno Reservoir
Mallory Reservoir
Highway
70
RIVER
Gerber Reservoir
Noble Reservoir
LOST
BOARD OF FORESTRY LANDS
COMMON SCHOOL FOREST LANDS

SOUTHWEST BLOCK



Scattered Tracts Outside Klamath County



Section I

Background and Planning Process

Location of Eastern Region State Forests

Location

The state forest lands in eastern Oregon offer many unique qualities and characteristics that stand out among all the state's forest lands. The geology, altitude, climate, and diversity of tree species on these lands provide major contrasts to other state forest lands.

The eastern region state forests have a total of 42,020 acres. The Klamath-Lake District has 33,265 acres, or a little over three-fourths, of this total. The remaining 8,755 acres are small pieces of land distributed across 12 eastern Oregon counties. These acres, which are also managed out of the Klamath-Lake District, are referred to as the scattered tracts.

The Klamath-Lake District covers a large part of south central Oregon, an area that stretches from Crater Lake National Park to the California border, and from the crest of the Cascades to Lakeview. South central Oregon includes Upper Klamath Lake, parts of three national forests, wildlife refuges, timber lands, agricultural and grazing lands, the city of Klamath Falls, and many smaller towns. The Klamath-Lake District state forests are concentrated in three areas of the district. The three groups of state forest lands are known as the North Block, East Block, and Southwest Block. Figure I-1 on the next page and the "Key Terms" box on page I-3 show the terms that will be used throughout this plan in describing the state forest lands.

Sun Pass State Forest comprises most of the North Block. It's located 40 miles north of Klamath Falls, near the southeastern corner of Crater Lake National Park. Sun Pass is bordered by the national park, Winema National Forest, and private lands. The North Block also includes various satellite pieces of land in northern Klamath County.

Most of the East Block lands are in the area of Yainax Butte, about 30 miles northeast of Klamath Falls, or roughly halfway between Klamath Falls and Bly. The East Block also includes satellite pieces of land. The East Block lands are bordered by Fremont National Forest, private lands, and BLM (Bureau of Land Management) lands. The bulk of the Southwest Block lands are in or near Bear Valley, about 15 miles southwest of Klamath Falls. A number of satellite pieces are scattered across southwest Klamath County. The Southwest Block lands are bordered by BLM and private lands.

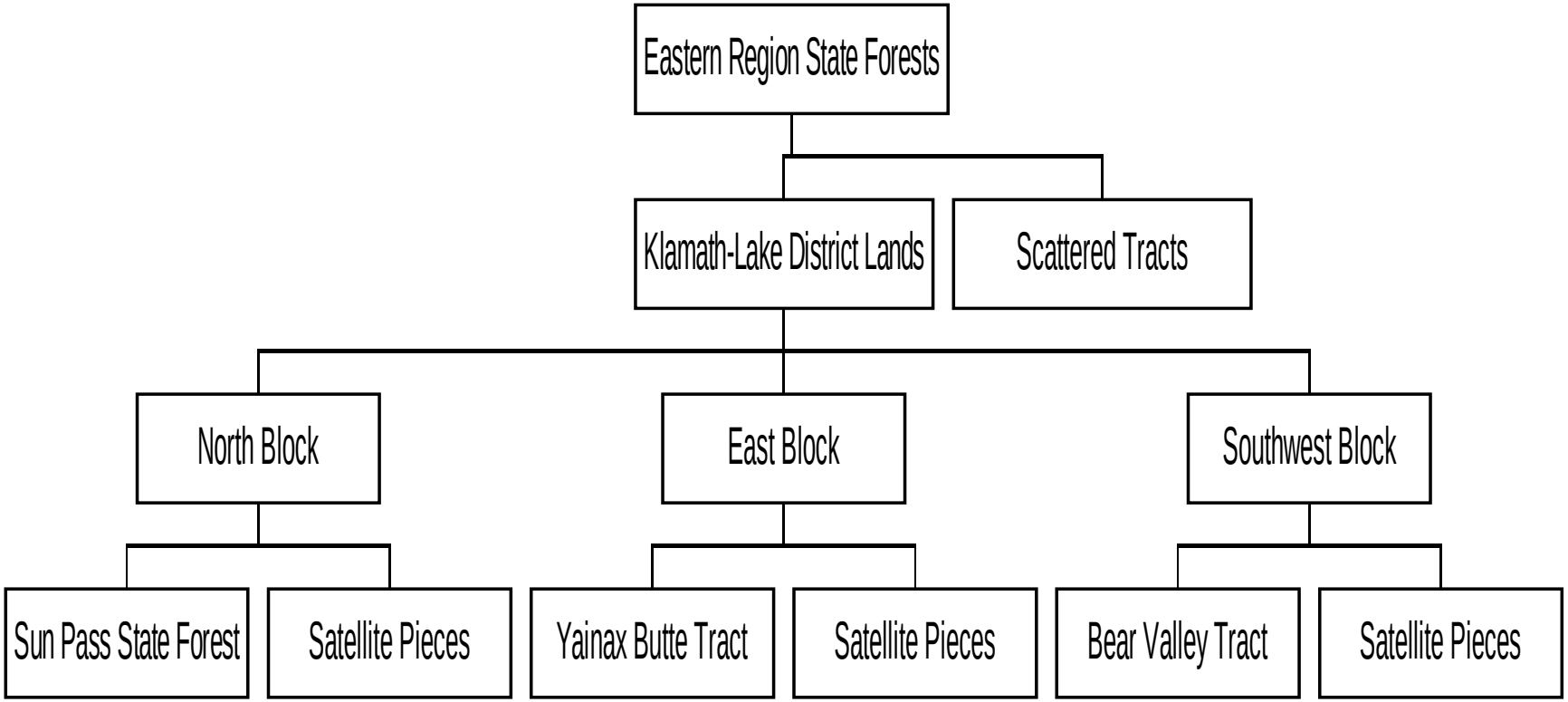


Figure I-1. The Eastern Region State Forests

The Eastern Region State Forests include many separate tracts of land. Throughout this plan, the various pieces of land will be described using the words defined in the "Key Terms" box on the next page. The relationships among these terms are diagrammed above.

Key Terms

The terms below will be used throughout this plan in describing the state forests of eastern Oregon. The terms are grouped to correspond to the diagram in Figure I-1 on the previous page.

Eastern Region State Forests — Includes all state forests in eastern Oregon. For this plan, eastern Oregon consists of Klamath County, Lake County, and all other counties east of the Cascade crest.

Klamath-Lake District lands — Includes all state forest lands in the North Block, East Block, and Southwest Block. Except for one 40 acre satellite piece in Lake County, all Klamath-Lake District lands are in Klamath County.

Scattered tracts — Small pieces of state forest scattered in other eastern Oregon counties besides Klamath and Lake Counties.

North Block — Includes the Sun Pass State Forest north of Klamath Falls, and nine satellite pieces in northern Klamath County. Six satellite pieces are located 20-33 miles north of Sun Pass, between Diamond Lake Junction on Highway 97 and the town of Chemult. The other 3 satellite pieces are located in the vicinity of the town of Crescent, approximately 50 miles north of Sun Pass.

East Block — Includes the Yainax Butte tract northeast of Klamath Falls, plus twenty satellite pieces in eastern Klamath County and Lake County.

Southwest Block — Includes the Bear Valley tract southwest of Klamath Falls, plus seven satellite pieces in western Klamath County. Six satellites are located northwest of the Bear Valley tract, and the remaining satellite is approximately two miles north of Klamath Falls and two miles east of Highway 97.

Sun Pass State Forest — The state forest located 40 miles north of Klamath Falls, and near the southeastern corner of Crater Lake National Park. Sun Pass comprises 20,804 acres of the 42,020 acres of state forest land in eastern Oregon.

Bear Valley Tract — The largest piece of state forest within the Southwest Block; it is located in the Bear Valley area.

Yainax Butte Tract — The largest piece of state forest within the East Block; it is located near Yainax Butte.

Satellite pieces — Small pieces of state forest in Klamath and Lake Counties, other than Sun Pass State Forest, Bear Valley Tract, and Yainax Butte Tract.

History

Early American Indian History

American Indians have been living on the land we now call Oregon for at least 10,000 years. Throughout this time, Indian peoples migrated from one area to another, and cultures changed. The entire history of the Indian peoples in south central Oregon is not known. When Euro-Americans first came to the area, the Klamath, Modoc, and Yahooskin Paiute tribes lived there. Although each tribe had its own culture, there were some similarities in the lifeways of these three peoples. Winter villages and seasonal base camps were established along the major rivers, lakes, and marshes. Dwellings in the permanent villages were circular, earth-covered lodges that held from one to eight families. Unlike Indian tribes along the Columbia River, who depended heavily on a single food source, salmon, the tribes of south central Oregon had no dominant food. A number of foods were equally important to them. Some major foods were wocus (water lily seeds), other plant foods, waterfowl, game, and freshwater fish such as mullet. Spiritual life was very important, and it was common for tribal members to go on vision quests. (Budy 1994, Zucker et al. 1987)

Euro-American Exploration and Settlement

British trappers for the Hudson Bay Company were the first Euro-American explorers in south central Oregon. Parties traveled south from The Dalles in 1825 and 1826, following approximately the route of present Highway 97. John C. Fremont led the first American group along the old Klamath Indian Trail in 1843. He entered the Klamath area again in 1846, this time from the south. The Applegate Trail, used by settlers to Oregon in 1846 and 1847, runs along the lower edge of Lower Klamath Lake, part of it through state forest land. The Williamson and Abbot party in 1855 conducted explorations and surveys for a railroad route to link the various proposed transcontinental routes. The Old Klamath Indian Trail later was developed into the Huntington and Old Fort wagon roads.

In 1863, soldiers began to build a military post in south central Oregon. Fort Klamath was built in the Wood River Valley, not far from the present-day Sun Pass State Forest. Soldiers constructed a sawmill on Fort Creek, officers' quarters, barracks, guardhouse and arsenal, small hospital, bakery, stables, and other structures. A 3,135 acre hay reserve was located to the north where 600,000 pounds of hay were cut annually for the horses and mules. The fort was abandoned in 1889, and none of the original buildings remain today.

In the 1860s and 1870s the army blazed and constructed a number of military roads in the area. In the fall of 1867, Lindsay Applegate built a road over the old Klamath Indian Trail north from the Indian Agency to the present town of Bend. (The road built in 1867 is not the same trail as the Applegate Trail described above.)

The growing number of non-Indian settlers in the area put greater and greater pressures on Indian lands. In the Treaty of Klamath Lake, signed in 1864, the Klamath Tribe ceded 13,000,000 acres in south central Oregon and northern California to the United States. They

kept 1,113,794 acres for a reservation, east and north of Upper Klamath Lake. In the following decades, there were a number of conflicts over reservation boundaries. The resolution of these conflicts nearly always ended up subtracting land from the reservation, with little or no compensation paid to the tribe. Other Indians were required to settle on the reservation, including members of the Modoc, Pit River, Shasta, and Northern Paiute tribes. By 1875, all of the Indian peoples on the reservation were generally referred to as the Klamath Tribe. (Zucker et al., 1987)

Despite the many problems associated with the reservations, most Indians remained there and tried to adjust to their new situation. However, in 1872, a group of Modocs led by Captain Jack attempted to return to their original homeland in northern California. The Modoc Indian War of 1872-1873 was fought in the area that is Lava Beds National Monument today. Captain Jack and his small band of Modocs held off 1,000 soldiers for months, but in the end they lost. The surviving Modocs were returned to the reservation. The war was the last Indian war in south central Oregon. By the early 1900s, the Klamath Reservation reached its final, reduced size of 862,622 acres. (Zucker et al., 1987)

Changing Patterns in Natural Resource Use

South central Oregon is rich in a wide variety of natural resources. For thousands of years, the Indian peoples harvested just enough of the area's resources to support their own people. The non-Indian people, who dominated the area's economy by 1900, used natural resources more intensively. They wanted to grow and harvest products to sell to others, and to export to other areas. Forestry, agriculture, and tourism, industries central to the area's economy today, developed rapidly during the early decades of the twentieth century.

The wagon roads built in the late 1800s had already connected south central Oregon to other areas. In 1909, the first railroad came to the Klamath area. The improved transportation led to rapid growth in farming and logging. Railroads were built into the forests to transport lumber to the mills. Railroad logging was common in the Klamath area from 1910 to 1945. The Bureau of Indian Affairs opened the Klamath Indian Reservation to commercial timber harvest in 1910. A complex rail system of mainlines, branches, and spurs was built across the reservation. After about 1935, trucks were used to haul logs to mainline railroads, reducing the use of railroad spurs. Eventually, trucks became the dominant transportation mode for moving logs to the mills. (Budy 1994)

The Bureau of Reclamation started its first project in the Klamath Basin in 1906, draining Lower Klamath Lake and creating thousands of acres of farm land. Other reclamation projects, from small-scale private undertakings to large federal projects, were completed over the entire basin. Farmers drained many shallow marshes and wetlands, turning these areas into fields and pastures. Water was diverted from streams and lakes for irrigation. The federal reclamation projects set aside some areas for wildlife refuges. In fact, the nation's first wildlife refuge was established just south of the Oregon border, at Tule Lake in northern California.

Dams were built to generate hydroelectricity, control water levels, and aid irrigation. A dam built at the lower end of Upper Klamath Lake allowed the natural lake to be managed as an irrigation and hydropower reservoir. In 1916, the Iron Gate Dam was built on the Klamath River in northern California without providing passage for anadromous fish. The impassable dam blocked chinook salmon from the upper Klamath, Sprague, Williamson, and Wood Rivers, resulting in the extinction of the upper Klamath Basin salmon runs (Nehlsen et al., 1991).

The tourism and recreation industries of south central Oregon also had their beginnings in the early decades of the twentieth century. Crater Lake National Park was established in 1902, and became a major attraction for tourists. People built resorts and summer homes around Upper Klamath Lake and other lakes and rivers in the region.

The Origin and Development of the State Forests

The State of Oregon acquired most of the Klamath-Lake District state forest lands in the 1940s and 1950s. A complete chronology of the purchases is in Brog et al., 1984. This account is summarized from that document. In December, 1943, the Board of Forestry purchased the first 14,450 acres of the present Sun Pass State Forest from Yawkey, Woodson, Ourbacker, and Algoma Lumber Company. When the Department of Forestry got the land, it had been heavily cut over. The only trees left were too small or too defective to be commercially valuable at the time. In some areas this logging released an existing understory of white fir, while in other places it created an ideal seed bed for ponderosa and sugar pine. This harvest history is largely responsible for the diversity of forest conditions found in Sun Pass today.

The Board of Forestry bought two smaller pieces of private land in the Sun Pass area in 1947 and 1948. Klamath County deeded 480 acres in the Sun Pass area to the Board of Forestry in 1944. In 1955, the Board of Forestry deeded 19 acres of Sun Pass lands to the State Highway Division for Kimball State Park. The state park was named after Jackson F. Kimball, an early local forester and district warden for the Klamath Forest Protective Association. In 1970 and again in 1987, the State Land Board exchanged satellite parcels for land in Sun Pass State Forest. These two exchanges resulted in 5,144 acres of Common School Forest Land being exchanged to the Forest Service for 3,199 acres of Winema National Forest land. In 1979, the Board of Forestry also exchanged land with the U.S. Forest Service, in order to consolidate land near Sun Pass State Forest and remove from state ownership small, satellite parcels that were difficult to manage. The Board of Forestry gained approximately 1,202 acres adjacent to Sun Pass, and gave the Forest Service about 2,365 acres of satellite parcels. These transactions largely completed the formation of Sun Pass State Forest as it is today.

Most lands in the Southwest Block were deeded to the Board of Forestry by Klamath County. In 1946, Klamath County deeded 2,860 acres of the present Bear Valley tract to the Board of Forestry. The county deeded other pieces of land in the Bear Valley area to the Board of Forestry in the late 1940s and early 1950s. During the same years, the Board of Forestry bought two small pieces of land in this area from private owners. In 1985, the Board of

Forestry exchanged 640 Bear Valley acres for 882 acres of satellite parcels. The Board agreed to the exchange in order to facilitate the creation of the Bear Valley National Wildlife Refuge, a major roosting area for wintering bald eagles in the Klamath Basin.

The lands in the East Block were acquired in two transactions. In 1948, Klamath County deeded 595 acres on Yainax Butte to the Board of Forestry. Then in 1957, the State Land Board signed a resolution for the Board of Forestry to manage 3,044 acres of Common School Forest Lands in the East Block.

The scattered tracts across eastern Oregon outside the Klamath-Lake District are owned by the State Land Board. During the late 1950s and early 1960s, the State Land Board signed resolutions for the Board of Forestry to manage these lands.

Managing the State Forests

Management of the Klamath-Lake District state forests began slowly. The district had its first special sale in May 1944, when it sold ten cords of firewood. In July 1949, the district sold its first regular timber sale. The timber went to Alfred Casteel for $2,500. In 1955, the Board of Forestry appointed a forester whose entire job was to manage the Klamath-Lake District state forests, allowing the development of a more extensive management program.

During the early years of state forest management, most timber sales were sanitation and salvage sales. They were designed to remove overstory trees, cull white fir, and pockets of heavy insect or disease infestation. Commercial thinning was done in mixed ponderosa and lodgepole pine stands.

The first tree planting on the forests was done in 1957, in Sun Pass. In the next few years, the main goal for tree planting was to rehabilitate non-productive brushfields in the East and Southwest Blocks. Later, the tree planting goal expanded to maintaining proper stocking levels after timber harvest, through interplanting. A tree improvement program began in 1970, with a goal of providing genetically superior seed in the future. In 1979, three progeny plantations were established, to provide trees for a future seed orchard for Sun Pass. The first precommercial thinning was done in 1961, also in Sun Pass.

The first forest inventory was done in 1959. The inventory was updated in 1976 and re-inventoried in 1990-91.

Early forest planning dealt mainly with timber harvest schedules and silviculture. The 1978 long-range plan was the first formal plan for the Eastern Oregon state forests (Oregon Department of Forestry 1978). It has served as the primary working tool for forest management to this day.

Both forest managers and the public have become increasingly aware of the many values associated with forests. The current planning effort for the Klamath-Lake District state forests (this document) recognizes the need to integrate a wide range of forest values into forest management, while recognizing that the state forests are intended to be an important contributor to timber supply for present and future generations.

South Central Oregon Today

Forestry, agriculture, and tourism are major industries in south central Oregon today. In agriculture, both crops and livestock are important. The region offers many recreational opportunities, including Crater Lake, mountains, forests, lakes, rivers, and high desert. The Klamath area is becoming increasingly known for its wintering population of bald eagles, the largest in the continental United States. In 1993, Klamath County's population was 60,300. The city of Klamath Falls had a population of 18,230, and the population of the city's urban growth area was 45,000 (personal communication, Klamath Falls Chamber of Commerce).

The Klamath area includes a significant Indian community. Under termination legislation originally passed in 1954, then amended twice and finally effective in 1961, the Klamath Tribe's federal status was terminated in 1961. From 1961 to 1973, the federal government bought most of the Klamath Indian Reservation and gave the lands to the Winema National Forest and the Klamath Forest Wildlife Preserve. The Klamath Indians retained their traditional hunting and fishing rights on the former reservation lands. Today, the Klamath Tribal Council and several other Indian community groups continue to work for tribal goals, and to promote the education, health, and welfare of the Klamath people. The Klamath Indians are interested in the management of state forests, and are particularly interested in the preservation of Indian cultural resource sites that may be on the state forests.

Forest Management Planning for State Forests

In the Eastern Oregon Region, the forest management planning system consists of the following elements: long-range plans, annual operations plans, and budgets.

Long-Range Plans

A long-range plan provides general direction for managing state forests. The Eastern Oregon Region's previous long-range plans focused on the timber resource. Their primary purpose was to define silvicultural systems and calculate timber harvest levels. Non-timber forest resources were addressed mostly through annual operations plans.

In contrast, the new long-range plan articulates a set of goals and strategies for managing non-timber resources as well as timber. Goals are general, non-quantifiable statements of direction. Strategies are specific actions that will be taken to achieve the management goals.

The following considerations guided the development of goals and strategies.

- Statutory direction (laws) for managing Common School Forest Land, Board of Forestry land, timber, wildlife, and other non-timber resources.
- The Oregon Constitution's mandates for managing Common School Forest Land.
- Policies of the State Land Board, the Board of Forestry, and the State Forester.
- Guiding principles for the Eastern Region Long-Range Forest Management Plan.
- Resource assessments and available resource data.
- Advice, recommendations, and plans of other agencies.
- Land use decisions.
- Public involvement in the planning process.

Forest management plans for state forests must fulfill statutory and constitutional obligations, which include generating income for counties, local governments, and the Common School Fund; and conserving and protecting the land's various natural resources. See Section II, "The Guiding Principles", for more discussion of these mandates. For a detailed discussion of legal and policy mandates, see Appendix C.

The statutory mandate for forest planning is found in ORS 526.255. This law requires the State Forester to report to the Governor and legislative committees on "long-range management plans based on current resource descriptions and technical assumptions, including sustained yield calculations for the purpose of maintaining economic stability in each management region." The State Forester's report also includes timber marketing and intensive management information for Board of Forestry Lands and Common School Forest Lands.

In addition, the Department of Forestry has a contractual obligation to prepare management plans for Common School Forest Lands. These plans govern activities undertaken by the Department of Forestry and the Division of State Lands, such as timber harvesting, grazing, and minerals management. The State Land Board must approve these management plans.

Annual Operations Plans for Timber and Silviculture

Annual operations plans show the exact location and nature of management activities proposed to be carried out during a July to June fiscal year. These plans are the most detailed level of planning done by the Department of Forestry.

Each year, there is an initial meeting of staff from the Department of Forestry's headquarters in Salem, and local managers. The purpose of this meeting is to review candidate timber sales, ensure consistency with long-range plan goals and strategies, and to identify areas where additional staff involvement may be needed. The local managers then make a thorough on-the-ground reconnaissance of the proposed sale areas and fill out a "presale plan report" for each sale. This report documents the objective for making the sale; a description of the timber resource; the land use, soil and terrain conditions; other environmental considerations; access, property line survey, and project construction needs; insect and disease problems; proposed logging methods; and planned site preparation and reforestation methods. Presale plan reports are not prepared for emergency timber salvage operations.

The presale reports are reviewed by local biologists from the Oregon Department of Fish and Wildlife, and as needed by Department of Forestry geotechnical specialists. Site-specific comments on streams, wildlife habitat, and soil stability are an integral part of the planning system. The presale plans are finally sent to the Salem headquarters for review and comment by staff, and approval by the Deputy State Forester.

Silviculture includes activities such as tree planting, animal damage control, vegetation control, precommercial thinning, fertilization, and pruning. The planning process is similar in concept to timber sale planning, although specific details may differ. Reforestation and vegetation management plans are prepared annually. Vegetation management plans include information about every site where herbicide applications are planned. Annual reforestation plans cover planting and animal damage control activities. Precommercial thinning is often integrated into timber presale plans.

Budgets

Budgets are used to set priorities and determine dollar amounts needed to accomplish the annual operations plans and associated activities such as monitoring, surveys, and special projects. If insufficient revenues are available to accomplish all planned activities, lower priority activities are postponed until additional funds become available.

Purpose and Scope of the Management Plan

The Eastern Region Long-Range Forest Management Plan (this document) provides direction for all Board of Forestry Lands and Common School Forest Lands in the Eastern Oregon Region. Of the region's 42,020 acres, 64% are owned by the Board of Forestry and 36% by the State Land Board. This plan supersedes the Timber Resource Inventory, Analysis, and Plan for the Eastern Oregon Area State Forests (Oregon Department of Forestry 1978).

The plan has a much more comprehensive approach toward forest planning than previous plans. It includes an assessment of the current condition of each resource, applicable laws and policies, and current management programs. The resource management strategies are intended to achieve the stated goals and address any underlying conflicts or problems. For example, the plan articulates the role of the state forests in providing wildlife habitat, while also addressing forest health concerns and allowing timber to be harvested.

The Eastern Region Planning Process

Evolution of the Plan

In the mid-1980s, it was recognized that the Klamath-Lake District's forest inventory, analytic method for uneven-aged management, and forest management plan were inadequate. The amount of timber harvesting was reduced, pending the development of a new inventory and plan. In September, 1989, preparations moved ahead for timber stand inventory (using community typing and the U.S. Forest Service stand exam procedure) and growth analysis (using the PROGNOSIS computer model) (Voelker 1989).

The field inventory was completed in 1990-91. A preliminary analysis of the data indicated that the timber harvest reduction was unduly conservative. Therefore, harvesting was returned to the level set by the 1978 plan until the new plan could be completed (Voelker 1992).

By 1992, the Department of Forestry had changed its planning emphasis from "timber management" to "forest management" in order to better integrate non-timber resources into long-range plans. The scope of the Eastern Oregon Region's planning effort was expanded accordingly, and a planning team was appointed (Woo and DeBlander, 1992).

The planning team then developed a "critical path" timeline, a list of Guiding Principles, and a public involvement process.

Planning Team, Resource Specialists, and Consultants

The core of the planning team consisted of the following people.

Core Team	Role on Planning Team	Job Title
Roy Woo	Project Leader	Klamath-Lake District Forester
Ed DeBlander	Project Manager	Klamath-Lake Management Unit Forester
Rick Quam	Technical Project Manager	Forest Planner (Salem)
Jane Hope	Project Assistant	Planning Specialist (Salem)
Lou Torres	Public Affairs Staff	Public Affairs Specialist (Salem)

Working with Roy Woo was a two-person advisory committee, consisting of:

John Lilly Assistant Director of Policy and Planning, Division of State Lands (Salem)

Ed Kentner County Commissioner, Klamath County

Ed DeBlander and Rick Quam collaborated on the technical planning, with the assistance of other Department of Forestry personnel. Specialists in other public agencies were designated to provide expertise about each of the various forest resources. See Appendix K for short biographies of the planning team members. Supplemental information was obtained from a number of other sources.

The state agencies that cooperated in providing information were the Division of State Lands; and the Departments of Forestry, Fish and Wildlife, Water Resources, Environmental Quality, Agriculture, Parks and Recreation, Employment, and Justice. The Klamath Tribes, U.S. Forest Service, Bureau of Land Management, and U.S. Fish and Wildlife Service also contributed information and advice.

The Oregon Natural Heritage Program compiled lists of wildlife, predators, and prey.

Val Rapp, a natural resource writing consultant, was instrumental in writing and reviewing the plan.

Technical Planning

The objective of the technical planning process was to develop an integrated set of goals and strategies for managing the forest's resources. Technical planning consisted of the following phases.

Data Collection

Data collection projects related to the plan included:

- An inventory of all state forest lands in 1990-91, using the USFS stand exam procedure.
- An inventory of snags (dead trees).
- A survey of scenic and recreation resources, and a questionnaire of recreation users.
- Development of a Geographic Information System (GIS).
- Three years of spotted owl surveys.
- A list of threatened, endangered, or candidate plants that are suspected or documented on the state forests.
- Lists, status, and habitat of vertebrate fish and wildlife that are known or likely to occur on the state forests.
- A description of known historic and cultural resources.
- Water rights recorded in the Water Resources Department database.
- Insect and disease surveys conducted by the Department of Forestry.

Resource Assessments

The designated technical specialists provided resource assessments, which covered the following topics.

- Current status and future trends
- Available data and additional information that would be useful
- Laws, policies, and programs
- Recommendations for managing the resource
- Potential conflicts with management of other resources
- Monitoring recommendations

The assessments were evaluated and additional information was gathered to fill gaps and answer questions. Resource descriptions were written. (See Section III of the plan.)

Development of Goals

The goals describe the desired development and/or protection of a specific resource. (See Section IV of the plan.) Draft goal statements came from many different sources, including the following, listed below and on the next page.

- **State and federal laws and administrative rules —** Some goal statements identify that there is a law pertaining to the management and/or protection of the resource and state that the law will be followed in developing and implementing the plan.

- **Board and state agency policies —** These include policies of the Board of Forestry, State Land Board, State Forester, and the other Oregon natural resource agencies participating in the planning process.
- **Other sources —** These include recommendations from planning team members, technical specialists (through their resource assessments), and the public (through two public meetings). These goals are not mandated in law or policy but are believed to be consistent with good stewardship of the land.

Development of Strategies

Drawing again from the input of resource specialists and earlier comments from the public, the planning team prepared a set of draft strategies for achieving the stated goals. (See Section V of the plan.) Further comments were not solicited from the public until publication of the entire draft forest plan.

Because this plan is built around goals and strategies, it does not emphasize numerical targets or objectives for the various resources. Section V of the plan describes the expected outcomes of the strategies, and explains how the strategies will achieve the stated goals. Section VI of the plan summarizes the anticipated costs and revenues that will result from managing each resource.

Balancing the Goals

The goals for one resource may conflict to some degree with the goals for one or more other resources. Any such potential conflicts were resolved in the strategy development phase of the planning process. The strategies attempt to achieve an optimum balance between the goals. It is important to recognize, however, that not all goals carried equal weight in the balancing process.

The highest priority was placed on meeting goals related to laws or administrative rules. In case of a conflict between federal and state law, the Oregon Attorney General advises that federal law supersedes state law. Within state law, the Oregon Constitution supersedes the Oregon Revised Statutes.

The next priority was on meeting current policy direction, in this order:

- **Board of Forestry and State Land Board policy —** These boards are charged by Oregon law with the responsibility for supervising the management of their respective ownerships. For this reason, policies of these boards must be given the highest weight.
- **State Forester's policies —** The State Forester works directly for the Board of Forestry and under contract to the State Land Board. There are no conflicts between State Forester's policies and Board policies.
- **Other state agency policies —** If there are potential conflicts with other state agency policies, the Oregon Department of Forestry works with the other state agency to resolve the difference. If the difference cannot be resolved, then the Board of Forestry, State Land Board, or State Forester's policy is met first.

The last priority was on meeting goals that are not mandated in law or policy. In case of conflicts between one or more goals at this level, the conflicts were resolved by developing strategies that provided the best balance between the goals, in the judgment of the planning team.

Alternative Strategies

The draft long-range plan did not include alternatives to the listed strategies. This decision was made with the concurrence of the planning team's advisory committee and key resource specialists.

During the planning process, a variety of approaches were considered for each forest resource. These were narrowed to the final set of draft strategies, based upon the criteria of achieving the planning goals and providing balance among forest resources. During the public comment period, the planning team received feedback as to whether the draft strategies met these criteria.

Decision-makers and the public may expect a long-range plan to offer a range of alternatives for them to comment and act upon. This expectation may arise from experience with the federal planning processes. In particular, any plan that requires a federal action must go through the NEPA (National Environmental Policy Act) process. This federal process requires a wide spectrum of alternatives that have been fully developed and analyzed. The Department of Forestry's management plan for the Elliott State Forest requires an Incidental Take Permit from the U.S. Fish and Wildlife Service. Therefore, several alternatives were included in the draft Elliott plan in order to satisfy the NEPA process and federal Endangered Species Act requirements.

The planning team believed that the Eastern Region's role in providing wildlife habitat could be accomplished without going through the NEPA process. The team also felt that timber management options that significantly deviated from the primary silvicultural systems would be impossible to balance with the planning goals for other resources. (The primary systems, uneven-aged and even-aged management, are discussed in Section III under "Forest Products: Timber.") Therefore, the team did not invest time in developing alternatives for wildlife or silviculture.

While this plan's draft strategies prescribe a certain direction for management, they also allow flexibility to meet site-specific needs. Fine-tuning occurs at other points in the planning system, such as pre-sale planning. New alternatives that significantly affect the long-term course of management will be considered through the adaptive management process, and will be approved as amendments to the long-range plan. (See Section VII, "Implementation.")

Public Involvement

Public involvement provides the planning team with a wider range of information and ideas, and is critical to gaining public understanding, support, and acceptance for any action or planned action. The planning team worked closely with all interested parties to provide background on the forest and the planning process; to seek public input on planned management actions; to solicit public response on a draft management plan once completed; and to follow up by describing how the plan will be implemented.

The public involvement process had four important objectives:

- Inform people about how state forests are managed.
- Seek appropriate insight, opinion, and data on planned management actions on the state forests.
- Gain understanding, acceptance, and support for the management planning process and the management plan.
- Capitalize on important opportunities to educate the public about forest systems and forest stewardship.

Throughout the public involvement process, the planning team stressed the overall context of the forest management plan: the Department of Forestry has statutory and trust land responsibilities that guide the forest management goals on the state forests.

Public involvement efforts were integrated with other planning efforts and were structured into the four phases described below and on the next page.

Briefing and Listening

The goal of briefing and listening was to open a dialogue with stakeholders and interested Oregonians, provide baseline understanding and education about the forest, and seek input on management needs.

A meeting was held in Klamath Falls on November 9, 1993 to brief the public on the upcoming planning process and to gather comments. A listening post format was used to record the comments. Written comments were received after the meeting.

A second meeting was held in Klamath Falls on June 28, 1994 to give the public a progress report and gather comments on the draft planning goals. Again, a listening post format was used, and written comments were received.

Informal Contacts

While the planning team worked on the forest management plan, several methods were used to interact with the public: scheduled meetings and tours, one-on-one meetings, distribution of informational materials, news releases, and outreach to local news media. An effort was made to contact individuals and groups who did not participate in the briefing and listening meetings. Status reports and meeting announcements were distributed through a mailing list of about 100 persons.

Public Response

Another public meeting was held on May 23, 1995. Written and oral comments on the strategies and the plan as a whole were taken for 30 days.

Public comments were weighed according to legal and policy mandates for state forests, the Department of Forestry's mission as defined by the Board of Forestry, and the technical feasibility of implementing suggestions.

Follow-up

The purpose of the follow-up phase is to present the final plan to interest groups that participated in development, describe ramifications of the final plan, and strengthen working ties between the department and interested public. This will be accomplished through on-request meetings and small group field tours. The Klamath-Lake District staff will carry out the follow-up phase in order to strengthen local ties.

A copy of the complete Public Involvement Plan and copies of all public documents are available at the Oregon Department of Forestry's Klamath-Lake District Office, 3400 Greensprings Drive, Klamath Falls, OR, 97601; and at Department of Forestry Headquarters, 2600 State Street, Salem, OR, 97310.

Plan Approval

The provisions of this long-range plan are intended to satisfy the legal and policy framework for managing Board of Forestry lands and Common School Forest Lands. The Department of Forestry also has a contractual obligation to prepare management plans for Common School Forest Lands. Accordingly, the plan required the approval of both the Board of Forestry and the State Land Board.

Section II

The Guiding Principles

1. The plan will be a comprehensive, integrated forest management plan taking into account a wide range of forest values.

When we say that the plan will be comprehensive, we mean that it will include consideration of the following commodity and amenity resources and issues.

- Air quality
- Botany (threatened and endangered plants)
- Cultural and historic resources
- Fish and wildlife
- Fire management
- Forest health considerations
- Gas, oil, mineral, and geothermal resources
- Grazing resources
- Legal issues
- Recreation and scenic resources
- Social and economic issues
- Timber resource
- Water quality and supply
- Wetland resource

For each of these resources and issues, the plan includes:

↵ Resource description: the resource's current condition; and laws, policies, and programs that affect the resource. (Section III)

↵ The management goals for development and/or protection of each resource. (Section IV)

↵ The strategies that will be used to accomplish the management goals. (Section V)

An integrated plan provides for development and protection of forest resources across the landscape. Single use focus is avoided. Compatible uses are emphasized.

2. The plan will be developed within the context of State Forest Lands in the Klamath-Lake District as managed forest lands. The remaining 53 smaller parcels of Common School Lands, which are distributed across 12 Eastern Oregon counties ("scattered tracts"), will be managed to maintain their "asset value."

Klamath-Lake District State Forest Lands

Board of Forestry Policy states, "The Department will intensively manage State Forest Lands (Board of Forestry and Common School Lands) in an exemplary fashion for the sustained production of timber in a cost effective and environmentally sound manner." The Department will also "... emphasize the long-term compatibility of growing and harvesting timber with other forest uses."

The mandate above gives us a primary use (timber production), while emphasizing compatibility with other uses. It is different from the multiple use mandate that applies to the federal lands managed by the Forest Service and Bureau of Land Management. Multiple use tends to equalize all uses.

Scattered Tracts

These tracts are difficult to manage efficiently. The Department of Forestry and the Division of State Lands have made it their policy to pursue an aggressive exchange program to dispose of most of these lands, in order to block up land in districts that have active management programs for state forest lands. The Department of Forestry believes this strategy will best meet Constitutional obligations. In the meantime, it has been decided that these lands will not be actively managed. These lands will be monitored, but management action will be taken only if something threatens to diminish asset values significantly. Example of potential threats are forest health problems, fire, and unauthorized public use. Lands determined to be unsuitable for forest management may be returned to the Division of State Lands for their management.

3. The plan will recognize that the forest is intended to be an important contributor to timber supply for present and future generations.

State Forest lands are managed under a "sustained yield" constraint. In other words, harvest level will be set to prevent significant long-term declines in future harvests.

The Eastern Region State Forest Lands will remain an important contributor to the local timber supply for the next century, even though they make up a small percentage of the region's forest land base. The relative importance of these lands has increased because of the declining harvest levels on federal forest lands.

4. The primary standard of management of all resources on the Eastern Region State Forests is maximization of income for the Common School Fund and production of income for local governments over the long-term, consistent with cost-effective and ecologically sound forest resource management.

The Forestry Program for Oregon describes the Board of Forestry's guidance to the State Forester for managing Common School Forest Lands and Board of Forestry Lands:

> "The Department of Forestry will intensively manage State forest lands in an exemplary fashion for the sustained production of timber in a cost-effective and environmentally sound manner. Such intensive management is designed to generate revenue for the beneficiaries of the land, including county government, local taxing districts and the Common School Fund. In carrying out this program, the Department will employ the Board of Forestry Policy for Practicing Silviculture on State Lands, and will emphasize the long-term compatibility of growing and harvesting timber with other forest uses."

The Oregon Constitution (Article VIII, Section 5) authorizes the State Land Board to manage Common School Forest Lands "with the object of obtaining the greatest benefit for the people of this state, consistent with the conservation of this resource under sound techniques of land management." According to a 1992 opinion of Oregon's Attorney General, the "greatest benefit for the people" standard requires the State Land Board to use the lands for schools and the production of income for the Common School Fund. The resources of the lands are not limited to those such as timber that are currently recognized as revenue generators for the Common School Fund. The Land Board should consider other resources, such as minerals, water, and plant materials, that may offer revenue for the fund. In addition, the Land Board may take management actions that reduce present income if these actions are intended to maximize income over the long term.

Board of Forestry Lands are managed to produce income for counties and local taxing districts. The Oregon Revised Statutes direct that the lands shall be managed "so as to secure the greatest permanent value of such lands to the state" and that income produced from the lands shall be shared with the counties. To this end, the statutes authorize the State Forester to produce timber and other commodities as well as to conserve, protect, and use a variety of natural resources.

5. Lands will be identified and managed to optimize long-term revenue, biological capability, and social values. The plan will recognize that there will be trade-offs between revenue-producing activities and other activities that do not produce revenue.

The concept of sustained yield over the long-term is a vital part of the management policy for Eastern Region State Forests. Short-term gain will not be sought at the expense of the long-term capability of the forest.

As part of the planning process, all lands will be inventoried and data collected on a number of resources. The planning process will also evaluate the economic and social impacts of management decisions and the overall role of the Eastern Region State Forests in local economies. As dictated by the constitutional and statutory obligations of the forest, the forest will be managed to produce long-term revenue. This management will be consistent with sustainable ecosystem and social values, which include impacts to local communities and amenity values on the forest.

6. The plan will examine opportunities to cooperate with other agencies, user groups, or organizations.

Management objectives can often be achieved more effectively and efficiently through collaboration with others. One example is the cooperation already going on between the Oregon Department of Fish and Wildlife and the Department of Forestry. The two agencies work together to reduce poaching and harassment of elk during critical calving and winter staging periods through a large seasonal area road closure, and to incorporate fish and wildlife considerations in timber sale plans.

Additional opportunities will be explored in the forest planning process to cooperate with adjacent landowners, user groups (both commodity and amenity oriented groups), and other individuals and groups who are interested in the management of the Eastern Region State Forests.

7. Diverse input from a variety of interested parties, including user groups, business interests, adjacent landowners, and the general public will be a high priority throughout the planning process.

Public involvement in the Eastern Region State Forests planning process is based on the fundamental truth that inclusion and consideration of diverse viewpoints is critical to public understanding, support, and acceptance of this plan.

The public involvement effort:

- Seeks appropriate insight, opinion, and data on planned management actions.
- Gains understanding, acceptance, and support for the management planning process and the management plan.
- Capitalizes on important opportunities to educate the public about forest systems and forest stewardship.

8. The plan will be goal-driven.

A goal-driven plan begins by defining overall management goals for the forest. Examples of overall goals for the forest are found in these guiding principles. Once overall goals have been established, then specific goals can be developed for each resource. These specific goals spell out exactly what the vision is for the development or protection of the resource. In a goal-driven plan, issues are considered within the context of the goals that have been developed. Strategies that do not meet the goals are not considered.

In contrast, an issue-driven plan begins by identifying concerns about existing management practices and works to analyze and address those concerns. This is usually done by developing a series of alternatives that deal with the issues in a piecemeal fashion.

9. The plan will manage the forest as a sustainable ecosystem, and maintain the forest's ecological processes and biodiversity in order to provide long-term sustainability.

The goal of ecosystem management is to maintain the complex processes, pathways, and interdependencies of forest ecosystems, keeping them intact and functioning well over long periods of time. The essence of maintaining ecosystem integrity is to retain the health and resilience of systems so they can accommodate short-term stresses and adapt to long-term change. The key elements include: maintenance of biological diversity and soil fertility; conservation of genetic variation and its dispersal; and conservation of the system's capacity for future biological diversity through evolution (Riggs 1990). Maintenance of these ecological processes and properties sets the boundaries within which specific ecosystem management objectives can be pursued, including the sustained yield of products.

Over much of Eastern Oregon, fire suppression and past harvesting practices have resulted in slow but significant change to the forest. The end result of these changes has been a forest characterized in many places by severely overcrowded trees, and a change in tree species composition from the more drought, insect, and disease-resistant ponderosa pine to true fir. This plan will address the sustainability of the current ecosystem and determine the sustainable ecosystem to be managed for in the future.

10. The forest will be managed to meet state and federal Endangered Species Acts while fulfilling the State Land Board's responsibilities under the Oregon Constitution and the Board of Forestry's statutory responsibilities. Management plans for threatened or endangered species will seek to complement or supplement habitat provided by other landowners.

The forest management plan must comply with all federal and state laws. Plans for complying with the state Endangered Species Act will recognize the State Land Board's constitutional responsibility to maximize long-term revenues from Common School Forest Lands.

The intent of the plan is to adopt management strategies that contribute to providing for the survival and recovery of currently listed T&E species, and assist in preventing future listings of other species. The fact is recognized, however, that the Eastern Region State Forests are one part of a larger landscape, and cannot by themselves provide sufficient habitat to guarantee the survival or recovery of a species. Habitat conditions on the Eastern Region State Forests should mesh with those of other public and private landowners in order to meet species population goals.

11. Adaptive management will be used to incorporate new information as it becomes available.

This plan will gather, for the first time, as much of the available natural resources data for the forest as possible. However, new information will continue to become available after the plan's completion, and will be incorporated into the plan through adaptive management.

Adaptive management is the process of monitoring and analyzing management actions in order to understand their effects, and adjusting plans accordingly. It acknowledges that we do not fully understand ecosystem processes, especially across landscapes, through time, and in response to natural or human-induced changes. Greater understanding occurs over time through research and monitoring programs. Adaptive management is a necessary approach if ecosystem management is to succeed.

Section III

Resource Description

Introduction

The Eastern Region State Forests have a wealth of resources. This chapter has four main subsections.

- **The land base —** This subsection describes the Eastern Region's land ownership. Additional information about where these lands are located, and the names given to the lands, is provided in Section I.

- **The landscape —** This category includes abiotic resources, such as the climate, geology, soils, topography, water resources, and air quality.

- **The ecosystem —** This category includes all biological resources, such as trees, other vegetation, wildlife, and fish. This part of the chapter begins with a general description of the forest ecosystems and biodiversity in eastern Oregon, and concludes with a subsection on forest health.

- **The human context —** This category includes the many ways that people use the state forests in the Eastern Oregon Region, as well as how management of their resources affects nearby communities and local economies.

For each resource, the description covers two main items.

- **Resource description —** The information that is currently known about the resource is summarized. Information may include quantitative data, such as the miles of streams. It also includes qualitative discussion of the resource's status.

- **Current programs —** Laws, policies, and programs that affect the resource and its management are described.

Land Base

State forests consist of Board of Forestry Lands and Common School Forest Lands. The State of Oregon acquired the two types of land in different ways, and the two types are owned by different entities within state government. The Board of Forestry lands are owned by the Board of Forestry, and the Common School Forest Lands are owned by the State Land Board. Each land ownership has its own set of legal and policy mandates. These mandates are summarized below. The Guiding Principles in Section II provide more information about how state forests of both ownerships will be managed under the new forest plan. Appendix C provides more background information about the two ownerships.

Board of Forestry Lands — The Board of Forestry Lands (BOFL) are owned by the Board of Forestry. The Board acquired these lands either through direct purchase, or through transfer of ownership from counties in exchange for a portion of the future revenue produced by these lands. For the Eastern Region State Forests, a total of 26,862 acres are Board of Forestry Lands. All BOFL in the Eastern Region are in Klamath-Lake District.

The Oregon Department of Forestry manages these state forest lands, under the Board of Forestry's supervision. These lands are managed "to provide a sustained contribution to the people of Oregon by the production of timber in a cost-effective and environmentally sound manner while providing recreational opportunities and considering soils, water, fish and wildlife habitat, and other forest values. A major portion of revenue derived from these lands is distributed to counties for further distribution to local taxing districts." (Oregon Board of Forestry 1995b)

Common School Forest Lands — The Common School Forest Lands (CSFL) are owned by the State Land Board. The State Land Board consists of the Governor, the Secretary of State, and the State Treasurer. When Oregon became a state in 1859, the federal government granted sections 16 and 36 of every township to the new state for the use of schools. Oregon's grant included 3.5 million acres of grazing and forest lands. Eventually, much of the land was either sold for the benefit of schools or lost through fraudulent land deals. The state also exchanged some lands in order to consolidate land in larger blocks. For the Eastern Region State Forests, a total of 15,158 acres are CSFL. The Klamath-Lake District has 42% of these acres, and the remaining 58% are the scattered tracts spread across eastern Oregon.

The Department of Forestry manages Common School Forest Lands under a contract with the State Land Board. These lands are managed "to generate the greatest amount of revenue in the long run for the Common School Fund consistent with sound techniques of

land and timber management. Consideration is given to the need to protect soils, water, fish and wildlife habitat, recreational opportunities, and other forest values as long as this need does not significantly detract from the generation of revenue in the long run." (Oregon Board of Forestry 1995b)

The scattered tracts are all CSFL. The long-range management plan for the scattered tracts is described in Appendix L. The Division of State Lands is also reviewing these lands through their Asset Management Plan. The two management plans will provide long range policy guidance to determine strategies for retention, sale, exchange, or removal from the Common School Forest Land list. Removing a tract from this list would place that tract under the Division of State Land's management.

Zoning

Most forest lands on the Klamath-Lake District are zoned Forestry. The purpose of this zone is to protect forest ecosystems, and to safeguard those sectors of the economy dependent on forest ecosystems.

Several satellite pieces have other zoning designations. The south 40 acres of a 160 acre satellite in the Southwest Block are zoned as Rural Residential (R-5). This zoning allows for a minimum lot size of 5 acres, and 1 dwelling per lot. Another 40 acre satellite in the Southwest Block is zoned Forest/Range. Forest/Range zoning promotes management and conservation of lands of mixed farm and forest use; these lands are valued primarily as wildlife habitat and rangeland. In the East Block, 160 acres of Yainax Butte and 3 satellite pieces with a total acreage of 280 acres are also zoned as Forest/Range.

The zoning definitions used above were taken from the Klamath County *Land Development Code* manual.

Acreage Summary for Eastern Region State Forests

Table III-1 on the next page and the two figures on page III-5 summarize acreage information for the Eastern Region State Forests.

Table III-1. Summary of Land Ownership

Eastern Region State Forests	Board of Forestry Lands: Acres	Common School Forest Lands: Acres	Total Acres
Klamath-Lake District State Forest Lands			
North Block			**22,845.79**
Sun Pass	17,604.45	3,199.42	20,803.87
North Satellites	2,041.92	—	2,041.92
East Block			**5,676.46**
Yainax Butte	716.39	3,043.88	3,760.27
East Satellites	1,756.19	160.00	1,916.19
Southwest Block			**4,743.26**
Bear Valley	4,216.66	—	4,216.66
SW Satellites	526.60	—	526.60
Total Klamath-Lake District State Lands	**26,862.21**	**6,403.30**	**33,265.51**
Eastern Oregon Scattered Tracts			
Scattered Tracts		**8,755.00**	**8,755.00**
Total for All Eastern Region State Lands	**26,862.21**	**15,158.30**	**42,020.51**

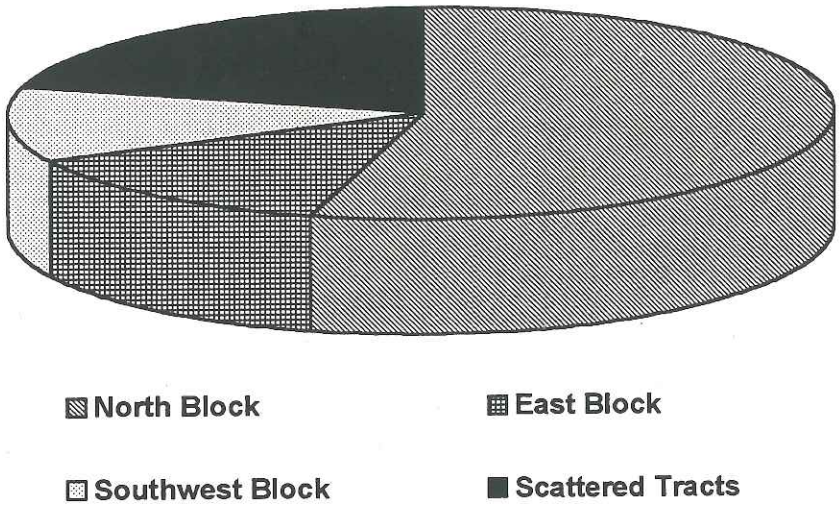


Figure III-1. Distribution of Eastern Region State Forests

As shown above, the North Block has slightly more than half of all land in the Eastern Region State Forests. As a group, the scattered tracts add up to a significant acreage. The East Block and Southwest Block comprise the remaining acres in the Eastern Region.

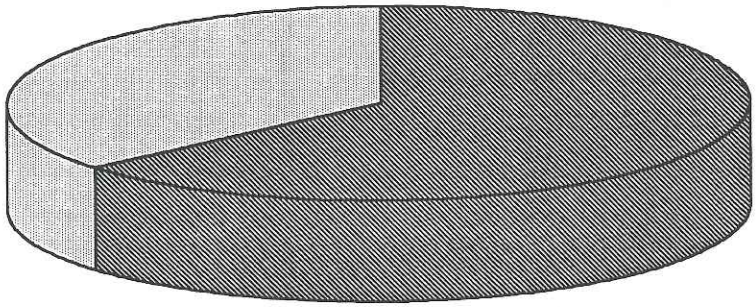


Figure III-2. Land Ownership in the Eastern Region State Forests

The Board of Forestry owns 26,862 acres, or about 64% of the Eastern Region State Forests. The State Land Board owns the remaining 15,158 acres, or 36% of the Eastern Region State Forests.

The Landscape

Climate

The Klamath-Lake District state forests must be understood in the context of the larger ecosystems of which they are a part. Climate is the major force that shapes large-scale ecosystems. The seasonal patterns of solar energy, temperature, snow, and rainfall are the controlling climatic factors that affect ecosystems. Climate is modified in a region by landforms such as the Cascade Mountains. The two forces of climate and landforms control the resulting soil and biota (vegetation and animals) of the ecosystem. (Bailey 1992 and 1993)

The Klamath-Lake District includes three major climatic zones. These zones and their ecosystems are described briefly below. Precipitation history is discussed on the next page, and landforms are discussed in the next subsection, "Geology, Topography, and Soils."

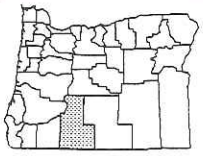
Subhumid forest land — This zone covers about 75% of the district. It includes most of the North Block, parts of the East and Southwest Blocks, and some of the satellite pieces. The average annual precipitation ranges from 18 to 40 inches, with heavy winter snows and little rainfall (6-13 inches) during the growing season. Winters can be very cold. Although summer days are often hot, summer frosts at night are common. In fact, killing frosts (32 degrees or less) have been recorded in every month of the year. The frequent summer frosts are the result of the thermal properties of the pumice and ash soils, the low humidities, and the clear nights. This zone can occur at elevations as low as 4000 feet near the Cascades, and as high as 6300 feet.

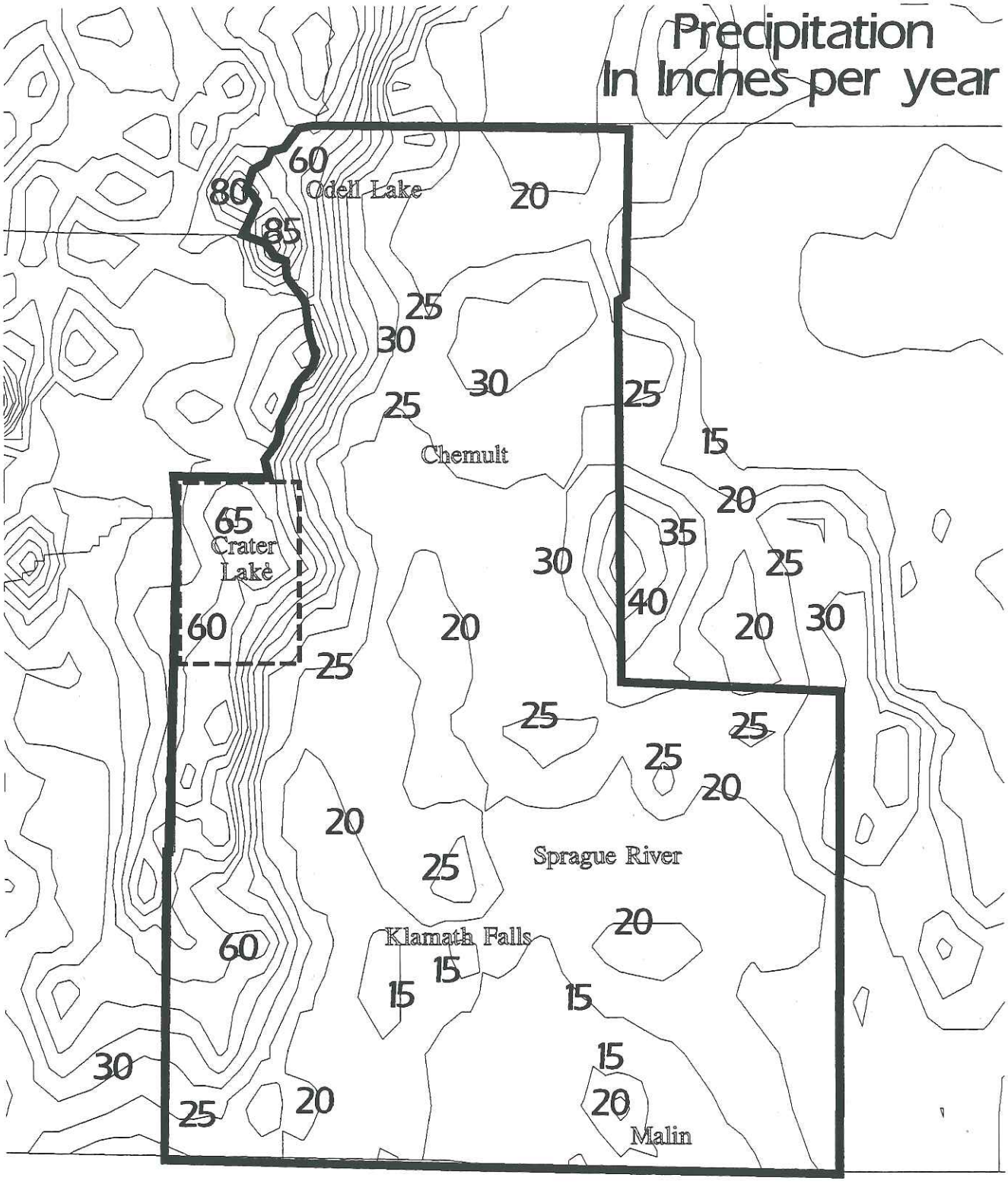
In the subhumid zone's lower elevations, vegetation is composed mainly of ponderosa pine with bitterbrush and grasses. White fir, Shasta fir, manzanita, and snowbrush dominate the higher elevations. Lodgepole pine is found mainly on the level pumice plains and in basins with poor air circulation and poorly drained soils.

Semi-arid subhumid transition zone — This zone covers about 20% of the district. It includes some lower elevations in the North and Southwest Blocks, some of the East Block, and some of the satellite pieces. The average annual precipitation is 15-20 inches, and the elevation ranges from 4500 to 5100 feet. The natural vegetation is sagebrush, grasses, mountain mahogany, juniper, and ponderosa pine. Tree growth is marginal due to the limited moisture.

Semi-arid rangeland — This zone covers about 5% of the district. It includes some of the East Block and some of the satellite pieces. The average annual precipitation is less than 15 inches and occurs mainly as winter snows. Summers are usually hot and very dry. The elevation ranges from 4000 to 4500 feet. The natural vegetation is sagebrush, rabbitbrush, grasses, and forbs. This zone is too dry to support forests.

Klamath County





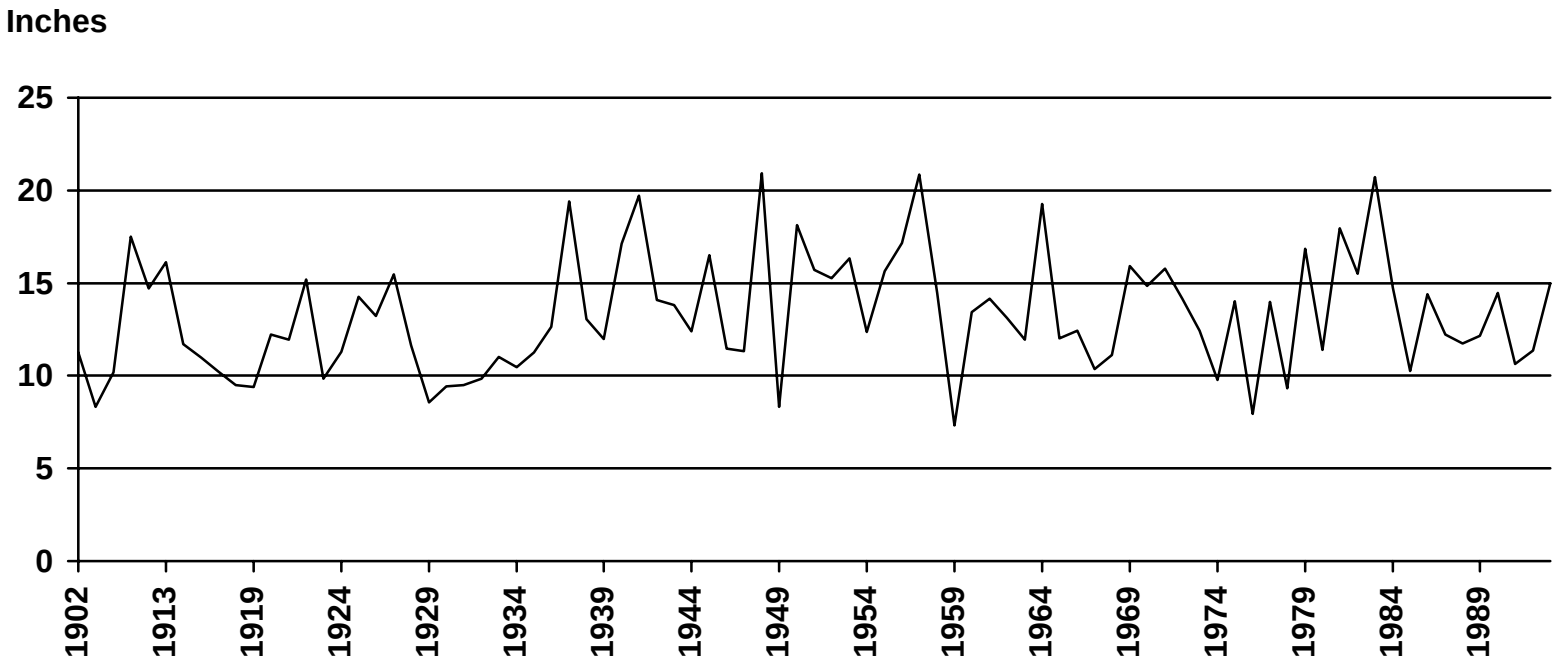


Figure III-3. Precipitation History for Klamath Falls

The chart above shows the annual precipitation for Klamath Falls from 1902 to 1993. The data is incomplete for the years 1903-1907, 1911, 1912, and 1914, so those years are omitted from the chart. Normal annual precipitation, based on the 1961-1990 period, averages about 13.5 inches. As the chart shows, however, precipitation in any year can vary considerably from the average, with some years having less than 10 inches and other years more than 20 inches. Klamath Falls is in the semi-arid rangeland zone. While the total amounts of precipitation would be different in the other two climatic zones, it is expected that the other zones would show similar patterns of variation.

Geology, Topography, and Soils

Geology

The geologic events of the last 25 million years have created the landforms of the Klamath-Lake District today. A basic understanding of the district's geology is necessary to understanding the modern landscape. This summary is based on Duncan and Steinbrenner 1975, and Alt and Hyndman 1981. Key terms are on the next page.

Approximately 25 million years ago, during the Miocene Epoch, the Klamath-Lake District was a broad coastal plain with a moist subtropical climate. Volcanic activity and geologic uplift changed the entire region during the Pliocene Epoch, which began about 13 million years ago. Volcanoes in the Cascade Range ejected large amounts of volcanic debris over the surrounding landscape. Eruptions from other fissures produced large flows of basaltic lavas that blocked the rivers draining south central Oregon. Large, shallow lakes formed over much of the area, and large amounts of volcanic ejecta were deposited into the lakes. Eventually the rivers cut their way to the sea again, the lakes drained, and normal weathering and erosion took place.

Two or three million years ago, uplift of the earth's crust caused extensive faulting in the region. Large, shallow lakes formed again in some areas, while in other areas large blocks of land were uplifted sharply. The uplift formed the northwest-southeast trending escarpments and valleys found throughout the region today. On the Sun Pass State Forest, the escarpments in the Fort Klamath area are an example of the uplifted side of one fault.

One million years ago, at the beginning of the Pleistocene Epoch, the climate changed dramatically across the northern hemisphere. The Ice Age began. Although the massive continental glaciers did not cover the Klamath area, the climate became much colder and wetter. Alpine glaciers covered all major mountain peaks in the area. Large lakes filled the fault block valleys. Volcanic activity continued in the Cascades.

As the Ice Age reached its end about ten thousand years ago, the large volcanoes of Mt. Shasta, Hood, Rainier, and others dominated the Cascades, as they do today. Mt. Mazama stood above the south central Oregon landscape, somewhere between 10,000 to 12,000 feet high. Roughly 7,000 years ago, Mt. Mazama exploded in a series of violent eruptions. These eruptions were much larger than the eruptions of Mt. St. Helens in 1980. Mazama's eruptions covered an estimated 5,000 square miles with pumice ejecta, and covered an even larger area with a fine, white ash. Geologists estimate that Mt. Mazama may have ejected as much as 10 to 12 cubic miles of rock. Eventually, the volcano collapsed into itself, and Crater Lake formed in the caldera. From the late Pleistocene into recent times, cinder cones such as Yainax Butte have erupted, covering areas near them with basaltic flows. Since the end of the Ice Age, the large lakes across south central Oregon have partially drained. Normal processes of erosion, weathering, and soil formation have been active, creating the soils and landforms seen in the Klamath-Lake District today.

Key Terms

Alluvial plain — A broad, level to gently sloping land surface built by extensive deposition of alluvium. It is currently above overflow level. (Duncan and Steinbrenner, 1975)

Alluvium — Unconsolidated soil and similar materials that were transported and deposited by a stream.

Andesite — A common volcanic rock; andesite is gray, brown, or green and commonly occurs as lava flows, ash deposits, and accumulations of angular debris. (Alt and Hyndman, 1981)

Basalt — A fine-grained, smooth, volcanic rock; basalt is frequently black, and sometimes greenish black or rusty shades of brown. The commonest volcanic rock. (Alt and Hyndman, 1981)

Caldera — A large, basin-shaped crater formed when a volcano collapses during an eruption. (Alt and Hyndman, 1981)

Cinder cone — A small basalt volcano that erupts a conical pile of bubbly fragments and then produces one or two lava flows that emerge from the base of the cone. (Alt and Hyndman, 1981)

Ejecta — Material erupted from a volcano or volcanic vent.

Escarpment — A long, more or less continuous, cliff or steep slope trending in one general direction. An escarpment separates two level or gently sloping surfaces, and is formed by faulting or erosion. (Duncan and Steinbrenner, 1975)

Geomorphology — Branch of geology that includes the study of surface features of the earth (landforms). (Duncan and Steinbrenner, 1975)

Landform — A configuration of the landscape resulting from the physical and chemical actions of water, wind, ice, and gravity acting on various geologic materials and structures over along period of time. (Duncan and Steinbrenner, 1975)

Miocene Epoch — A geological epoch that spans the time interval between 25 and 11 million years ago.

Moderate slope — In this discussion, slopes of 20-40%. Gentle slopes are less than 20%, and steep slopes are more than 40%.

Olivine — A pale green mineral that occurs in small crystals scattered through black igneous rocks. (Alt and Hyndman, 1981)

Pliocene Epoch — A geological epoch that spans the time interval between 11 and 3 million years ago.

Pumice — A spongy, porous volcanic rock that is very light weight. Some pumice is light enough to float on water.

Residual soil — Soil developed from the rock on which it lies; mineral soil.

Site index — A measure of forest productivity. It is expressed as the height of the tallest trees in a stand at an index age. In this document, an age of 50 years is used.

Topography

North Block

The underlying geology of the Sun Pass area consists mainly of interlayered basalt and basaltic andesite flows and ejecta of varying thickness. These layers have been cut by numerous, often steeply sloped, faults. Lake basins and escarpments are the North Block's dominant topographic features. Large, shallow lakes were formed when basalt flows blocked ancient rivers. The ridges and escarpments that run north-to-south through the lake basins were formed as the land uplifted along fault lines. One of these escarpments borders the Agency Lake basin and runs northward through Sun Pass State Forest.

Sun Pass State Forest generally slopes toward the south, with the exception of a west-facing escarpment in the southeast corner. The eastern part of the forest is mostly a pumice plain with gentle slopes. The northwestern part of the forest is characterized by volcanic flows and gentle slopes. Four major landforms shape the forest. Sun Mountain is in the forest's northeast corner, east of Highway 232. Sand Ridge, which lies along the forest's northern boundary, influences the north central part of the forest. The final major landforms are Sun Creek and Annie Creek, both year-round streams. Sun Creek runs through the center of the forest, creating a large draw and some wide alluvial plains. Annie Creek runs along the forest's western boundary, and also has meadows and alluvial plains.

Southwest Block

The underlying geology of the Southwest Block consists of interlayered basalt and basaltic andesite flows. The area's topography is dominated by a series of northwest-trending faults. The state land in Bear Valley is characterized by gentle to moderately sloping topography. South and west of the state lands, Hamaker Mountain (6596 feet) and Chase Mountain (6345 feet) are the area's dominant landforms. Bear Valley runs from northwest to southeast through the largest block of state land in this area.

East Block

The underlying geology of the East Block consists of olivine basalt flows. The Yainax tract is characterized by gently sloping lava plains. Yainax Butte, which is east of the state land, is the area's dominant landform at 7226 feet. Several springs and meadows are found in the tract.

Soils

Soil is a basic forest resource. The long-term productivity of the soil is a major influence on the long-term health of the forest ecosystem. Forest management must protect the soil and maintain its long-term productivity. As you might expect from the district's geologic history, the soils of the Klamath-Lake District are mostly volcanic, pumice and ash-based soils. There are also some alluvial soils, found in stream valleys on Sun Pass State Forest, and some older, residual soils (mineral soils), found in the Southwest Block. These three main soil types, pumice and ash, alluvial, and residual, have very different characteristics, and each type must be managed differently. Soils of the three main state forest areas are discussed below. The discussion of soils is based on Duncan and Steinbrenner, 1975.

Sun Pass State Forest

The soils on Sun Pass State Forest have been grouped into two main associations: pumice soils and alluvial soils. Pumice soils cover most of the uplands, while alluvial soils are found near the two streams, Annie and Sun Creeks. The two soil groups are discussed on the next page. Site index information is in Table III-2 on the next page.

Pumice soils — The pumice soils are known as the Hallet Association. They were formed by airborne deposits of pumice. The Hallet group includes 4 soil series, and is found east of the escarpment, covering about two-thirds of Sun Pass State Forest. Except for the Boundary series, these soils occur on gentle to moderately sloping pumice plain uplands at elevations from 4,500 to 6,300 feet. The Boundary series occurs in broad, nearly level pumice plains, and has a sandy loam texture with few rocks. The Hallet series includes deep, pumicy sand soils that have 20-40% coarse "popcorn" pumice. Some soils in the Hallet series contain 20-40% basaltic rock, and may include rock outcrops. The Howlock series occurs only on toe slopes where fine pumice materials have accumulated. It has a loamy sand texture, and no rocks. Soils in the Wocus series are developing in finer pumice than the Hallet series. They have only 10-30% popcorn pumice.

Alluvial soils — The alluvial soils are known as the Annie Association. The Annie group includes five soil series, and covers about one-third of the forest. The Annie series is made up of deep, gravelly, loamy sand soils found on nearly level alluvial plains near the confluence of Annie and Sun Creeks, west of the escarpment. The soils of the Grayback series are developing on the surface of an ash-flow deposit. The Millhayes series consists of pumice alluvium deposited on an older pumice flow. Soils in the Paunina series are found in broad, nearly level pumice plain basins. The Slabhouse series occurs on nearly level alluvial plains near the mouths of Annie and Sun Creeks, and consists of deep, sandy loam soils with 10-20% fine pumice gravel.

Bear Valley Tract

Most soils on the Bear Valley tract are older, residual soils, and fall into the Pokegoma Association. While this association includes 13 series, the 2 primary series found on Bear Valley are Hamaker and Woodcock. The Hamaker series is shallow, stony, and associated with extensive rock outcrops. The Woodcock series occurs on the flanks of old volcanic eruptive centers. These soils are a clay loam, with 20-40% angular basaltic rocks. Site index information is given in Table III-2 on the next page.

Yainax Tract

Most soils on the Yainax tract are classified into the Ze-eks Association. Out of 13 series in the association, the 2 primary series found on Yainax are Currier and Ze-eks. The Currier soils are moderately deep soils that have developed from fine volcanic ash and basaltic materials that have moved downslope on the steeper slopes. They have a clay loamy texture and contain 20-40% rock. The Ze-eks soils occur on gently sloping lava plains. They are deep, fine-textured soils developing from fine volcanic ash, and have a loamy ash texture. About 10-20% of the surface may be covered by pillow-sized lava boulders. Site index information is given in Table III-2 on the next page.

Table III-2. Site Indexes for Major Soil Types [1]

Unit of measure is feet.

Soil Type	Ponderosa Pine	Lodgepole Pine	White Fir	Douglas-Fir
NORTH BLOCK				
HALLET ASSOCIATION				
Boundary Series	65	55	85	— [2]
Hallet Series	50	55	75	—
Howlock Series	60	60	85	—
Wocus Series	65	60	85	—
ANNIE ASSOCIATION				
Annie Series	60	60	80	—
Grayback Series	65	55	80	—
Millhayes Series	50	55	80	—
Paunina Series	60	60	80	—
Slabhouse Series	70	55	85	—
SOUTHWEST BLOCK				
POKEGOMA ASSOCIATION				
Hamaker Series	75	—	80	85
Woodcock Series	70	—	75	90
EAST BLOCK				
ZE-EKS ASSOCIATION				
Currier Series	50	45	70	—
Ze-eks Series	55	45	70	—

Source: Duncan and Steinbrenner 1975. Soil Survey of the Klamath Falls Tree Farm.

1. Site index is a measure of forest productivity, expressed as the height of the tallest trees in a stand at an index age. In this table, the index age is 50 years.
2. Information not available for this species in this soil type.

Properties of Pumice and Ash Soils

Many soils on the Klamath-Lake District, especially on Sun Pass, are pumice and ash soils. These soils have some unique properties as compared to older, residual soils, and management practices need to consider these properties.

Thermal properties — Pumice and ash soils have thermal properties that are characteristic of insulating materials such as styrofoam or fiberglass. The thermal properties are strongest when the soils are dry, and weaker when they are wet. When dry, these soils have little capacity to store heat, they transfer heat slowly, and they radiate little heat at night. Heat does not penetrate deeply within the soils, but the temperature at the soil surface does change significantly when heat is added.

These thermal properties create a number of effects. Since the soils store little heat, they do not have heat available to radiate back into the atmosphere at night. As a result, the air gets very cold at nights. The cold air moves downslope and creates frost pockets in flats and openings. Summer frosts are common on pumice and ash soils. During the day, however, since heat is not absorbed, temperatures at the soil surface can be very high. Surface soil temperatures above 160 degrees have been recorded in open areas during the summer (Carlson 1979).

Pumice and ash soils have a high capacity to hold water. This capacity, combined with the thermal properties, makes these soils susceptible to frost heave. Frost heaving usually occurs when the soil is wet on the surface, temperatures are above freezing during the day, but drop below freezing at night. When the water freezes in a thin layer of surface soil, more water is pulled up through the soil. This water then freezes and forms ice crystals. As the process continues, the ice crystals elongate, creating ice columns that can become four to eight inches tall. (Carlson 1979)

Water repellency — Pumice and ash soils can be water-repellent. More research is needed to understand fully what causes the repellency. Some observations suggest that all pumice and ash soils may be water-repellent during the driest part of the summer (Carlson 1979). There may be two types of water repellency, with one type caused by fire and the other type associated with fungal mycelia. However, the effects are similar for both types. The water repellency can cause rapid water runoff in summer thunderstorms when the soils are dry, causing surface soil erosion and severe erosion on roads and fills.

Most of Sun Pass State Forest's soils are covered by a layer of duff and litter. The combination of vegetation, duff, and litter appears to mitigate the erosion risk. It is desirable to maintain some amount of duff and litter when conducting timber harvesting, prescribed burning, or other forest management activities.

Displacement and dust — In most soils, clay and organic matter are the cementing agents that hold the soil together, helping the soil to form an aggregate. Pumice soils have very low amounts of clay and organic matter, and do not hold together as well as most soils. When pumice soils are dry, they can be easily displaced or moved by management activities. Dust can be a severe problem on roads and skid trails. On slopes over 40%, dry ravel (downhill movement of dry soil) can be a severe problem. When they are moist, pumice soils are more

resistant to displacement. To minimize soil displacement and dust, it is preferable to log on these soils when they are moist or frozen.

Soil fertility — The soil fertility is low compared with most mineral soils, and 75-80% of the nutrients are in the upper 6 inches of soil. Management activities should avoid excessive displacement of topsoil. It is desirable to maintain a layer of duff and litter.

Water storage capacity — Pumice and ash soils are very permeable and have rapid infiltration rates, but they also have a high capacity to store water.

Compaction — Pumice soils like the Hallet soils on Sun Pass are difficult to compact even when wet, so compaction is not a major problem. In fact, it may be difficult to get optimum compaction for road construction. Ash soils like the Ze-eks soils in the East Block can be compacted when they are wet.

Road construction — These soils are suitable for roads but are subject to frost heaving, as discussed under "thermal properties." Also, it may be difficult to find rock suitable for road construction. Road surfaces can be difficult to maintain due to lack of fine and gravel-sized materials.

Water Resources

Introduction to the Upper Klamath Basin

The Klamath-Lake District's forests supply water for a variety of uses: agriculture and ranching, wildlife, aquatic life, domestic use, and power generation. This subsection describes the district's water resources and hydrology in a watershed context. We will consider the role of the forests in supplying, storing, and transporting water for downstream uses. In this context, we will provide information about problems with the Upper Klamath Basin's aquatic ecosystem. The status of scientific research, programs, and water management policies will be reviewed.

Here's how the subsection on water resources is organized.

Major Headings	Topics
• North Block • East Block • Southwest Block	For each block, these topics are covered: watersheds, hydrology, surface waters, forests, water uses and water rights, water quality
• Human impacts on water resources	Conditions in Agency Lake and Upper Klamath Lake, livestock grazing in the East Block, forest management considerations
• State management of water resources	Oregon's Biennial Water Management Program, water quality, water supply, forest practices
• Watershed programs and research	Klamath Basin Ecosystem Restoration Office, Klamath-Lake forest health partnership, environmental research and pilot projects

The planning area lies in the upper part of the Klamath River drainage, an area we will call the Upper Klamath Basin. The Upper Klamath Basin includes all lands above Iron Gate Reservoir, which is about 60 miles below the city of Klamath Falls. The central feature is Upper Klamath Lake, which is Oregon's largest freshwater lake. The lake receives most of its water from the Williamson and Sprague Rivers sub-basin and the Upper Klamath Lake sub-basin, which includes the Wood River and numerous small streams.

Lower Klamath Lake and Tule Lake lie south of the Oregon-California border, and drain into the Klamath River below the city of Klamath Falls. The Lost River flows into this basin from the east.

The Upper Klamath Basin lies in a rain shadow east of the Cascade Mountains. Precipitation varies from 60 inches per year at the highest elevations (Crater Lake) to only 10 inches at the basin floor (Klamath Falls) (Logan and Markle, in Campbell 1993). Most of the basin is a transient snow zone in which precipitation occurs as snow, winter and spring rain, and thundershowers in the summer.

Key Terms

Best Management Practices (BMPs) — Forest practice rules adopted by the Board of Forestry that ensure, as much as possible, that nonpoint source discharges of pollutants resulting from forest operations regulated by the Board meet the water quality standards established by the Environmental Quality Commission.

Ephemeral stream — Streams that carry surface run-off only during or immediately after a rainstorm or snow melt. Channels are not well-defined, and are often covered with leaf litter.

Forest operation — Any commercial activity relating to the growing and harvesting of trees.

Forested wetland — A wetland that supports wetland vegetation as well as a tree canopy that is adapted to periodic inundation or soil saturation.

Formazin turbidity unit (FTU) — A measure of turbidity (see "turbidity" below). FTUs measure the amount of light scattered or absorbed by the water; this indicates how many particles are in suspension in the water.

Intermittent stream — Any nonpermanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two physical criteria. (USDA Forest Service et al., 1994a)

Reach — A short length of stream channel; typically a section between two bends.

Significant wetland — As defined in OAR 629-56-310, significant wetlands are "wetlands that are larger than eight acres; estuaries; bogs; and important springs in eastern Oregon." Includes forested and non-forested wetlands larger than eight acres (OAR 629, Division 645).

Turbidity — The relative clarity of the water, which may be affected by material in suspension in the water.

Watershed — The drainage basin contributing water, organic matter, dissolved nutrients, and sediments to a stream or lake. (USDA Forest Service et al., 1993b)

Wetland — As defined in Oregon's Forest Practice Rules OAR 629-24-101 (81), wetlands are "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

The North Block

Watersheds

Drainage patterns are not well-defined in the North Block, so it is hard to delineate watersheds based on surface drainage. Aquifers are important for transporting water.

Sun Pass State Forest is above Agency and Upper Klamath Lakes. Water flows out of the forest through Annie Creek, Sun Creek, Wood River, and (through aquifers) Williamson River. Satellite parcels near Chemult drain into the Klamath Marsh basin, which in turn drains into the Williamson River. Surface drainage in the Chemult area is almost nonexistent; the streams that originate in the Cascade Mountains disappear into volcanic deposits before reemerging in Klamath Marsh.

Hydrology

Precipitation at Sun Pass and the North Block satellite parcels varies between 20 and 30 inches per year. It occurs as snow, winter and spring rain, and summer thundershowers. A snowpack forms at the higher elevations in the Cascade Range.

Most North Block soils are pumice and ash soils. The geologic history of these volcanic soils is described in the previous subsection. Pumice and ash soils are very permeable and have rapid infiltration rates, but they also have a high capacity to store water (Carlson 1979). The porosity of these soils explains the scarcity of surface drainage and the abundance of aquifers. Temporary streams (intermittent and ephemeral) are uncommon in the North Block.

The area's permanent streams are fed by an extensive groundwater system as well as the mountain snowpack. Many streams run for just a few miles before vanishing into the ground. The water may reappear in places like Klamath Marsh. Groundwater also supplies springs that emanate from the base of the escarpments. It may take several years for water to travel through aquifers, and some of the springs are just beginning to show the effects of the drought that began around 1987 (personal communication, Lorena Corzatt, 1994).

Geothermal energy has been a subject of interest in recent years. The basin's geothermal aquifers are a separate, fault-controlled system that lies below Mt. Mazama's volcanic deposits (personal communication, Lorena Corzatt, 1994).

Surface Waters

Annie Creek

Annie Creek, a tributary of Wood River, originates in Crater Lake National Park. It is a permanent stream, fed by the park's snowpack as well as groundwater. After leaving the park, it crosses 0.5 miles of Winema National Forest and 0.75 miles of Sun Pass State Forest. It then crosses private livestock pastures and is joined by Sun Creek before meeting Wood River, about 4 miles from the state forest.

Existing water rights allow Annie Creek to be diverted for agricultural use and fish rearing. The return flow from these uses reenters Annie Creek and Wood River. The 0.75 mile stretch across the state forest is protected by the Department of Forestry's "Protective Conservancy — Critical Wildlife Habitat" land use classification. Under the Forest Practices Act, Annie Creek is classified as a large, fish-bearing stream. (See page III-31 for an explanation of Forest Practices Act classifications.)

Sun Creek

Sun Creek, a tributary of Annie Creek, also originates in Crater Lake National Park. After leaving the park, it runs across Sun Pass State Forest for three miles, then across private livestock pastures for one mile before joining Annie Creek. Its year-round stream flow is generated by mountain snowpack and groundwater.

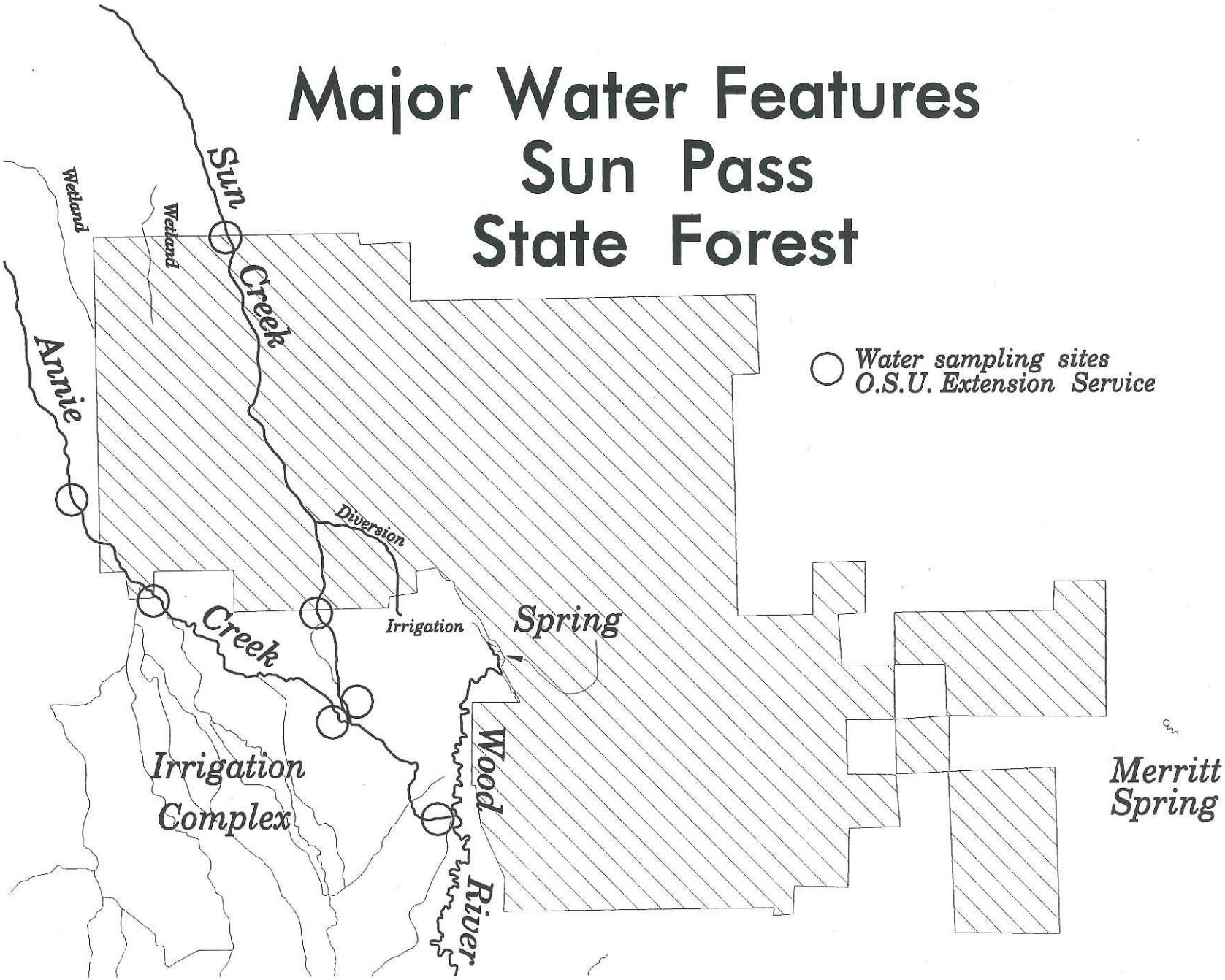
Sun Creek has been greatly altered by agricultural water uses. Its water is diverted into irrigation canals at two points: the first is one mile upstream from where Sun Creek crosses the state forest boundary, and the second is at the state forest boundary where the stream flows on to private land. Return flow from the fields enters Annie Creek and Wood River. Once it enters private land, Sun Creek meanders for 0.5 miles before becoming an irrigation ditch. What remains of Sun Creek spills into Annie Creek through a 24-inch culvert near the intersection of Highway 62 and Dixon Road.

On the state forest, Sun Creek's lower reach appears to have been channelized many years ago. Riparian vegetation grows only on the stream banks, and the water runs at high velocity. The Department of Forestry protects the upper reach with a "Protective Conservancy — Critical Wildlife Habitat" land use classification. This segment has a wide, natural riparian area with multiple channels and an active beaver population.

Sun Creek supports a population of bull trout inside Crater Lake National Park. Within the national park, efforts are underway to restore bull trout habitat and eliminate competition and interbreeding with brook trout.

Under the Forest Practices Act, Sun Creek is classified as a large, fish-bearing stream.

Major Water Features
Sun Pass
State Forest



Wood River

A spring emanating from the escarpment at Kimball State Park creates Wood River. It is not certain, but the aquifer could originate from as far away as the east side of Crater Lake National Park (personal communication, Lorena Corzatt, 1994). Wood River meanders across agricultural land for ten miles before meeting Agency Lake. On the way, it is fed by Annie Creek and return flow from irrigation.

Sink Creek

Sink Creek is a fish-bearing stream that originates in Mt. Thielsen Wilderness. At times of high stream flow, the water reaches one of the northern satellite parcels before it disappears into the ground on its way toward Klamath Marsh.

Other Springs

The head of Spring Creek is about two miles southeast of the main Sun Pass block. Spring Creek flows through Collier State Park and into the Williamson River. Merrit Spring is located about one-half mile east of the state forest. Several other springs emanate from the escarpment bordering the Agency Lake basin. They supply Crooked River and an Oregon Department of Fish and Wildlife fish hatchery about four miles south of the state forest.

Wetlands

National Wetland Inventory maps show two linear wetland segments between, and parallel to, Sun Creek and Annie Creek. The segments are noted as intermittent, temporarily flooded riverine wetlands. The maps also show areas of wetlands on the privately owned pastures along the state forest's southern boundary.

Downstream Surface Water and Water Uses

Water from Sun Pass State Forest ultimately reaches Agency Lake, Upper Klamath Lake, and the Klamath River. Downstream water uses include agriculture, aquatic habitat, and power generation. The Upper Klamath National Wildlife Refuge is located in wetlands thirteen miles south of the state forest.

Forests

North Block state forests are predominantly uneven-aged, mixed conifer stands that have been shaped by selective timber harvesting. The stands include a variety of tree sizes and have many small openings. For the most part, clearcutting is practiced only in the higher elevation, lodgepole pine-dominated, northeast corner of the forest.

Water Uses and Water Rights

An inventory of water rights has been obtained from the Water Resources Department (WRD) for Sun Pass and the Chemult satellite lands. Some pre-1909 water claims may exist without showing up in WRD records.

Annie Creek and Sun Creek are important sources of water for irrigation and livestock. According to WRD records, water is appropriated from these streams to 9,573 acres of irrigated fields. Of this total, 8,546 acres are primary and supplemental appropriation from Annie Creek, and 1,027 acres are primary appropriation from Sun Creek.

The records name several canals that are supplied by Sun and Annie Creeks: Scott Ditch, Shattuck Ditch, Loosely-Streeter-Cardwell Ditch, and Copeland Lateral Ditch. Diversion points inside Sun Pass State Forest account for 2,911 acres of appropriated water from Annie Creek and 856 acres from Sun Creek (WRD water rights database). There are no formal easements for the irrigation canals that cross Sun Pass State Forest. Also, any lands that were formerly owned by the U.S. Forest Service may have patents that reserve the right to construct a canal in the future (personal communication, Patty Cate, 1994).

Annie Creek also supplies water to a fish pond. According to WRD records, there is little or no groundwater use in the vicinity of Sun Pass State Forest. However, individual households may use groundwater for domestic use without obtaining a water right.

The Department of Forestry holds out-of-stream water rights for road construction (dust abatement) from these streams: Sun Creek, Annie Creek, Wood River, Williamson River (a tributary of Upper Klamath Lake), and Sand Creek (a tributary of Williamson River).

The Oregon Department of Fish and Wildlife has filed applications for instream water rights on Sun Creek, Annie Creek, and Wood River. The purpose of instream water rights is to reserve enough stream flow to support aquatic life. Although instream rights protect aquatic habitat against more recent (junior) claims, they do not prevail over older (senior) water rights.

Water Quality

Until recently, only a limited amount of information about water quality was available from USGS (U.S. Geological Survey) and USFS (U.S. Forest Service) monitoring in the Sun Pass area. The USGS collected data for Annie Creek above its confluence with Sun Creek. It is not known whether the data was collected within private pasture lands or public forest lands. The small data set (five samples) recorded cool stream temperatures and a mean turbidity value of 7.8 FTU (formazin turbidity unit), which was somewhat higher than expected. The mean turbidity may have been high because there was one high data value in a small set; it may not reflect actual ambient conditions. A single sample of Sun Creek showed a moderately cool July stream temperature of 15 degrees C. (Oregon Department of Environmental Quality, 1988)

Water quality and hydrology data were collected from the Wood River Valley in the Bureau of Reclamation's research project, Basin-Wide Optimum Aquatic Resource Management (fiscal years 1991-1993 phase). Five sample points between the headwaters and the mouth of Wood River provided information on the amount of water coming in from tributaries and the amount of water removed by irrigation diversions. Two other sample points were located on irrigation return flow canals, and two were located on marsh sites in the Upper Klamath National Wildlife Refuge. Preliminary figures, without interpretation, were published in a 1992 annual report. The research is ongoing, and will eventually produce a model of nutrient loading in Upper Klamath Lake resulting from tributaries. A related study is examining nutrient export from a discrete area of flood-irrigated cattle pasture in the Wood River Valley. (Campbell, Ehinger, and Kann, in Campbell 1993)

In a related study, the Oregon State University Extension Service has sampled eleven points on Sevenmile, Annie, and Sun Creeks. The project is attempting to identify cultural activities in forestry and agricultural land uses that may contribute to the nitrogen and phosphorus loading of Agency Lake from the Wood River sub-basin (Hathaway and Todd, in Campbell 1993). Seven of the sample points are on Sun Creek and Annie Creek. These will make it possible to compare water entering and leaving Sun Pass State Forest. The sample points are shown on the map of Major Water Features following page III-18.

The East Block

Watersheds

The East Block's state forests are scattered over an area that drains into Upper Klamath Lake (via Sprague River) and Lower Klamath Lake (via Lost River). These two watersheds divide the main Yainax Butte tract.

Hydrology

The East Block is drier than the North and Southwest Blocks. Precipitation totals little more than twenty inches per year, and occurs in the form of snow, winter and spring rain, and summer thundershowers.

In the vicinity of Yainax Butte, much of the soil is derived from fine volcanic ash over deeply weathered basaltic rocks. Clay loam soils are also present. Groundwater sustains a number of small springs and wet meadows. However, there is insufficient groundwater to sustain permanent stream flows. The streams flowing from Yainax Butte are intermittent, flowing only in the spring or after heavy rainstorms. In comparison to pumice soils, the ash soils are more susceptible to compaction and erosion. Severe compaction could disturb the function of ephemeral streams (personal communication, Keith Mills, 1994).

Surface Waters

Streams — Two unnamed, intermittent streams flow toward the south from the Yainax tract. One of these terminates in wetlands in the agricultural valley east of Keno and Mallory Reservoirs. The other terminates in wetlands at Dry Prairie. The drainage system

ultimately reaches Gerber Reservoir and Lost River. According to the National Wetland Inventory maps, there are three livestock ponds as well as seasonally and temporarily flooded emergent wetlands along the streams.

Tamarack Spring — Tamarack Spring is in the Yainax tract. The area around the spring is classified as temporarily and seasonally flooded emergent wetlands by the National Wetlands Inventory. It includes wet meadows and forested wetlands of lodgepole pine and aspen, and meets the Forest Practices definition of "significant wetland." The Department of Forestry classifies 37 acres as "Protective Conservancy — Critical Wildlife Habitat." Tamarack Spring is used as a watering site for livestock under a grazing lease administered by the Division of State Lands. Two watering holes and a system of dikes and ditches were constructed some time ago. Recently, eight acres surrounding the spring were fenced to exclude livestock. However, there is still a watering trough in the wet meadow, just outside the fence.

Cold Spring — Cold Spring is on a hillside about one mile from Tamarack Spring. It is used as a watering site for livestock. The spring has been fenced except for part of the watering hole. Ditches and dikes have been built in the meadow below the spring.

Streams on satellite parcels — The East Block satellite parcels are crossed by the following intermittent streams: Ish Tish Creek, Ponine Creek, Mill Creek, Snake Creek, and Reservoir Creek. One parcel is partially covered by Noble Reservoir, a body of water approximately 0.75 miles long.

Forests

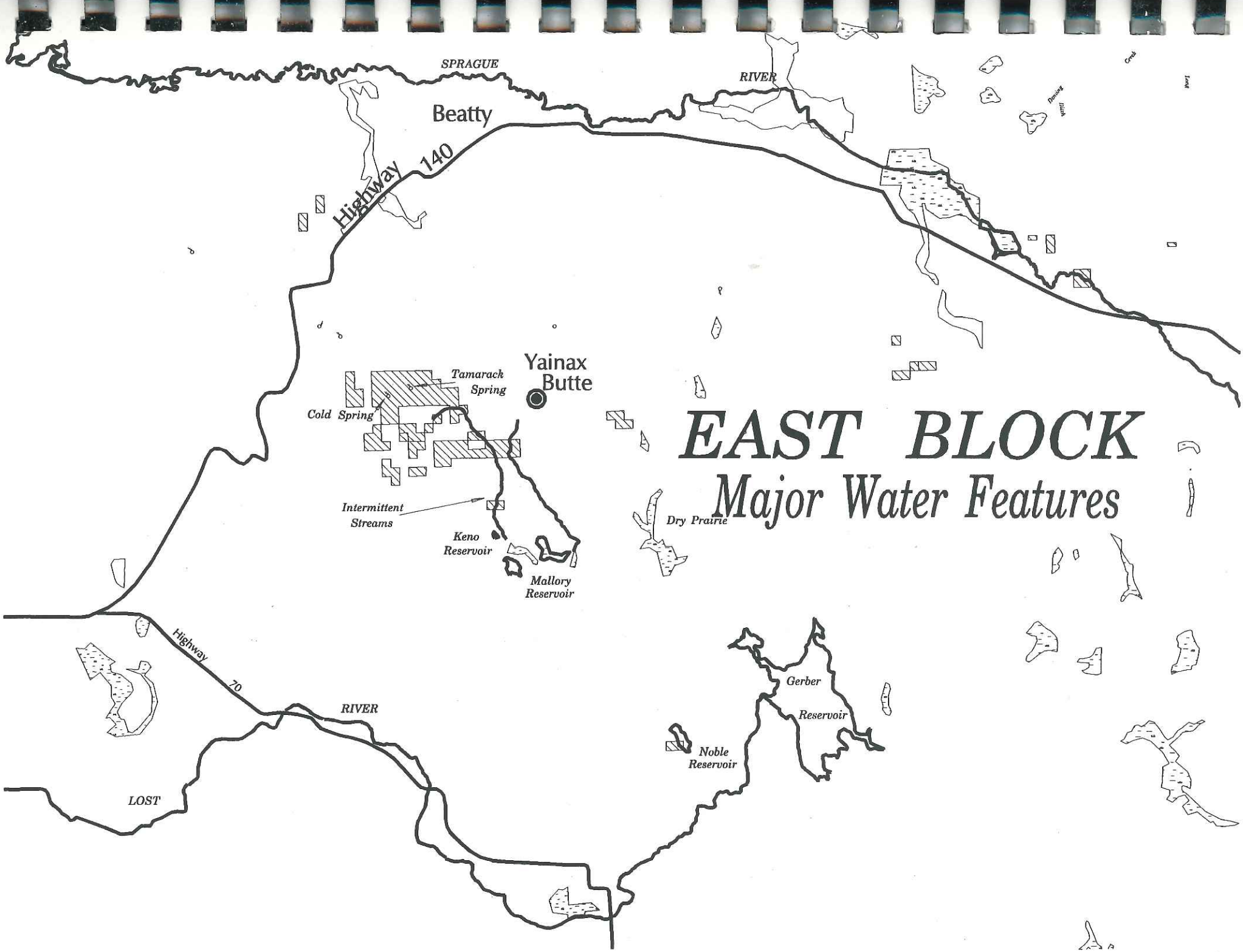
The Yainax Block state forests have pine and mixed conifer forests. These are generally managed on an uneven-aged basis through partial cutting. Timber harvesting practices vary on the intermixed public and private ownerships.

Grazing

The Yainax tract and other satellite parcels are leased for grazing and are associated with grazing allotments administered by the U.S. Forest Service. See "Livestock Grazing" on page III-26 and also see the subsection "Grazing" later in Section III for more information on the grazing allotments.

Water Uses and Water Rights

In a search of the Water Resources Department's database, several water rights were verified on intermittent streams in the Yainax Butte vicinity. Some pre-1909 water claims may exist without showing up in WRD records. The only known water right on state forest land is the livestock pond on an intermittent stream (Section 34, T37S, R12E) that flows toward Keno Reservoir. Livestock watering sites at Cold Spring and Tamarack Spring did not turn up in the search. The status of these water uses needs to be determined. It is also uncertain what the status or need is for permits to build dikes and ditches in wetlands and intermittent streams.


SPRAGUE
RIVER
Beatty
Highway 140
Yainax Butte
Tamarack Spring
Cold Spring
Intermittent Streams
Keno Reservoir
Mallory Reservoir
Dry Prairie
EAST BLOCK
Major Water Features
Highway 70
RIVER
LOST
Gerber Reservoir
Noble Reservoir

The Southwest Block

Watersheds

The Southwest Block state forests are scattered over a wide area, with a core area of 2,828 acres in the Bear Valley tract. Some of these lands drain into the Lower Klamath Lake basin and others drain directly into the Klamath River.

Hydrology and Surface Waters

The Southwest Block has older, residual clay loam soils that are shallow and stony. These soils are less permeable than pumice and ash soils and are compactible. Springs are not common, and a larger amount of water runs off the surface into intermittent and ephemeral streams. Precipitation totals only 20 to 30 inches per year, in the form of snow, winter and spring rain, and summer thundershowers.

The only significant watercourse on state land is an intermittent stream in Bear Valley. After crossing 0.75 miles of state property, the stream enters the Bear Valley National Wildlife Refuge. It eventually disappears into the ground and seeps toward the lowlands around Lower Klamath Lake. National Wetlands Inventory maps show seasonally and temporarily flooded emergent wetlands along the stream. The wetlands end where the stream is diked to create a small farm pond.

Forests

The Southwest Block's pine and mixed conifer forests are primarily managed on an uneven-aged basis through selective harvesting. Current and historical timber harvesting practices in the area may vary on the intermixed federal and private ownerships.

Water Uses and Water Rights

A database search by the Water Resources Department found a few recorded water rights in the vicinity of state forests. No water rights were found on state forests themselves. Note that pre-1909 water claims may exist without showing up in WRD records.

A small pond near the headwaters of Bear Valley supplies a transmission site on top of Hamaker Mountain. The Department of Forestry maintains one water right for dust abatement.

Human Impacts on Water Resources

In the last few pages, the Upper Klamath Basin's hydrology was discussed in terms of climate, geology, soils, and other natural factors. Human activities have had major impacts on the basin's water resources. These impacts are discussed below.

Conditions in Agency Lake and Upper Klamath Lake

Because activities on land may affect aquatic ecosystems, and Sun Pass State Forest is a significant landholding in the watershed, the condition of the aquatic ecosystem is an important topic in this plan. The most critical environmental concern in the Klamath Basin is the rapid disappearance of two species of fish, the Lost River sucker and the shortnose sucker, from Upper Klamath Lake and its tributaries. As much as twenty years ago, conditions in the lake and its tributaries had reached a state that could not support reproduction or growth and survival of the fish. Both sucker species were listed as endangered by the federal government in July, 1988. (Campbell 1993) In all, fifteen of the basin's seventeen naturally-occurring aquatic species are listed by the State of Oregon on threatened, endangered, or sensitive species lists.

The geologically old Upper Klamath Lake was historically a eutrophic lake, but is now classified as hypereutrophic (U.S. Army Corps of Engineers 1978). See the "Key Terms" box on the next page for definitions of trophic status. High productivity in the lake is visibly evident in the extensive blooms of blue-green algae that cause rank, odorous scums on the water surface each summer. Human activities may have contributed to increasing eutrophication in the lake. Activities that may affect the lake include reclamation of adjacent wetlands, livestock grazing, agricultural practices, logging, and hydrologic changes that occur because the lake has been dammed and is operated as an irrigation and hydropower reservoir (Campbell 1993).

The USDI Bureau of Reclamation is coordinating a research effort that is raising people's awareness of environmental conditions in Agency Lake and Upper Klamath Lake. The Basin-Wide Optimum Aquatic Resource Management project is discussed later in this subsection, under the heading "Watershed Programs and Research." Initial research and pilot restoration projects are slated for the Agency Lake/Wood River sub-basin near Sun Pass State Forest.

Degraded water quality may be the most serious threat to the endangered fish and other aquatic species. Massive blooms of a blue-green alga, *Aphanizomenon flos-aquae*, occur during the summer and greatly change the water quality in portions of the basin, especially Upper Klamath Lake. During the summer, alkaline conditions (high pH of 10.5 and above) occur for extended periods when algae strip carbon dioxide from the water column during photosynthesis. When photosynthesis stops at night, the algae continue to respire and consume oxygen. Thus, dissolved oxygen concentrations may be very low by morning. Decomposition of plant material during algal die-offs also consumes oxygen and, in

Key Terms

Trophic status — In hydrology, refers to levels of nutrients in a body of water; trophic status is categorized into the five levels listed below.

Ultra-oligotrophic — Cleanest, clearest water, with very low levels of phosphorus and chlorophyll; supports little or no photosynthetic plant life (such as algae).

Oligotrophic — Somewhat higher levels of phosphorus and chlorophyll, but still supports a limited amount of photosynthetic plant life.

Mesotrophic — Mid-range levels.

Eutrophic — High levels of phosphorus and chlorophyll, and high levels of photosynthetic plant life; water is turbid; the water also has limited amounts of dissolved oxygen.

Hypereutrophic — Very high levels of phosphorus, chlorophyll, and photosynthetic plant life; water is turbid and has very little dissolved oxygen.

addition, creates ammonia as a by-product. Laboratory experiments indicate that the ambient summertime water quality conditions can be acutely toxic to juvenile suckers. (Monda and Saiki, in Campbell 1993)

Recent research has shown that the lakes have high levels of phosphorus. The high levels of phosphorus derive from natural sources as well as surface run-off affected by agricultural activities (Logan and Markle, in Campbell, 1993). The phosphorus concentration in streams that flow from relatively new volcanic materials is typically about three times higher than in other pristine streams (personal communication, Chip Andrus, 1994). Water samples taken near the headwaters of Wood River confirm these high natural levels of phosphorus. However, levels of both phosphorus and nitrogen are even higher at the mouth of Wood River than at its headwaters, indicating that these nutrients are continuing to enter the river along its course. (Campbell, Ehinger, and Kann, in Campbell 1993)

Phosphorus levels are an important factor affecting algal growth rates. Thus, an effective means of restoring the lakes might be to drop the phosphorus level by reducing the amount of phosphorus coming into the lakes. Sediments also play a role in nutrient loading (Ehinger, in Campbell 1993). The substrate of Upper Klamath Lake has fine sediments that are high in nutrients. The sediments are suspended daily by wind action, making the nutrients in them easily available to the algae (Logan and Markle, in Campbell 1993).

Another threat to the endangered fish species is competition and predation from introduced fish species such as the fathead minnow.

Livestock Grazing

The Yainax tract and other satellite parcels are associated with grazing allotments that are administered by the U.S. Forest Service. The Bureau of Land Management administers allotments in the Southwest Block. Leases for state lands in these allotments are issued by the Division of State Lands and the Department of Forestry. There is a complete description of these grazing activities in the "Grazing" subsection later in Section III.

Earlier in the "Water Resources" subsection, streams, springs, and wet meadows affected by grazing were listed. The major impacts of livestock on water resources appear to be limited to specific high-use sites. Because of the scarcity of water, these sites are often valued for wildlife habitat.

The Yainax Coordinated Resource Management Plan (CRMP) provides information about the broader impacts of grazing . The CRMP is the management plan for grazing at Yainax Butte. The CRMP acknowledges "damage to some water resources and adjacent riparian areas which affects water quality (sanitation), channel stability, and watershed condition." Federal agencies are concerned about how the CRMP relates to their efforts to benefit the endangered shortnose sucker. But according to a BLM fish biologist (name not cited in the CRMP), the Gerber Reservoir population of shortnose suckers is believed to be stable, even under widely fluctuating pools. The Yainax Butte CRMP does not cite any evidence that land management is having adverse effects on the sucker or the quality of water reaching Gerber from the Dry Prairie area. Dry Prairie is a good buffer for potential water problems in the upper watershed. In order to improve riparian habitat that may impact the sucker, the CRMP prescribes certain protective measures with regard to Ben Hall Creek and Horse Canyon. (USDA Forest Service et al., 1993c)

A better understanding of watershed conditions will come out of current studies that will bring the Yainax CRMP up to NEPA (National Environmental Policy Act) requirements. The revised CRMP will include a biological opinion from the U.S. Fish and Wildlife Service on the Forest Service grazing program in the entire Lost River watershed (personal communication, Julie Bolton, 1994)

Forest Management Considerations

In forested areas, humans may affect water resources by harvesting timber, manipulating stand structure, and building roads. Some of the possible effects are summarized below.

The general characteristics of pumice and ash soils were described earlier in this subsection, under the heading "North Block." Erosion in pumice and ash areas is generally associated with roads. If roads are in troughs, water cannot spread out or drain off the roadways. Water moving at high volume and velocity can erode the road surface. By removing outer berms, cross-draining, outsloping, and other procedures, erosion and water dispersal can be controlled (Carlson 1979). Ground-based logging, if done on steep slopes, can also contribute to erosion (personal communication, Keith Mills, 1994). The

Klamath-Lake District staff has observed that at Sun Pass State Forest, any sediment-carrying water that runs off a road surface tends to be quickly absorbed into the ground, so the sediment does not reach streams.

Where ephemeral drainages exist, roads may intercept them and route their water into intermittent streams (personal communication, Lorena Corzatt, 1994). However, various studies of the way roads affect downstream peak flows have been inconclusive (personal communication, Chip Andrus, 1994). Ephemeral drainage is minimal at Sun Pass State Forest because the soils are very porous. Therefore, roads do not disturb the drainage system in this way on Sun Pass.

Trees are known to consume large amounts of soil moisture and transpire it into the atmosphere. Various studies have shown that water yield increases following clearcutting, selective cutting, and insect infestations (personal communication, Chip Andrus, 1994). Trees also tend to intercept snow and allow it to sublimate into the atmosphere. Unlike the west slopes of the Cascade Range, in eastern Oregon trees contribute very little moisture to the soils in the form of "fog drip."

Selective harvesting, as practiced in the Klamath-Lake District, creates an uneven-aged stand structure that is reasonably efficient at capturing precipitation. The U.S. Forest Service has experimented with ways to manage snowpack and water yield through different timber harvesting techniques. The results have depended on local conditions, and have been somewhat inconclusive. Large clearcuts are thought to increase wind exposure, causing snow to blow away or sublimate into the atmosphere (personal communication, Lorena Corzatt, 1994). Clearcutting has been done mostly in the higher-elevation, lodgepole pine-dominated portion of Sun Pass State Forest.

State Management of Water Resources

Oregon's Biennial Water Management Program

In 1909, the Oregon Legislature declared that all water in the state belongs to the public. Over the last eighty years, many state agencies have been given the job of helping manage the public's water. Today, twelve state agencies protect and oversee development of Oregon's water resources. Since 1989, before each legislative session the state has formulated a Biennial Water Management Program to help coordinate the state's water-related programs and clearly display them for both the Legislature and the public. The Program is approved jointly by the Water Resources Commission and the Strategic Water Management Group (SWMG), which is a coalition of state agencies. (The functions of SWMG were reassigned to the Water Resources Department and the Department of Environmental Quality by the 1995 Oregon Legislature.)

Background Information

The State of Oregon uses benchmarks as reference points to set state agency goals and priorities, allocate agency budgets, and measure government performance. First developed in 1991, the benchmarks are organized into three major categories: people, quality of life, and the economy. Many of the more than 270 benchmarks are directly or indirectly related to water.

The Biennial Water Management Program uses benchmarks as reference points. Two benchmarks of interest in the Klamath Basin are: (a) the percentage of key rivers and rivers with instream water rights meeting instream flow needs; and (b) the percentage of rangelands which are in good or excellent condition. The next few pages present information summarized from the 1993-1995 Biennial Water Management Program.

Watersheds

Numerous state efforts are underway to improve degraded habitat, riparian areas, wetlands, and uplands. The Governor's Watershed Enhancement Board (GWEB) promotes common goals and encourages partnerships of government, private organizations, and interested citizens. Recent legislation has enabled the formation of local watershed councils as advisory groups. Project funding is addressed in part through GWEB.

Rangeland Management on State Lands

The State Land Board has approved new administrative rules for rangeland management on Common School trust lands. In addition, the Oregon Department of Fish and Wildlife (ODFW) recently examined the effects of grazing on aquatic and terrestrial habitats.

Stream Flows and Waterways

ODFW, the Department of Environmental Quality, and the Parks and Recreation Department are authorized to apply for new instream water rights for fish and wildlife, water quality, recreation, and other public uses. Approximately 800 applications have been filed, mostly by ODFW.

ODFW also administers a program to develop comprehensive fish management plans for all basins in the state, and it carries out programs to install and operate fish screens on certain water diversions.

The Department of Forestry is encouraging stream improvement through the cooperative Stream Enhancement Initiative with the Oregon Forest Industries Council and ODFW. The Water Resources Department seeks to improve the health of water resources within critical basins through the cooperative Stream Restoration Program.

Wetlands Management

The Biennial Water Management Program's goals for wetlands include: (a) establishing water quality protection programs for wetlands; (b) acquisition and restoration of wetlands; and (c) a planning and regulatory program that provides predictability for development, agricultural, and wetland protection interests.

The Division of State Lands (DSL) has begun to develop a statewide wetland conservation strategy to better integrate programs at the state level. DSL is also compiling a statewide inventory of wetland resources. To further the restoration of wetlands, DSL has been coordinating efforts to (a) establish criteria for wetland restoration within watersheds; (b) establish Oregon's eligibility for the Wetland Reserve Program, a federal program for restoring wetlands to farmed sites; and (c) clarify water right requirements for wetland restoration projects.

DSL and the Department of Forestry are among the state and federal agencies that signed a memorandum of understanding to increase the coordination of wetland restoration and protection projects on public lands in Oregon.

Water Quality (DEQ)

Water quality protection is mandated by federal and state law. The goal of the federal Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Oregon has adopted statutes and rules to achieve these goals.

The state's water quality is under the authority of the Environmental Quality Commission and is regulated by DEQ (Department of Environmental Quality). DEQ's water quality program for forest lands is administered by the Board of Forestry through the Forest Practices Act's administrative rules, discussed later in this subsection. These rules specify "best management practices" (BMPs) for forest operations, which ensure that water quality will meet DEQ standards. Any forest operation that complies with the rules is deemed to comply with the state's water quality standards. (ORS 527.710; 527.765; 527.770) There are no administrative rules or BMPs to regulate livestock grazing. However, in DEQ's opinion, sufficient guidelines are available to help meet water quality standards. Assistance is available from agencies such as DEQ, Natural Resource Conservation Service, Oregon Department of Agriculture, and BLM (Hammon 1995a).

Water Supply (WRD)

The term "water supply" refers to capturing precipitation, transporting water in streams and aquifers, and storing water using human-made structures or natural means. The state's water supplies are under the authority of the Water Resources Commission, and are regulated through WRD (Water Resources Department).

Under state law (ORS 536.300), the Water Resources Commission is required to develop an integrated, coordinated state program for managing Oregon's water. The program consists of state water policies, basin rules, and the Biennial Water Management Program.

State Water Policies

The Commission has adopted a number of state water policies to guide water management decisions (OAR Chapter 690, Division 400). Other state agencies and public corporations are directed to conform to statements of water resources policy (ORS 536.360). The policies on water storage and on the protection of water resources on public riparian lands pertain most directly to watershed health and the Eastern Region Long-Range Forest Management Plan (Homer 1994).

Policy on water storage — Storage can be enhanced through means ranging from natural processes to engineered structures. With respect to forest management, the policy directs state agencies to "encourage enhancement of watershed storage capacity through natural processes using non-structural means." The policy supports stream restoration and watershed health programs that contribute to increased natural storage.

Policy on the protection of water resources on public riparian lands — This policy advises public land management agencies to protect the water-related functions of riparian lands through their land management plans and practices, to compile databases of riparian area condition, to monitor effectiveness, and to mitigate activities in riparian areas.

Water Rights

To assist the Eastern Oregon Region in the development of its plan, the WRD provided records of water rights on, or close to, most of the state forest lands. There are some limitations to data generated by the Water Rights Information System. For example, the database represents information contained in the legal rights of record, but does not necessarily reflect actual use because many rights are not fully exercised or may be abandoned but not canceled. In addition, the data may not reflect all water right transfers.

The state's control over water was established through a unified water code that was passed in 1909. The code allocates water through four basic provisions:

- Surface or groundwater must be used for a beneficial use.
- The right to use water is attached to specific land. If the land is sold, the water right goes with it.
- In a time of shortage, the junior (most recent) water rights holders lose their use of the water first.
- Water rights are good forever unless they are not used for five consecutive years.

Generally, Oregon law does not favor one kind of use over another. Some uses of water are not required to have water rights (Water Resources Department 1994).

In some cases, property owners may have vested water rights that predate the 1909 law. These claims can be determined and made a matter of record only through a legal adjudication proceeding. In 1987, the Oregon legislature required persons who claim pre-1909 rights in areas not yet adjudicated to file a water-use registration statement before December 31, 1992.

The Klamath River Basin adjudication began in 1977, but has been halted pending the outcome of a lawsuit regarding the federal government's obligation to participate in the state's adjudication process. The issues raised in the lawsuit could be resolved by 1995, but may not be resolved until 1996 (Oregon Water Resources Commission 1993). The claims for federal reserved water rights (Klamath Indian tribal rights, federal agency rights, and Bureau of Reclamation rights) have yet to be filed, pending the outcome of the litigation (Oregon Water Resources Department 1993).

Forest Practices (ODF)

The protection of water resources was recently strengthened through changes in the Forest Practices Act, which regulates forest operations. In 1991, Senate Bill 1125 called for the Board of Forestry to review the existing system of classifying and protecting waters. The bill set a new target for achieving state water quality standards:

> "The board shall establish best management practices and other rules applying to forest practices as necessary to insure that to the maximum extent practicable nonpoint source discharges of pollutants resulting from forest lands do not impair the achievement and maintenance of the water quality standards. Such best management practices shall consist of forest practices rules adopted to prevent or reduce pollution of waters of the state ..." (Oregon Department of Forestry 1994a)

The water protection rules have now been regrouped and are found in OAR 629, Divisions 635-660. The overall goal of the rules is to provide resource protection during operations adjacent to and within streams, lakes, wetlands, and riparian management areas so that, while continuing to grow and harvest trees, the protection goals for fish, wildlife, and water quality are met (OAR 629-635-100 (7); Oregon Department of Forestry 1994a).

Background Information

The Oregon Forest Practices Act (FPA) regulates timber harvest and other activities on non-federal forest lands in Oregon. The Board of Forestry develops and enforces administrative rules that carry out the FPA. In response to Senate Bill 1125, the Board of Forestry redefined FPA stream classifications in 1994. Each stream is classified by two characteristics: size and use.

Size classifications:

Small — Average annual flow is under 2 CFS (cubic feet/second).
Medium — Average annual flow is between 2-10 CFS.
Large — Average annual flow is greater than 10 CFS.

Use classifications:

Fish-bearing or non-fish-bearing.
Domestic water use or no domestic uses.

The rules address the following issues, among others.

- The need for a water classification system that matches appropriate protection measures to the beneficial uses and physical characteristics of the waters.
- Water temperatures.
- Large woody structure.
- Sedimentation.
- Obstructions to juvenile fish passage.

In addition to stream classifications, there are also classifications for significant wetlands, stream-associated wetlands, other wetlands, and lakes. The protection measures are appropriate for the beneficial uses found in each water classification, and include: (a) retaining a portion of the trees, understory vegetation, snags, and downed logs; and (b) maintaining soil productivity, hydrologic function, and water quality. A monitoring program will verify the overall effectiveness of the rules over time.

The rules allow some flexibility as to how a desired future condition might be achieved. An example of a desired future condition is "to provide a stream-side stand that will function similar to mature forest conditions along fish-bearing streams." As an alternative to the general prescription, a site-specific or alternative plan could be developed.

Watershed Programs and Research

Klamath Basin Ecosystem Restoration Office

The Klamath Basin Ecosystem Restoration Office (ERO) is a partnership aimed at maintaining and restoring the function and health of the Klamath Basin ecosystem. The program's geographic area includes the entire Klamath River watershed, from the headwaters to the mouth of the Klamath River. ERO was established in 1993.

Funding and staffing for ERO is provided by current budgets from four federal agencies: the U.S. Fish and Wildlife Service, the Bureau of Reclamation, the Bureau of Land Management, and the U.S. Forest Service. ERO promotes a more efficient and effective use of existing federal, state, and local resources. It encourages agencies, private organizations, and individuals to participate in voluntary ecosystem restoration work. Funding is available for projects that provide immediate returns, such as spawning habitat improvement, erosion control, stream bank stabilization, riparian fencing, and wetland restoration. ERO also conducts long-range planning to ensure that individual restoration efforts address the needs of the entire basin.

Environmental Research and Pilot Projects

The U.S. Bureau of Reclamation is leading a coordinated effort to improve lake and watershed conditions in the Klamath Basin. Oregon State University, the Klamath Tribe, and other organizations are contributing research for the project. Currently, research and pilot projects are focusing on the Wood River/Agency Lake sub-basin of Upper Klamath

Lake. Later, the results of this work will be used to develop management recommendations for the entire lake basin.

Studies are taking place in three research projects funded by the Bureau's WATER (Water Technology and Environmental Research) program.

- Basin-Wide Optimum Aquatic Resource Management Project
- Water Quality Protection and Enhancement Project
- Wetlands Ecology and Utilization Project

Basin-Wide Optimum Aquatic Resource Management Project

The Basin-Wide Optimum project is coordinated with federal agencies, Oregon State University, and the Klamath Tribe. The project has five phases. ("FY" means Fiscal Year.)

Phase 1 (FY91-93)	Water quality and hydrology field research along the Wood River, 7-Mile Canal, 4-Mile Canal, Crystal Creek, and Thomason Creek.
Phase 2 (FY94-95)	Evaluation of management options by modeling hydrology and nutrient loading changes and initiating pilot management projects.
Phase 3 (FY95-96)	Planned implementation for those management options selected.
Phase 4 (FY95-97)	Monitoring effectiveness of implemented management options and making adjustments.
Phase 5 (FY98-99)	Final report that can be extrapolated to the entire Klamath Basin.

Research papers from this project's 1992 Annual Report were cited earlier in the Water Resources subsection, under the heading "Conditions in Agency Lake and Upper Klamath Lake."

TMDL Process

The Department of Environmental Quality has initiated the development of a Total Maximum Daily Load (TMDL) for the Klamath River from the Link River to Keno Dam. A TMDL is the total amount of a pollutant that can enter a body of water without triggering a violation of the water quality standard for that pollutant. The Klamath River consistently violates state water quality standards for dissolved oxygen, pH (acidity-alkalinity), and ammonia toxicity. These violations adversely impact beneficial uses of the river. To address these water quality issues, the Department of Environmental Quality

(DEQ) has collected water quality data to quantify the nature and extent of the problems. DEQ is in the process of developing a water quality model to simulate water quality conditions and various scenarios to improve water quality. The TMDL process is a phased approach where the initial focus will be to establish waste load allocations for point source discharges, and eventually identify load allocations for nonpoint sources of pollution in the basin. (Hammon 1995b)

Klamath-Lake Forest Health Partnership

Public and private landowners are in the early stages of a cooperative effort to manage the South Fork of the Sprague River watershed. Even though there is no significant state forest acreage in the program area, the Klamath-Lake District is active in coordinating the partnership. The emphasis is on maintaining and restoring a healthy ecosystem on a watershed basis. Initially, a water basin analysis, or ecological assessment, will be prepared to characterize the watershed's aquatic, riparian, and terrestrial systems.

State Scenic Waterway and Wild and Scenic River

In 1988, Oregonians passed a ballot measure that designated parts of many Oregon rivers to be State Scenic Waterways. Part of the upper Klamath River was included in the measure. The Oregon State Scenic Waterways Program was established by voter initiative in 1970, and is administered through the State Parks and Recreation Department. The program provides for river protection and some controls over development for rivers included in the system.

In September 1994, part of the upper Klamath River was designated as a federal Wild and Scenic River. The eleven mile Wild and Scenic River stretch begins below the John C. Boyle powerhouse (northwest of the Bear Valley tract) and extends to the California border. The federal and state designations have some overlap on the river, but since both designations have the same general purpose, no conflicts between the two are expected. The federal Wild and Scenic designation requires that a river remain freeflowing (no dams or impoundments are allowed) and provides protective management for the river channel itself and federal lands along the river.

Air Quality

Air quality affects public health and welfare. Two activities on Eastern Region State Forests can affect air quality: prescribed fire and wildfire. The "Key Terms" box on the next page defines terms and acronyms used in this subsection. Figure III-4, on the page after the "Key Terms" box, displays graphically the relationships between the laws and programs described below.

Laws and Programs — The Big Picture

The federal Clean Air Act is the main law regulating air quality. The goal of the Clean Air Act is "to protect and enhance the quality of the Nation's air resources so as to promote the public health and welfare and the productive capacity of its population." The Clean Air Act is administered by the Environmental Protection Agency (EPA), a federal agency.

Under the Clean Air Act, the EPA is responsible for setting air quality standards. They develop NAAQS (National Ambient Air Quality Standards), which establish the maximum concentration for various pollutants that may be present in the ambient (surrounding) air. Standards are measured on a short-term (3, 8, or 24 hours) or annual basis. The primary NAAQS are set at levels to protect public health. When pollutant concentrations and durations exceed these levels, health can be affected. The secondary NAAQS are set to protect welfare. For example, the sulfur compounds in some air pollutants can cause acid rain, which in turn can have negative effects on the environment, including trees, aquatic plants, and aquatic animals. Air pollution can impair visibility, and this is also considered an effect on public welfare. The Clean Air Act also establishes PSD (Prevention of Significant Deterioration) standards, which determine the maximum amount that pollutants may exceed 1977/1978 baseline levels.

The Clean Air Act delegated the authority to implement the law to the states. In Oregon, the Department of Environmental Quality (DEQ), a state agency, develops and carries out programs to meet the air quality standards (NAAQS). Other agencies are also involved. The Department of Environmental Quality has developed the Oregon State Implementation Plan, or SIP, which contains general provisions for protecting air quality in all areas of the state. Under the SIP there are specific sub-plans for different kinds of air pollution. For example, one sub-plan covers field burning, another covers auto emissions, and so on. Two sub-plans affect forest management.

- **Smoke Management Plan —** This is Oregon's plan for prescribed burning. The plan covers all prescribed burning on Oregon forest lands, including federal, state, and privately owned lands. The Department of Forestry and DEQ develop the plan jointly with input from interested parties and users. The Department of Forestry then implements and administers the plan.
- **Visibility Protection Plan —** This plan is developed by DEQ to protect visibility in Class I areas (see the "Key Terms" box) from a variety of pollution sources. The prescribed burning strategies to protect visibility are implemented under the Smoke Management Plan.

("Laws and Programs" continued on page III-38)

Key Terms

Ambient — Surrounding.

Class I areas — National park lands and some wilderness areas are designated as federal mandatory Class I areas under the Clean Air Act.

Clean Air Act — Federal law passed in 1970, and amended several times since. The authority to implement the act is delegated to the states. The act is implemented, in part, through a permit system.

Class I-III — The Clean Air Act divides clean air into three classes; Class I allows for minimal degradation of air quality, while Class III allows a relatively greater degree of degradation.

DEQ — Oregon Department of Environmental Quality.

Dispersion — The spreading or scattering of smoke.

EPA — Environmental Protection Agency. This federal agency administers the Clean Air Act, among other responsibilities.

Exceedance — Documented instance of a NAAQS standard being exceeded in a particular area.

NAAQS (National Ambient Air Quality Standards) — Under the federal Clean Air Act, the Environmental Protection Agency was responsible for setting air quality standards. They developed NAAQS, which establish the maximum concentration for various pollutants that may be present in the ambient (surrounding) air. Standards are measured on short-term (3, 8, or 24 hours) or annual basis.

Non-attainment area — An area in which national air quality standards have not been met. Special provisions apply to these areas.

Particulate — Small particles that are in smoke produced by burning wood and other forest debris. Two kinds of particulate are controlled under federal and/or state regulations: TSP and PM-10.

PM-10 — Particles smaller than 10 microns in diameter, present in wood smoke.

Prescribed burning — Controlled fire burning under specified conditions in order to accomplish planned objectives; also called slash burning, as a frequent objective is to reduce the amount of slash left after logging.

PSD — Prevention of Significant Deterioration standards. These standards determine the maximum amount that pollutants may exceed 1977/1978 baseline levels.

SIP — State Implementation Plan. This plan implements the Clean Air Act and contains general provisions for protecting air quality in all areas of the state.

SPZ — Special Protection Zone. An area established around cities that are non-attainment areas; Klamath Falls has an SPZ established around it.

TSP — Total suspended particulate in smoke.

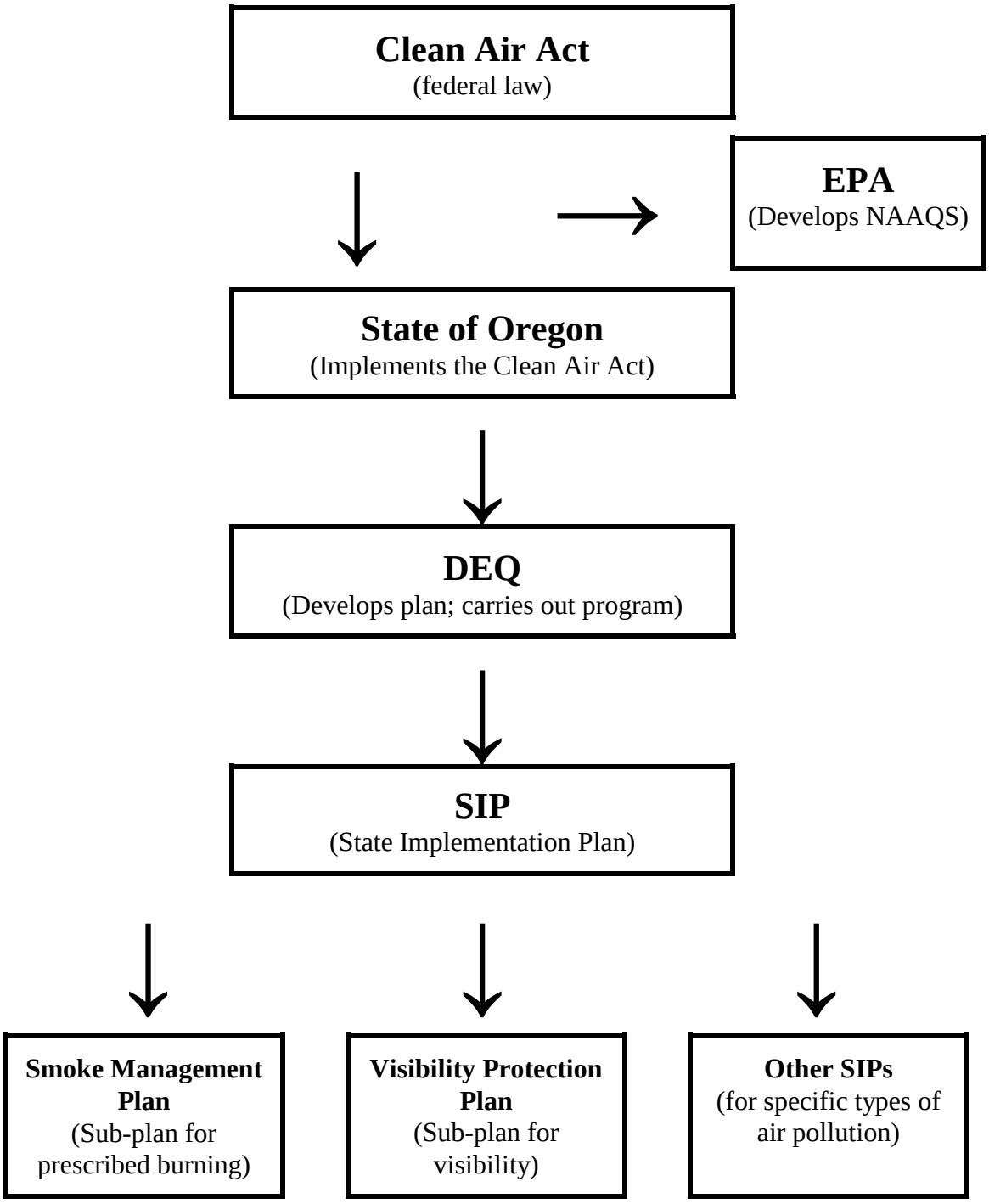


Figure III-4. Programs Regulating Air Quality in Oregon

The federal Clean Air Act is the main law regulating air quality. The law is implemented by the Department of Environmental Quality through the State Implementation Plan, or SIP. The goal of the SIP is to attain and maintain the national air quality standards, known as NAAQS. Sub-plans have been developed by other state agencies to address specific air quality concerns.

("Laws and Programs", continued from page III-35)
DEQ has the responsibility to monitor air quality throughout the state and refine air quality control programs if areas are not meeting any of the NAAQS. DEQ has established a network of samplers and nephelometers to monitor PM-10 levels, the pollutant of most concern from prescribed burning. (Nephelometers are instruments that measure the concentration of a substance suspended in a solution, such as pollutants in the air.)

Air Quality Programs and Eastern Region State Forests

The last three pages described the programs regulating air quality in Oregon. The next several pages describe specifically how these programs affect the state forest lands on Klamath-Lake District. As mentioned already, two air quality plans affect forest management: the Smoke Management Plan and the Visibility Protection Plan.

The Smoke Management Plan

The Smoke Management Plan regulates prescribed burning on forest lands in Oregon. Its goal is to attain and maintain NAAQS, in order to protect public health and welfare from the adverse effects of air pollution. To judge if forest areas are in attainment with the NAAQS, the Department of Environmental Quality monitors areas that represent the worst case. If these monitored areas are in attainment, it is assumed that other areas are also meeting the standards.

The smoke from burning forest slash contains two kinds of particles that are regulated: TSP and PM-10. TSP is no longer included in federal regulations. Under state regulations, the allowable level of TSP is not to exceed 150 micrograms of pollutant per cubic meter of air per 24 hour period, or an annual average of 60 micrograms. Under both federal and state regulations, the allowable level of PM-10 is not to exceed 150 micrograms per 24 hour period, or an annual average of 50 micrograms. These standards are for designated urban areas and wilderness areas (Oregon Department of Environmental Quality 1994). In terms of tonnage, the amount of PM-10 typically generated by prescribed burning in eastern Oregon is 1.4 percent of the total fuel burned (Matlick 1995).

The Smoke Management Plan has established Special Protection Zones for a number of cities that are non-attainment areas, including Klamath Falls. These cities have exceedances of the fine particulate (PM-10) standards. Klamath Falls is also having exceedances of the carbon monoxide standards. The Smoke Management Plan mandates that prescribed burning be reported in this area.

The Special Protection Zone for Klamath Falls (SPZ) is a zone surrounding the Klamath Falls area where the special burning regulations are in effect to give additional protection to Klamath Falls. The SPZ, and additional requirements for it, are in effect from November 15 to February 15 each year. Prescribed burning is allowed in the SPZ only when the smoke management meteorologist believes there will be no measurable smoke impacts within the PM-10 non-attainment area. Landowners are responsible for monitoring the burn intermittently for at least 3 days, to ensure the smoke is not affecting the non-attainment area. Between December 1 and February 15, no new ignitions are allowed in the SPZ on a day that a "Red" day has been declared through the local

woodstove curtailment program. The SPZ and its provisions will continue to apply as long as Klamath Falls is in PM-10 non-attainment status.

Klamath County Voluntary Smoke Management Program

The Klamath-Lake District participates in a voluntary smoke management program for Klamath County, along with other major forest landowners. The Special Protection Zone provisions are implemented through this voluntary program. The participants are: Klamath-Lake District (ODF), Cavenham Forest Industries, Modoc Lumber Company, Thomas Lumber Company, Weyerhaeuser Company, Whiskey Creek Timber Company, Klamath County, Winema National Forest, Fremont National Forest, and the Bureau of Land Management (BLM) Lakeview District.

All participants have signed a Memorandum of Understanding (MOU), which went into effect on April 24, 1991 (Klamath-Lake District et al., 1991). Although smoke from residential woodstoves is recognized as the main cause of the PM-10 problem, the forestry community takes responsibility, through the MOU, for managing prescribed burning to minimize its effects on air quality.

The MOU establishes procedures for the signing parties to follow. These procedures are summarized below. For the full text, see the MOU. Procedures for all parties:

1. The Klamath Basin Air Quality Control Area, which includes the urban Klamath Falls area, is the area protected from the smoke that results from commercial forest slash burning. The plan applies to all commercial forest land in the southern two-thirds of Klamath County.
2. The Salem Smoke Management section of the Department of Forestry will provide smoke management forecasts and advisories specific to Klamath County, issued once daily, when needed.
3. Public education and awareness is a key issue. Cooperation needs to be exemplary, public credibility needs to be improved, and signing parties should readily admit any accidental smoke intrusions. The documentation and reporting must be accomplished.
4. The Klamath-Lake District, along with the BLM Lakeview District and the Winema and Fremont National Forests, will coordinate the location of planned burns for the following day.

The MOU also includes specific procedures for private landowners and federal agencies. For private landowners, the Klamath-Lake District acts as the coordinating agency for the interpretation of smoke management forecasts and advisories. Advisories may allow some burns, but not others, depending on tonnage, weather, and burn location. Private landowners submit various reports to the district, including information on planned burns, smoke monitoring after burning, and burning accomplishments.

The Visibility Protection Plan

The goal of the Visibility Protection Plan is to remedy any existing impairments of visibility and to protect future visibility conditions in Oregon's Class I areas. National park lands and some wilderness areas are designated as federal mandatory Class I areas under the Clean Air Act. (The new wilderness areas established by the Oregon Wilderness Act of 1984 have not been designated as Class I areas by Congress. The Sky Lakes and

Mt. Thielsen Wildernesses are in this category.) The Clean Air Act Amendments of 1990 required that visibility be protected in Class I areas, as well as air quality (Oregon Department of Environmental Quality 1993c). The following Class I areas are near state forest lands in Klamath and Lake Counties:

- Crater Lake National Park — northwest of state forest lands.
- Gearhart Mountain Wilderness — east of state forest lands.
- Mountain Lakes Wilderness — south of state forest lands.
- Diamond Peak Wilderness — north of state forest lands.

The Visibility Protection Plan is implemented through the requirements of the Smoke Management Plan. The Smoke Management Plan designates certain Class I areas as either protected or smoke sensitive, and prescribes appropriate smoke management strategies. The goal of the visibility plan is to protect visibility during the high use months, July 1 through September 15. Very little or no prescribed burning takes place during this period.

Air Quality Trends on Eastern Region State Forests

Prescribed burning and wildfire on Eastern Region State Forests could affect air quality. The trends for each activity are discussed below.

Prescribed Burning

The Klamath-Lake District uses a variety of tools to treat slash left after logging. See "Fire Management" later in Section III for additional information on tools used to treat slash. Slash is treated to reduce fire hazard and to achieve silvicultural objectives. Treatment methods include several types of prescribed burning and alternatives to burning. The district's slash treatment trends over the last four years are discussed briefly below.

Prescribed Burning Treatment Methods

- **Prescribed burning of slash piles on landings —** These piles consist mainly of tree limbs removed on the landing, after the whole tree was yarded to the landing. This method removes most slash from the harvest unit. Slash piles can be covered and burned on days when the smoke has minimal impacts on air quality. The district has burned an average of 3,018 tons of landing piles annually, over the last 4 years. This amount translates into an annual average of 42 tons of PM-10, using the 1.4 percent conversion factor.
- **Prescribed burning of slash piles in harvest units —** These piles consist of slash left on the unit, piled by tractor. The district has burned an average of 2,017 tons of tractor piles annually, over the last 4 years. This burning has produced an average of about 28 tons of PM-10 annually.
- **Broadcast burning —** A broadcast burn is a prescribed fire that burns over a designated area within defined boundaries, such as a harvest unit, in order to accomplish planned objectives. The most recent broadcast burning on Klamath-Lake District was in 1986, when approximately 400 acres of lodgepole clearcut units were burned. The district may use this technique on some future harvest units, if site conditions and silvicultural objectives show a need for this type of treatment.
- **Underburning —** An underburn differs from a broadcast burn in that the burn area still has overstory trees. Underburning prescriptions call for low flame lengths in order

to keep the overstory trees alive. The district has not done any underburning yet, but expects to use this technique in the future, to meet fuel management and silvicultural objectives for some sites.

Alternative Fuel Treatment Methods

The district also uses slash treatment methods that do not involve burning. Alternative methods have included mechanical slash disposal (using a slashbuster) and sales of slash and small diameter trees for chips/biomass.

The district must consider many objectives when treating slash, including silvicultural needs, wildlife needs for large woody debris, effects on fire hazard, and effects on air quality. By reducing slash accumulations, the district can minimize a fire hazard, thus reducing the risk of air pollution resulting from wildfires.

Summary of Air Quality Trends

The base years for evaluation of PSD (Prevention of Significant Deterioration) trends are 1977/1978. The Klamath-Lake District state forests have decreased their smoke emissions since the base years. In the 1970s, slash was typically piled by tractors and subsequently burned. As described above and in "Fire Management" later in Section III, there have been changes in slash treatment and wood utilization. The amount of material burned, as measured in tons, has been reduced by 40 percent since the 1970s (DeBlander 1995).

Air Quality Trends on Other Lands in Eastern Oregon

The U.S. Forest Service (USFS) has proposed a significant increase in prescribed burning in northeastern Oregon, in order to treat the area's serious forest health problems. Their proposed burn program would increase prescribed burning from 25,000 to 70,000 acres per year. The USFS believes the program would help prevent catastrophic wildfires and help to restore and maintain ecosystem health on the 3 million affected acres (out of 6 million acres in the area). Representatives from state and federal agencies have been meeting over the past year to explore approaches that would address the forest health needs, while still complying with Clean Air Act and other legal requirements. A proposal has been developed that would allow about 70% of the Forest Service's requested increase in prescribed burning (Oregon Department of Environmental Quality 1993a).

Under the proposal, there would be no net change in total emissions, when prescribed burning and wildfire emissions are added together. While emissions from prescribed burning would increase, the agencies believe that the emissions from wildfires would decrease as forest health problems are treated. Also, non-essential prescribed burning would be decreased, and more biomass would be removed from logging areas before burning. In partnership with other agencies, the Forest Service has agreed to fund and operate a new, extensive smoke monitoring network in northeastern Oregon. Since the program would have no net increase in total emissions, the process of meeting legal requirements should go quickly, allowing the new program to begin.

The Ecosystem

Biodiversity

Biodiversity Concepts

Biodiversity is a term frequently used in conjunction with all types of land planning but often its meaning is not clear. The Society of American Foresters defines biodiversity as "the variety and abundance of species, their genetic composition, and the communities, ecosystems, and landscapes in which they occur." The following operational definition has been modified from Gast et al. 1991.

> Biodiversity is the variety, function, distribution, and structure of ecosystems and their components, including all successional stages, arranged in space over time that support self-sustaining populations of all natural and desirable naturalized flora and fauna.

Both definitions emphasize processes and their interactions that lead to landscape, ecosystem, species, and genetic diversity. The basic concepts in this discussion of biodiversity were taken from the paper, "Biodiversity Planning on the Elliott State Forest" (McAllister 1993). The "Key Terms" box on the next page defines some terms used in this discussion.

Landscape Diversity

A landscape is defined as a unit of land with separate plant communities or ecosystems forming ecological units with distinguishable structure, geomorphology, and disturbance regimes. Landscape diversity may be described as inherent or induced. Examples of inherent landscape diversity include climate, soils, topography, and aspect. Examples of events that cause induced landscape diversity are fire, windstorms, human activities, and animals. Induced diversity is generally considered to result from successional changes in vegetation. Total landscape diversity represents the sum of both inherent and induced diversity.

Fragmentation is another important concept in biodiversity. It represents the spatial arrangement of seral stages resulting from natural and human-caused disturbance. Some organisms are favored by high interspersion of early and late seral stages and flourish under management that results in a highly fragmented pattern. Other species may require extensive tracts of relatively uniform habitat, or have limited ability to travel or disperse between suitable patches. If patches of suitable habitat become too small and dispersed, then these populations may not remain sustainable.

Key Terms

Composition — The different species of plants and animals that live in an ecosystem.

Disturbance — A force that causes significant change in an ecosystem's structure and/or composition; can be caused by natural events or human activities.

Fragmentation — The spatial arrangement of successional stages across the landscape as the result of disturbance; often used to refer specifically to the process of reducing the size and connectivity of late successional or old growth forests.

Function — Activity or process that goes on in an ecosystem; some typical functions are plant growth, animal reproduction, decay of dead plants.

Induced landscape diversity — Aspects of the landscape that change as a result of disturbances such as fire, windstorms, human activities, and animals; for example, the successional stages of vegetation that occur after a wildfire.

Inherent landscape diversity — Aspects of the landscape that are relatively permanent (changing only slowly over long periods of time) in any particular landscape, but that vary among landscapes. Examples are climate, soils, topography, and aspect.

Landscape — A unit of land with separate plant communities or ecosystems forming ecological units with distinguishable structure, function, geomorphology, and disturbance regimes.

Late successional habitat — A forest stand whose typical characteristics are a multi-layered, multi-species canopy dominated by large overstory trees; numerous large snags; and abundant large woody debris (such as fallen trees) on the ground. Other characteristics such as canopy closure may vary by the forest zone (lodgepole, ponderosa, mixed conifer, etc.).

Seral stages — Developmental stages that succeed each other as an ecosystem changes over time; specifically, the stages of ecological succession as a forest develops.

Structure — The physical parts of an ecosystem that we can see and touch; typical structures in a forest are trees, standing dead trees (snags), fallen dead trees.

Succession — A series of changes by which one group of organisms succeeds another group; a series of developmental stages in a plant community.

Disturbance and Biodiversity

The frequency, type, and size of disturbance events will affect different levels of biological organization. Succession is the process used to describe the change in community development between disturbance events. Because disturbance events are so variable, successional patterns and resulting community composition through time will vary accordingly. The resulting biodiversity will also change. Taken collectively, landscape diversity would be maximized as component communities vary collectively through succession.

Disturbances can be classed as either natural or human caused. Natural disturbances tend to be quite variable, ranging from disturbances that affect entire forests to those affecting one to several trees. Examples of natural disturbance include fire, insect and disease outbreaks, periodic flooding of riparian forests, and wind-generated blowdown. Human-caused disturbances generally differ from natural disturbances by being more uniform and less intense.

Compositional Diversity

The composition of a forest may be described in terms of plant communities or ecosystems. A plant community is a general term for an assemblage of plants living together. The term can be applied to a single stratum in a local area, such as the herbaceous layer of a forest floor, or to a seral vegetation unit undergoing a transition to a stable climax assemblage of vegetation. In this case, both the seral condition and the climax vegetation are plant communities. The natural variability of plant communities and plant associations on the Klamath-Lake District state forest lands is discussed in the next subsection on vegetation.

An ecosystem is the interaction of a plant community with the abiotic environment. Ecosystems are functional systems of complementary relationships with a transfer and circulation of energy and matter. As with plant communities, ecosystems can vary in scale.

Structural and Functional Diversity

Structural diversity is measured both horizontally and vertically. Horizontal structure refers to the spatial distribution of logs, stumps, root wads, and piles of limbs, as well as the distribution of wildlife and plant species. Vertical diversity is determined by the heights of trees or other vegetation, and by the branching and leaf characteristics of the plants. The juxtaposition of horizontal and vertical diversity is referred to as patchiness. Patchiness has implications for overall landscape, compositional, and functional diversity.

Functions are the processes associated with structures. Primary production, nutrient cycling, water use, and animal habitat use are examples of ecosystem functions. Both horizontal and vertical structures are clearly important to the proper ecological functioning of a forest ecosystem.

The amount of retained late successional habitat is an important element in achieving biodiversity goals because of its relative rarity and its unique ecological role within the overall forest sere. Patch size, distribution, and linkages between areas of late successional habitat are often as important as the total quantity. When late successional forests are

fragmented, they lose internal habitat (habitat sheltered from other influences because it is surrounded by late successional habitat). Thus, fragmentation reduces late successional habitat function well beyond the amount of actual acres of late successional habitat lost, because the adjacent open areas influence the unique conditions present within late successional habitat.

Species and Genetic Diversity

The term "species richness" refers to the number of different species that inhabit a given area. There are three ways to look at species diversity:

- Species richness within plant and animal communities.
- Richness between communities along some environmental gradient, such as from a forest at the top of a mountain to one at the bottom, where conditions of temperature and moisture cause changes between the two forests.
- Richness within landscapes encompassing multiple communities of plants and animals.

Genetic diversity refers to the genetic material within populations and within individuals. Genetic diversity is important at all biotic levels of the ecosystem: vertebrates, invertebrates, trees, shrubs, herbs, fungi, viruses, and bacteria. Greater genetic diversity may result in increased genetic variation and the related capacity for adaptation. Such diversity increases the specie's ability to respond to changing environments such as global climate change, and insect and disease pests.

A Conceptual Strategy for Managing Biodiversity

Managing for biodiversity requires managing at various levels of biological organization: species, genetic variation within species, communities of organisms, and functional diversity. Functional diversity includes the many processes in which the organisms transfer energy with each other and the physical environment.

Managing for diversity also requires recognition that certain concepts and many details of managing ecosystems require further testing and refinement. Because of our lack of complete understanding, an adaptive management approach is required that integrates management, research, and monitoring. A draft, unpublished paper written for the Department of Forestry suggests the following conceptual strategy for managing biodiversity (McAllister 1993).

Basic Strategy

Three fundamental elements are required in developing a biodiversity strategy.

1. Manage at a variety of scales from large landscapes to individual trees.
2. Recognize that all species cannot be managed equally on every acre.
3. Manage habitat for multiple species rather than single species.

An operational strategy for biodiversity management on the Klamath-Lake District state forest lands is the "coarse filter - fine filter" approach proposed by Hunter (1990). The coarse filter component is based upon the premise that maintaining a range of seral stages, stand structures, and sizes, across a variety of ecosystems and landscapes will meet the needs of most organisms. Individual species or habitats that have special status (not addressed using the coarse filter) are managed specifically under a fine filter strategy. Fine filter management superimposes specific management actions in addition to those management actions required under the coarse filter management. Collectively, coarse and fine filter management maintain and restore ecosystem diversity.

A biodiversity strategy is characteristically implemented at two levels: the forest stand and the broader landscape. The stand (defined in the "Vegetation" subsection) is a relatively homogenous area forming an operational unit to which a silvicultural treatment is applied. Stand management defines the composition and structure through time. The landscape represents the distribution of many stand level units through time and space.

Landscape Considerations

Landscape planning objectives should follow from the consideration of seral stages, fragmentation, and special habitat considerations.

1. Base forest planning on ecological classifications that are map scale-dependent.
2. Manage for a variety of seral stages, stand structures, and stand sizes across the landscape, emulating natural patterns. Take the stand structures, seral stages, etc., of neighboring landowners into consideration as well as their future management goals and directions.
3. Maintain habitats of individual species or groups of species at particular risk of extinction.
4. Maintain unique ecosystems. Examples on Klamath-Lake District lands include riparian areas, springs, wetlands, rock outcrops, and talus slopes.
5. Minimize fragmentation wherever possible.

Stand Level Considerations

The landscape level considerations deal with the broad distribution of forest stands over the landscape and through time. Stand structure and function differ with seral stage, ecosystem, and disturbance history. Stand level management deals with the structure and function of the individual stand. The most important structural features for maintaining diversity are:

- Dead and dying wood (snags, wildlife, and coarse woody debris)
- Large and old trees
- Vertical and horizontal structure
- Herb and shrub communities

Relationship between Coarse and Fine Filter Planning

Coarse filter planning provides the foundation for protecting biodiversity. When special habitat requirements dictate, fine filter habitat requirements should be superimposed on the coarse filter to ensure that overall biodiversity goals are reached.

Fine filter/coarse filter planning on the Klamath-Lake District state forest lands should be accomplished at the landscape planning level. Planning considerations at this level are best capable of integrating the two strategies and assessing trade-offs. The main goal will be to maximize compatibility between coarse and fine filter planning efforts. It is also at the landscape level that short and long-term resource and commodity trade-offs are identified and adjustments made. It is expected that adjustments would be made through time as commodities and natural resources change, and planning goals are modified accordingly.

Adaptive Management

A critical element of successful planning is the integration of plan implementation, monitoring and research, management reviews, and management refinements into a comprehensive system that allows for directed adjustments to ensure attainment of biodiversity goals.

Monitoring can be divided into the following three elements: implementation, effectiveness, and validation/research. Implementation monitoring addresses whether the management direction was implemented as specified; effectiveness monitoring tests whether the actions have the desired effect; and validation/research monitoring tests the critical assumptions used in building the plan. The three types of monitoring can be summarized this way:

- Implementation — did we do what we said we were going to do?
- Effectiveness — did it have the results we thought it would have?
- Validation /research — were our assumptions correct that we used?

Adaptive management ensures that the monitoring and research information is fully incorporated into the management plan. It provides a process that triggers review and possible revision of the plan based upon this information. It is important to realize that biodiversity planning is largely experimental. Many forest activities that will be carried out as part of such a plan should be viewed as being based on hypotheses.

Biodiversity Situation on Klamath-Lake District State Forest Lands

The following discussion applies primarily to Sun Pass State Forest, about which we have the most information. However, much of this information probably applies to some extent on other Klamath-Lake District state forest lands as well.

Inherent Biodiversity

Inherent biodiversity results from variation in such things as climate, soils, and topography. On the Klamath-Lake District, the main climatic influence is the decreasing moisture gradient from the summit of the Cascades to the east, which causes changes in the inherent vegetation pattern. Soil changes also result in an inherent difference in vegetation. Much inherent biodiversity was probably lost when Mt. Mazama erupted about 6,000 years ago, covering the existing soils, vegetation, and topography with a thick layer of pumice.

Today the most significant sources of inherent biodiversity are topographic features, which were described earlier in Section III. Sun Creek and Annie Creek and their associated riparian systems are extremely important because of the relative rarity of water and riparian habitat in this area. The escarpment is a significant source of rock outcrop and talus habitat. All of these features are classified as protective conservancy because they provide critical wildlife habitat. See "Land Use Classifications" later in Section III for a description of the state forest system for land use classifications.

Pre-1900 Induced Biodiversity

Before the early 1900s, the vegetation of the Klamath-Lake District state forests was quite different from what it is today. In the early 1900s, there was a major change in the frequency of occurrence of the primary source of disturbance, fire. Historically, both natural fires and fires set by resident American Indians were important in the ecosystem dynamics of the forest. Recent studies show an historic fire interval ranging from 5 to 15 years in the lower elevation ponderosa pine sites to more than 250 years in the high elevation true fir sites. The vast majority of the state forests are under 5200 feet in elevation and were historically dominated by ponderosa pine, an indication that fire was a frequent visitor.

These fires maintained a forest landscape that looked very different from what we see today. The pre-1900s landscape was characterized by openness and mature trees. This forest was characterized by an overstory of 10 to 30 mature trees per acre primarily of fire-resistant species such as ponderosa pine (USDA Forest Service 1990b). The understory was open with only a few smaller trees surviving the periodic wildfires. Brush occurrence and diversity were low. The shrub and grass component was very sparse. Fires also occurred too frequently for duff layers and woody debris to build up. Compositional and structural diversity would have been low within this band of fire-dominated forest.

Post-1900 Induced Biodiversity

The advent of fire suppression in the early 1900s caused gradual but highly significant change in the forest. The lack of fire has allowed the establishment of conifer regeneration to proceed unchecked. This has allowed many forest areas to become severely overcrowded with trees. Many of these trees are the more shade-tolerant and fire-susceptible firs. While these fir trees frequently outgrow the pines, we are now finding that in many cases they are not well-suited to the long-term growing conditions in this area. The subsection "Forest Health" later in Section III discusses this situation in more detail. The lack of fire has also allowed the development of a diverse shrub layer in the understory, as well as the development of a thick duff layer and down woody debris. In summary, the effects of fire suppression have presented us with challenges and opportunities. The challenges are related to the forest's increased susceptibility to catastrophic fire and insect and disease outbreaks. The opportunities are related to:

1. The increase in biodiversity resulting from the increased structural and compositional diversity.
2. Increases in site productivity resulting, in part, from the well-developed duff layer and increased presence of nitrogen-fixing shrubs such as snowbrush.

Fire suppression is just one example of change in induced diversity caused by human activity. In December 1943, the Board of Forestry purchased the first 14,450 acres of the present Sun Pass State Forest from Yawkey, Woodson, Ourbacker, and Algoma Lumber Company. Before this purchase, Sun Pass had been heavily cut over. Cutting focused primarily on large trees of high value species such as ponderosa pine, Douglas-fir, and sugar pine. The large white firs that existed were worth too little to remove and were nearly always left behind. The only trees of the high value species that were left behind were those too small or too defective to be commercially valuable at the time. When Sun Pass was inventoried in 1990-1991, the most common age class for overstory ponderosa pine was 65 to 85 years. These trees would have been 15 to 35 years old in 1943. A few trees up to 130 years old have survived; however, most of these show signs of defect and were probably left behind for this reason.

In some areas this cutting released an existing understory of white fir. In other areas it created an ideal seedbed for ponderosa and sugar pine. Apparently, a sufficient seed source was left in these two species to ensure successful regeneration because nearly all the unoccupied ground was thickly covered with seedlings and saplings of these two species when active management of these lands began in the late 1950s.

Uneven-aged management was the management regime of choice from the 1950s to mid-1970s, and concentrated on two silvicultural objectives: removal of defective, large, overstory white fir, and removal of heavily mistletoe-infected overstory ponderosa pine. Healthy overstory pine and firs were left. The understory was still too small for commercial thinning. By the late 1970s, precommercial thinning of the dense understory and regeneration was added to the list of high priorities. During the early to mid 1980s, the Klamath-Lake District experimented briefly with even-aged management in the ponderosa pine and white fir forest zones. The experiment consisted of three clearcut units totaling 219

acres and several large overstory removals. The initial plan for the overstory removals was to allow the residual understory to grow to merchantable size, then clearcut and plant. These areas have subsequently been precommercially thinned, interplanted, and returned to an uneven-aged management regime. The impact of this experiment, in the units where it was done, was to set back succession to an earlier stage than normally occurs in an uneven-aged treatment, thus increasing landscape biodiversity.

Current Situation — Influence of Recent Management on Biodiversity

The state currently uses two silvicultural systems in managing the Klamath-Lake District state lands. In the ponderosa pine and white fir forest zones, uneven-aged management is generally used. In the lodgepole pine forest zone, even-aged systems such as seed tree and clearcutting are used. The impacts of these two systems on biodiversity are very different.

Uneven-aged management — The Klamath-Lake District's uneven-aged management system is described in detail later in Section III under "Forest Products — Timber", but is summarized here. Stands in the ponderosa pine and white fir forest zones are scheduled for treatment based on the level of stand density, with overstocked stands being scheduled first. The objectives of this treatment are generally as follows:

1. Create a healthy, insect and disease-resistant stand by reducing stocking levels in all size and age classes and by altering species composition. Altering species composition usually means favoring a residual stand with a large ponderosa pine component, while retaining some level of all naturally occurring tree species for biodiversity.
2. Create or retain an uneven-aged stand structure capable of sustained timber output through periodic partial cut entries.
3. Establish a viable cohort of ponderosa pine regeneration.
4. Enhance wildlife habitat through sustained recruitment of wildlife trees, snags, down woody debris, and cover areas; and maintenance of early seral areas for production of forage.
5. Maintain soil productivity through management of compaction and slash, woody debris, and the duff layer.

Treatment is accomplished in two stages. The first stage is a timber sale, which reduces density and alters species composition in the sawlog-size trees, and creates openings and understocked areas for new seedlings. Numerous small openings are formed as a result of group selections of less desirable species such as white fir and lodgepole pine. The openings range from less than a tenth of an acre, to a few openings as large as several acres. Even-aged groups of ponderosa pine, sugar pine, and Douglas-fir are usually thinned from below to provide good growth rates and resistance to insect attack. Groups of large trees of the desirable species are marked to leave individual trees based on tree quality, ability to survive and grow to the next entry, and need for seed trees and future wildlife trees. Large, high defect white firs are left whenever possible as present and future wildlife trees, snags, and down woody debris.

The second stage consists of post-harvest precommercial thinning and interplanting. The thinning has the objective of reducing density in the sub-sawlog-sized material and favoring healthy trees of desirable species. The larger openings are generally interplanted if it is felt that an insufficient number of desirable seed trees exist in the immediate vicinity to ensure adequate regeneration. In smaller openings with sufficient seed trees, natural regeneration is relied on.

This silvicultural system tends to create within-stand conditions with a lot of fine scale biodiversity. Small openings can be viewed as the early successional stages. Groups of older trees of various ages can be viewed as the later successional stages. When viewed at a larger landscape scale, however, the picture changes. The openings are small, make up a small proportion of total stand area, and are set in a matrix of older trees of various ages and species. When this management scheme is practiced across the landscape on many contiguous stands, the picture that emerges is one of a relatively uniform forest with a narrow range of mid to late successional seral stages and minimal fragmentation. The small openings; retention of some large trees, snags, and downed woody debris; well-developed brush layer; and multiple canopy layers give this forest some late successional habitat characteristics. However, due to the intensity of management and resulting lack of some late successional elements such as sufficient large snags and large woody debris, this forest would probably not meet most definitions for late successional habitat. This system also mimics some aspects of low intensity fire by reducing overall stand density and focusing on removal of fire-sensitive species such as white fir and lodgepole pine.

Even-aged management — Even-aged management is most frequently practiced in the lodgepole pine forest zone. Both clearcutting and seed tree cutting have been used and are planned for the future. Both types of management would retain green trees and snags at least to the levels required by the Forest Practices Act. A few mixed conifer stands scheduled for long-term uneven-aged management occasionally require stocking reductions below the standard residual basal area targets, in order to correct some silvicultural problem such as an insect or disease infestation, or a species composition imbalance. (See Appendix A, Glossary, for the definition of basal area.) In this case, parts of these stands may meet clearcut definitions. However, this kind of intermediate treatment is viewed as necessary to return the stand to a healthy, uneven-aged condition.

Even-aged management results in less stand biodiversity than uneven-aged management. With the retention of snags and green trees, these silvicultural systems mimic fairly closely some of the more intense disturbances such as catastrophic fire, major windthrow events, and insect and disease outbreaks. Because even-aged management occurs on such a small percentage of the Klamath-Lake District state forest lands, it is a valuable tool to vary the magnitude and extent of disturbance events and increase biodiversity.

Management under the new forest plan will differ in some ways from the current management that has just been described. Future management strategies are described in Section V, under the headings “Forest Health”, “Timber”, and “Wildlife and Fish.”

State Forest Lands in the Larger Landscape

In the East and Southwest Blocks and the satellite parcels on the North Block, landscape level planning is difficult for several reasons. First, state forest lands are a very small part of the landscape in these areas. In addition, these lands are not blocked to any great extent, but are intermingled with Forest Service, BLM, industrial private, and nonindustrial private lands. Much communication and coordination needs to be developed between the various landowners in these areas before landscape level management can become a reality. The Yainax Butte Coordinated Resource Management Plan (CRMP), which deals primarily with grazing management, is an example of the kind of coordination that needs to happen on a large scale and for all resources. The Yainax Butte CRMP is discussed later in Section III, under "Grazing."

Sun Pass State Forest, however, is a relatively contiguous block of land, bordered to a large extent by federal ownership. Crater Lake National Park forms the east-west boundary on the northwest side of the forest. The Winema National Forest forms boundaries on the west, northeast, and southeast. Private forest land is intermingled with and forms much of the boundary on the east side of the forest. Private agricultural land, primarily pasture land, forms the southwest boundary.

The best way to discuss biodiversity in this larger context is to talk about the variation in successional stages and forest zones on the different ownerships bordering Sun Pass. The part of Crater Lake National Park next to Sun Pass forms a large block of late successional mixed conifer (white fir zone) forest.

The Winema National Forest lands that border Sun Pass are highly variable. They include the following management areas and forest types.

- Four late successional reserves. These reserves border parts of all four sides of Sun Pass and are primarily in the white fir forest zone.
- Managed forest land in the ponderosa pine and white fir forest zones that has had uneven-aged harvesting or overstory removal and precommercial thinning of residual understories. These areas would mostly fall in the mid-seral stage. These areas border sections of all common boundaries.
- Managed forest land in the lodgepole pine forest zone. Much of this zone is in an early seral stage as a result of clearcutting and seed tree cutting during the recent mountain pine beetle outbreak. Some of this type remains in a mature, unmanaged, late seral stage. These areas border a large part of Sun Pass's north boundary with the Chemult District.

There are many private forest land parcels adjacent to and intermingled with state forest land on Sun Pass's east boundary. These private lands have been heavily harvested over the last five years. Much of this harvesting has been heavy overstory removal with no treatment of the residual understory. These areas would fall into the early to mid-seral stages.

Biodiversity in the Forest Management Plan

The Eastern Region Long-Range Forest Management Plan does not list specific goals for biodiversity. The plan addresses biodiversity through goals and strategies for forest resources such as timber, plants, and wildlife. See Sections IV and V for the goals and strategies.

Vegetation

The Forest Ecosystems of Klamath-Lake District

The vegetation of the Klamath-Lake District state forests is highly variable. This variability is closely tied to the variations in climate, soils, and elevation described in previous subsections. All three management blocks have some common elements, however. Ponderosa pine and white fir are the most common tree species, and the manzanitas (pinemat and greenleaf) and the Ceanothus genus (squawcarpet and snowbrush) are the most common brush species.

As in all forest ecosystems, the Klamath-Lake District state forests go through stages of succession called seral stages, after a disturbance such as a wildfire. See the "Key Terms" box on the next page for the definition of seral and other terms used in this discussion. During these seral stages one species may dominate or several tree species may occur together. The species that dominate the earlier seral stages are referred to as seral species. Seral species frequently require disturbed soil and lots of light to become successfully established. Over time, these stages develop towards the climax stage. The climax stage for a particular piece of forest land will usually feature one tree species, known as the climax species, as the dominant or most common species. The climax tree species can regenerate in duff and litter under the canopy of the seral species, and also under its own canopy.

The Klamath-Lake District state forests have four climax species: ponderosa pine, Douglas-fir, white fir, and lodgepole pine. Each species dominates in different environmental conditions. For ponderosa pine, Douglas-fir, and white fir, the availability of moisture determines where each occurs as the climax species. Lodgepole occurs as the climax species on the coldest sites.

Ponderosa pine — Ponderosa pine is the climax species on the driest sites. In areas where it is the climax tree species, it is usually found in pure stands, although it will sometimes be found in association with juniper, incense cedar, or lodgepole pine.

Douglas-fir — Douglas-fir occurs as a climax species only on certain sites in the Southwest Block. These sites are moister than the ponderosa pine sites, but not moist enough to allow significant establishment of white fir. The stands on these sites usually have a mixture of ponderosa pine and Douglas-fir, with smaller amounts of juniper and incense cedar.

White fir — Under natural conditions, white fir occurs as the climax species on the sites with the most moisture. Currently, however, it occurs across a wide range of moisture regimes and elevations. The spread of white fir as a climax species has resulted from ecological changes brought about by forest fire suppression over the past century.

Key Terms

Climax plant species — Species that are self-perpetuating in their environment in the absence of perturbing, degenerating, or disturbing influences.

Climax stage — A highly stable stage of ecological succession. An ecosystem will stay at the climax stage until disturbance affects the ecosystem and the stages of ecological succession begin again.

Forest zone — The land base on which a particular series is found.

Plant association — A classification system for grouping plant species that reoccur on the landscape within particular environmental tolerances. They are stable groupings of plant species capable of self-perpetuation and can be thought of as climax plant communities.

Plant communities — A general term for an assemblage of plants living together and interacting among themselves in a specific location and at a specific point in time.

Seral plant species — Species that do not self-perpetuate in their environments in the absence of disturbing influences, but are replaced by climax plant species.

Seral stages — Developmental stages that succeed each other as an ecosystem changes over time; specifically, the stages of ecological succession as a forest develops.

Series — Collection of plant associations having the same climax species in the dominant layer. As an example, the lodgepole pine series includes all the lodgepole pine plant associations.

Stand — A term used in this plan to designate a contiguous area of land in the same vegetative series and having the same management history.

Before modern fire suppression, a major break in this forest zone occurred at the elevation level of 5200 feet. Below this level, periodic low intensity wildfires kept white fir from becoming established as a significant component. Here, because of its resistance to fire, ponderosa pine dominated the forest, and appeared to be the climax species rather than one of the seral species. Above 5200 feet, white fir dominated.

Since the advent of fire suppression, white fir has been able to invade and in many cases begin to dominate sites below 5200 feet, right down to the true climax ponderosa pine sites. Because of the wide range of sites that white fir now dominates, it is mixed with all the conifer species found on these state lands. At the lower elevations, it is most frequently found with ponderosa pine. In some areas these stands will also contain significant amounts of sugar pine, Douglas-fir, and incense cedar. At higher elevations, climax white fir stands begin to pick up species such as Shasta red fir, lodgepole pine, and small amounts of western white pine.

Lodgepole pine — Lodgepole pine occurs as the climax species on the coldest sites. On the Klamath-Lake District state forests, these sites are found only in the North Block where a combination of pumice soils (which do not retain much solar heat) and flat basins occurs. This combination forms frost pockets that collect cold air and can have sub-freezing temperatures in all months of the year. Lodgepole pine is the only conifer tree species able to withstand these temperature extremes and therefore is usually found in nearly pure stands in these situations. Lodgepole pine is also a very prolific seeder and can aggressively regenerate disturbed areas in all the other sites. For this reason it can also be very common in the seral stages of the other climax forests.

Plant Associations

Each climax species discussed above forms a series (see "Key Terms") that can be further subdivided into plant associations. Plant associations are groups of plant species that reoccur on the landscape within particular environmental tolerances. They are stable groupings of plant species capable of self-perpetuation, and can be thought of as climax plant communities. These species characterize the plant community that would occur on a particular piece of land under long-term, stable conditions. There are several main uses for plant associations (Topik et al. 1988).

1. Plant associations can be used to describe key environmental features of sites.
2. Plant associations provide site-specific information that can help managers to understand the results of natural events and management activities on a site, and also to understand research results.
3. Managers can then prescribe appropriate management activities for sites, based on their improved ability to predict site response to treatment.
4. Plant associations can form the basis for a natural inventory system of land resources.

In the 1989 to 1991 forest inventory that was conducted on the Klamath-Lake District state forest lands, plant associations were identified for all stands classified as "production lands" in the land use classification system. The classification system is discussed later in this chapter, under the heading "Land Use Classifications." Appendix D lists the plant associations for the three main blocks of state forests, with acreages of production land listed for each plant association.

Threatened, Endangered, and Other Listed Plants

Background

The Department of Forestry must comply with the Oregon Endangered Species Act (ESA) for plants as well as the federal ESA. (See Appendix C for more information on these acts.) The Oregon Department of Agriculture has developed administrative rules that direct state agencies how to comply with the state ESA. OAR 603-73-090 (5)(a) requires state agencies to "Ascertain by state agency field survey, consultation with the Oregon Department of Agriculture, or from the Oregon Natural Heritage Program ... if listed species occur or are likely to occur on lands targeted for state action ..."

The intent of the administrative rules is that state agencies be reasonably certain that their actions are not negatively impacting listed species. The Department of Forestry must demonstrate a good faith effort at determining the presence of listed species.

The Department of Forestry has developed a process in compliance with (5)(a), to determine whether listed plant species occur on state forest lands and could be impacted by forestry activities. These activities include land actions that may be site and time specific (e.g. timber harvesting, road construction, plantation release spraying); or ongoing on a regular basis over a broad area (e.g. livestock grazing, roadside spraying). Land exchanges are considered to be land actions under some circumstances. The process is a two-phase protocol:

1. Create a base list of threatened and endangered plant species that have a strong possibility of occurring somewhere within the planning area. This phase is discussed in detail below.
2. Assess proposed land actions for impacts on species that are on the base list. This phase involves developing an assessment methodology for each species on the base list. The objective of the assessment methodology is to allow the Department of Forestry to screen specific activities in specific locations for potential conflicts with species on the base list. This phase will take place when specific land actions are evaluated. At that time, it will be determined whether any of these species actually do occur or are likely to occur.

If this process finds that a listed species occurs or is likely to occur on the site of a proposed land action, then the conservation requirements of OAR 603-73-090 (5)(b) through (5)(e) apply.

Base List

A base list was developed of the species that have a strong possibility of occurring somewhere within the planning area. The list encompasses all state forest lands in Klamath-Lake District. The following steps were used to create the base list.

Carol Tyson, botanist for the Winema National Forest, developed the initial list of plant species of concern. This list included species on the Oregon Department of Agriculture's threatened, endangered, and candidate lists; all four of the Oregon Natural Heritage Program's (ONHP) lists; and the U.S. Fish and Wildlife Service's federal lists. Carol initially reviewed the Oregon Natural Heritage Program's species lists for Klamath County. Both the Forest Service (Winema and Fremont National Forests) and the Bureau of Land Management have done extensive plant surveys on federal lands in Klamath County. Carol used the results of these surveys in combination with the ONHP lists to create a comprehensive list of suspect and documented species for state forest lands in Klamath-Lake District. The resulting list is shown in Appendix E.

None of the plant species on this list are currently listed as threatened or endangered under the State of Oregon or federal ESAs. Twelve of the species are currently listed as candidate species under the Oregon ESA. Two of the candidate species, *Astragalus peckii* (Peck's milkvetch) and *Botrychium pumicola* (pumice grape-fern), are currently being proposed for addition to the State threatened and endangered list. Peck's milkvetch is found on dry, sandy soils in lodgepole/bitterbrush forest openings and sagebrush scrub. Pumice grape-fern is found in fine pumice gravel without humus above 7800 feet and in lodgepole pine basins down to 5000 feet. Habitat for both species could exist in the North Block.

These two species were proposed to the Oregon Department of Agriculture and accepted by them as comprising the base list for the Klamath-Lake District state forests.

Wildlife and Fish

There are 269 vertebrate species known or expected to occur on the Klamath-Lake District state forest lands. This total includes 12 amphibians, 5 fish, 15 reptiles, 157 birds, and 80 mammals. Each of these species requires habitat conditions that may be found within one or more plant communities and seral stages that occur on these lands. Appendices F, G, H, and I provide a detailed list of these species along with their habitat associations and status. This list was prepared for the Oregon Department of Forestry by the Oregon Natural Heritage Program, with subsequent fine-tuning by local Oregon Department of Fish and Wildlife biologists.

Wildlife diversity is generally correlated with a diversity of seral stages. See the previous subsections on "Biodiversity" and "Vegetation" for a discussion of seral stages and forest development on the Klamath-Lake District state forest lands. As long as all forest seral stages are maintained in appropriate quantities and suitable condition, habitat for most species should be retained over time.

Game Species

Thirty-four of the vertebrate fish and wildlife species likely to be found on these state lands are state game animals. Table III-3 on the next page lists these species by category. Each category is discussed briefly below.

Game Fish

Brook, brown, and rainbow trout are known to occur on the Klamath-Lake District state forest lands, but are confined to Sun Creek and Annie Creek in Sun Pass State Forest. Bull trout are known to be found in Sun Creek upstream of Sun Pass State Forest in Crater Lake National Park, but have not been confirmed on state land. Bull trout are also on the Federal Candidate Species List and the State Sensitive Species List (critical category) and are discussed further in those sections.

Game Mammals

Seven game mammals are known to occur on Klamath-Lake District state forest lands.

Game Birds

Of the twelve game bird species, seven are classed as waterfowl and five are upland birds. Of the seven waterfowl, only the mallard, Canada goose, and wood duck are known to occur on state forest land. Habitat for these species on state forest land is limited to beaver ponds on Sun Creek and Annie Creek, and a few stock ponds and seasonal wetlands in the Southwest and East Blocks. All five upland game birds (the ruffed grouse, blue grouse, California quail, mountain quail, and mourning dove) are known to occur on state forest lands.

Table III-3. Game Animals Likely to be Found on State Forest Lands [1]

Game mammals	Western gray squirrel, black bear, mountain lion, elk, black-tailed deer, mule deer, pronghorn antelope
Furbearers	Beaver, muskrat, red fox, gray fox, raccoon, marten, mink, Pacific fisher, river otter, bobcat
Game Birds	Canada goose, wood duck, mallard, cinnamon teal, common merganser, blue grouse, ruffed grouse, California quail, mountain quail, American coot, common snipe, mourning dove
Game Fish	Rainbow trout, brown trout, bull trout, brook trout
Game Amphibian	Bullfrog

Furbearers

Of the ten furbearer species, seven are known to occur on Klamath-Lake District state forest lands, including the beaver, red fox, gray fox, raccoon, marten, mink, and bobcat. The marten is also listed as a state sensitive species, critical category. The Pacific fisher is also listed as a federal candidate species and a state sensitive species, critical category.

Amphibian

The bullfrog is the only amphibian listed as a game animal. It is not known for certain to occur on state forest land.

Non-game Species

Non-game species in Oregon are divided into two categories: protected and "predatory animals" species. Protected species are defined as all non-game species that do not fall into one of the "predator animals" categories. Protected species may not be collected or taken without a Scientific Taking Permit. Predatory animals include coyotes, rabbits, rodents, and birds (starlings, house sparrows, and rock doves) that are or may be destructive to agricultural crops, products, and activities (ORS 610.002). Predatory animals may be taken at any time, with certain restrictions. In all, 234 of the species known or likely to be present on Klamath-Lake District state forest lands are categorized as non-game species. This includes 1 fish, 15 reptiles, 11 amphibians, 62 mammals, and 145 birds.

State Sensitive Species List

Under state statutes (ORS 469.012 (1)), the Fish and Wildlife Commission adopted a Sensitive Species Rule (OAR 635-100-040) in 1988 to help prevent species from qualifying for listing as threatened or endangered. This rule requires the Oregon Department of Fish and Wildlife (ODFW) to maintain a list of those naturally-reproducing native species that are likely to become threatened or endangered throughout all or any significant portion of their range in Oregon. The Sensitive Species List is a "watchlist" or early warning system. It does not mandate protection measures. These species have been highlighted for a number of reasons, most of which are related to declines in the quantity, quality, or isolation of their habitats, and/or vulnerability to competition with other species. ODFW recommends that these species receive additional management attention and support, as they are likely to be the next candidate species for formal threatened or endangered species listings. This list is updated biennially.

Twenty-eight species that are known or likely to occur on Klamath-Lake District state forest lands are found on ODFW's sensitive list, including 4 amphibians, 16 birds, 6 mammals, 1 reptile, and 1 fish. The list is broken into four categories: critical, vulnerable, peripheral, and undetermined status. The critical category is of most concern, as these are species for which listing as state threatened or endangered is pending, or those for which listing may be appropriate if immediate conservation actions are not taken. Fourteen of the 28 sensitive species are in the critical category. Of these, the following are known to occur on state forest lands: northern goshawk, white-headed woodpecker, pileated woodpecker, pine marten, flammulated owl, and black-backed woodpecker.

Threatened, Endangered, and Candidate Species

Four threatened and endangered species are known or likely to be found on Klamath-Lake District state forest lands: American bald eagle, northern spotted owl, peregrine falcon, and California wolverine. All threatened, endangered, and candidate species that are found or likely to be found on these lands are listed in Table III-4 below. The endangered shortnose and Lost River suckers were not identified as being known or likely to occur in waters within state forests. However, state forests could impact these species through the quality or quantity of water flowing from state forest lands. The water resource strategies in Section V address water quality and quantity. See the "Key Terms" box on the next page for definitions of terms related to threatened and endangered species.

Table III-4. Threatened, Endangered, and Candidate Species [1]

Federal endangered species	Peregrine falcon
Federal threatened species	Bald eagle, northern spotted owl
Federal candidate species	Foothill yellow-legged frog, Cascade frog, spotted frog, northern goshawk, mountain quail, loggerhead shrike, bull trout, Pacific w. big-eared bat, Pacific fisher, California wolverine, western pond turtle
State endangered species	Peregrine falcon
State threatened species	Bald eagle, northern spotted owl, California wolverine

1. These species are found or likely to be found on Klamath-Lake District state forest lands. Not all species in the table have been documented on state forest lands.

Of the eleven federal candidate species listed above, only the northern goshawk and mountain quail are known to occur on Klamath-Lake District state forest lands. The status of the threatened and endangered species on these lands is discussed in detail in the pages following the "Key Terms" box.

Background Information

Federal and state agencies make formal classifications of wildlife species, according to standards set by federal and state Endangered Species Acts. The various classifications are defined below. Federal designations are made by the U.S. Fish and Wildlife Service (USFWS) or the National Marine Fisheries Service (NMFS). State of Oregon designations are made by the Oregon Department of Fish and Wildlife (ODFW).

Federal Classifications

Candidate species, category 1 — Species for which there is substantial information to support listing the species as threatened or endangered; listing proposals are either being prepared or are delayed by work on higher priority species.

Candidate species, category 2 — Species for which information indicates that listing is possibly appropriate, but conclusive data are not available; additional information is being collected.

Endangered species — A species determined to be in danger of extinction throughout all or a significant portion of its range.

Proposed threatened or endangered species — Species proposed by the USFWS or NMFS for listing as threatened or endangered; not a final designation.

Threatened species — Species likely to become endangered species throughout all or a significant portion of their range within the foreseeable future.

State Classifications

Endangered species — Any native wildlife species determined by the State Fish and Wildlife Commission to be in danger of extinction throughout any significant portion of its range within Oregon; or any native wildlife species listed as endangered by the federal ESA.

Sensitive species — A watchlist, developed by the Oregon Department of Fish and Wildlife, of wildlife species that are likely to become threatened or endangered throughout all or a significant portion of their range in Oregon. Subdivided into four categories: critical, vulnerable, peripheral, and undetermined status.

Threatened species — Any native wildlife species that the State Fish and Wildlife Commission determines is likely to become endangered within the foreseeable future throughout any significant portion of its range within Oregon.

Bald Eagle

Bald eagles are common year-round residents in the Klamath Basin, with both a significant nesting population and a large wintering population. Klamath-Lake District state forest lands currently appear to play a minor role in providing habitat for this species. One nest site exists on state forest land in Sun Pass State Forest. This nest site was initially discovered in 1989 and was unoccupied at the time. The site has been surveyed annually since then and has remained unoccupied. The Bear Valley tract in the Southwest Block is adjacent to the Bear Valley Wildlife Refuge administered by the U.S. Fish and Wildlife Service. This refuge primarily provides roosting habitat for wintering bald eagles, but also has a few nest sites. State forest lands adjacent to the refuge do not provide winter roost habitat, but are probably important as a forest land buffer to prevent the encroachment of human disturbances such as subdivisions. (personal communication, Ralph Opp, 1994).

Uneven-aged management practices used in the areas just mentioned should provide a continuing supply of the large trees preferred by bald eagles for roosting and nesting.

Northern Spotted Owl

Spotted owls and Sun Pass State Forest — Starting in 1992, Oregon State University's Oregon Cooperative Wildlife Research Unit has been under contract with the Oregon Department of Forestry to conduct spotted owl surveys on state forests inside the spotted owl's range. All surveys are done to the standards required by U.S. Fish and Wildlife Service's protocol. Surveys have been conducted annually on Sun Pass State Forest since 1992. The strategy for each year's surveys has been to survey all stands scheduled for harvest in the next decade. A majority of the forest is scheduled for uneven-aged management, with a 20 year reentry period. Therefore, about half the acres and stands, well-distributed across the forest, were selected for survey. These were the stands most likely to contain suitable habitat. These same stands were surveyed in each of the 3 years. The 1992 owl survey crew marked 31 survey stations to adequately cover these stands. The same 31 survey stations were called 3 times each year.

As a result of these surveys, 3 owl pair activity centers have been located within 1.5 miles of Sun Pass State Forest. The Annie Creek and Lower Sun Creek sites are in Crater Lake National Park. The Sand Ridge site is located just east of the park boundary on the Winema National Forest.

During the three years of survey, nine owl responses were recorded. Five of these were night responses to the survey, and the other four were follow-up day responses. Seven of the responses were from the Lower Sun Creek owls. One response was from the Sand Ridge owls. The ninth response was never identified and is discussed in more detail in the next paragraph. The Annie Creek owls were never called from Sun Pass call stations.

Of the nine responses, four responses were within the forest boundary and five were in the park. Of the four on state land, all but one were right next to or within 0.25 miles of the forest boundary. The fourth response was heard on June 22, 1992, approximately 2.5 miles south of

the national park boundary near Sun Creek. The callers felt that this was a spotted owl although it did not give the standard calls. Two follow-up visits on July 23-24 and August 13-14, 1992, as well as the subsequent surveys in 1993 and 1994, failed to relocate this bird. It is the Department of Forestry's opinion that this was an immature floater that did not establish an activity center in Sun Pass.

Based on these survey results, the Oregon Department of Forestry has made the following findings.

1. Based on the survey results, spotted owls do not use Sun Pass State Forest.
2. Based on the survey results, spotted owls nesting adjacent to Sun Pass appear to avoid the forest.

Spotted owls and the Southwest Block — Three years of protocol owl surveys have also been conducted in the Bear Valley Tract. These surveys included all parcels that might be suitable owl habitat. In 1992 and 1993, these surveys were conducted by BLM personnel under a cooperative agreement with the BLM. In 1994, the survey was conducted by Oregon State University's Cooperative Wildlife Research Unit.

Three spotted owl responses were detected during the three year survey period, all in 1992. None of these responses resulted in the location of an activity center within 1.2 miles of state forest land.

Most of the land in the Southwest Block is located in the Bear Valley tract. This tract includes all the state forest land south and east of the Klamath River, west of Highway 97, and north of the California border. Most of the total land base in this area is owned by the BLM and Weyerhaeuser Company. Both have conducted owl surveys on their lands. These surveys have located one pair of spotted owls in this area on BLM land. There have been several responses by single owls, but follow-up surveys were unable to locate activity centers. In addition, an owl banded as a juvenile near Surveyor Mountain, approximately 10 miles northwest of the Bear Valley tract, was located the following year as part of a mated pair in northern California south of the Bear Valley tract.

The repeated presence of single owls that do not establish activity centers and the documented movement of the Surveyor Mountain owl indicate that this area has importance as a travel corridor. (Personal communication, Gayle Sitter, 1994)

Satellite pieces in the Southwest Block have not been surveyed by the Oregon Department of Forestry. However, nearby areas have been surveyed by Weyerhaeuser Company and BLM. One 80 acre satellite piece located on Buck Mountain has an owl pair activity center within 1.2 miles. The Buck Mountain piece is in a BLM spotted owl density study area. This pair is monitored annually as part of this study.

Spotted owls and the East Block — All state forest parcels in the East Block are outside the range of the northern spotted owl.

American Peregrine Falcon

A pair of peregrine falcons nests in the cliffs above Crater Lake. This pair has been sighted foraging in the Fort Klamath valley meadows and marshes. Sun Pass State Forest lies in a direct line between the lake and these foraging areas, so it is almost certain that these birds fly over the forest in their travels. It is unlikely that the birds fly below the canopy during these flights. Some incidental foraging may occur as they fly over the forest (personal communication, Chris Carey, 1994).

California Wolverine

Wolverines are not known for certain to occur on Klamath-Lake District state forest lands. Populations in south central Oregon appear to be on the increase, though, as evidenced by increases in confirmed sightings in recent years (personal communication, Chris Carey, 1994). Recent sightings have occurred on both sides of the Cascades in southern Oregon and have included two sightings within two miles of Klamath-Lake District state forest land, one in the North Block and one in the East Block. Wolverines are wide-ranging animals with large home ranges. This increases the probability that individuals do move through and use state forest lands periodically.

Current Programs for Fish and Wildlife

Land Use Designations

Klamath-Lake District state forest lands are classified into ten land use designations (see "Land Use Classifications" later in Section III). These designations describe the primary use of each parcel of land. One of the land use categories is called Conservancy - Critical Wildlife Habitat. This category is used to designate lands whose highest and best use is to provide fish and wildlife habitat. This designation does not preclude management; however, management activities should have as their primary objective the enhancement of habitat. The critical wildlife habitat areas on the Klamath-Lake District are described briefly below.

North Block — Three areas have been designated in Sun Pass State Forest, including 61 acres along Annie Creek, 155 acres along Sun Creek, and 143 acres along the steepest part of the escarpment that runs north-south through Sun Pass. All the conservancy areas in the North Block are Board of Forestry lands.

The areas along Sun and Annie Creeks include the creek, riparian area, and canyon sides. These areas were designated as critical wildlife habitat because of the relative scarcity and importance of water and riparian habitat in the pumice zone. These areas have not been entered by timber harvest since the forest was purchased by the state in 1944. In general, the riparian areas are in excellent condition and contain many important habitat components, including active beaver ponds, marshy beaver meadows, willow thickets, cottonwood and aspen groves, and numerous snags and down wood. The canyon sides contain dense white fir with scattered snags and large trees.

The escarpment area contains cliffs, rock outcrops, talus slopes, and scattered large trees. This area was designated as critical wildlife habitat because of the importance and scarcity of cliff and talus habitat for many wildlife species. This conservancy area also contains the only bald eagle nest tree known to occur on Klamath-Lake District state forest land. This nest tree has been unoccupied since its discovery in 1989.

East Block — There is one conservancy area in the East Block, totaling 37 acres of Common School Forest Land. This conservancy area is centered around Tamarack Spring and includes the spring itself, the surrounding wet meadow, and an adjacent wetland forested with aspen and lodgepole pine. Again, this area was designated as critical wildlife habitat because of the scarcity and importance of water and associated riparian habitat in this otherwise dry area. The spring and about 8 acres of wet meadow have been fenced to exclude livestock grazing.

Southwest Block — No critical wildlife habitat areas are located in this block.

Sun Creek Cooperative Road Closure

The Sun Creek Cooperative road closure is a gated road closure that affects approximately 7,600 acres of Sun Pass State Forest, from Highway 232 west. This closure was originally proposed by the Oregon State Police and the Oregon Department of Fish and Wildlife. The state police had concerns because of the large amount of elk poaching occurring in this area during the late fall and early winter, when elk stage here before migrating to the west side of the Cascades. Late fall is a very busy time of year for game law enforcement and this area is heavily roaded and difficult to patrol effectively. In addition, ODFW biologists were concerned about harassment to calving elk in riparian habitat near Annie Creek and Sun Creek.

The closure is implemented by a Memorandum of Understanding (MOU) between the U.S. Forest Service (Winema National Forest), the Oregon Department of Forestry, and the Oregon Department of Fish and Wildlife. The Department of Forestry and the Forest Service are the landowners, and the Department of Fish and Wildlife is the primary coordinator. Other cooperators include the Oregon Hunter's Association and the Rocky Mountain Elk Foundation, who provided materials and labor for gate construction and installation. The closure initially took effect on November 1, 1992. The MOU lists the following objectives and restrictions.

Road Closure Objectives:

1. Reduce human and vehicular harassment to elk and other wildlife during critical calving and early winter staging periods.
2. Improve law enforcement effectiveness to reduce illegal harvest of elk.
3. Reduce damage to roads.
4. Maintain access to the Diamond Lake Snowmobile Trail through the closure area.

Road Closure Restrictions:

1. The use of motorized vehicles, except snowmobiles, shall be prohibited during the period November 1 through June 30 each year.
2. Snow grooming equipment shall be permitted along designated trails during the closure period.

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3. Federal and State employees shall be permitted access into the closure while in performance of official duties.
4. Special Use Permits can be issued for authorized use during the closure period by the administering land management agency. Conditions of the permit shall restrict possession of a firearm in the vehicle and include a map showing project boundaries.
5. The agreement can be terminated upon 60 days written notice by any one of the cooperators.

Although not required by the MOU, the Department of Forestry has decided to prohibit timber sale operations during the critical May through June calving period. This restriction is included in timber sale contracts sold since the closure was implemented.

Two full closure periods have passed since the initial implementation. In June 1994, a biologist for ODFW monitored elk use in the closure area. It was determined that elk use was heaviest in the southwest portion of the closure near Annie Creek, and included use by young calves. It was estimated that a herd of 60 to 80 elk were using the area (Waterbury 1994). Before the road closure this southwest portion of the closure was heavily impacted by human and vehicle harassment. Public compliance with the closure has been excellent. There has been a significant reduction in poaching. In addition, damage to roads has been significantly reduced.

Current Timber Management Practices

The Department of Forestry's current timber management practices include the following standard practices to protect and enhance wildlife habitat.

Snags and large trees — A minimum of one large, high defect tree per five acres is designated to remain standing on a timber sale unit. These trees fulfill several roles over time, providing habitat first as live green trees, then as snags, and eventually as large, down woody debris. Many of these trees are large, cull, white firs; but all species are represented. In recent timber sales we have been able to exceed this target and have averaged nearly one of these trees per acre. High value wildlife snags are left and protected whenever possible. Marking is done to ensure that these trees are not a hazard during logging.

Cover areas — During precommercial thinning, five to ten percent of thinning areas are left in dense thickets, preferably in five acre or larger patches, to provide hiding and thermal cover.

Annual sale plans — Klamath-Lake District personnel work closely with the Oregon Department of Fish and Wildlife (ODFW) biologists in the development of annual timber sale plans. Proposed sale areas are reviewed by ODFW biologists to determine if the standard practices described above are sufficient to meet the specific wildlife needs on that site. ODFW biologist then make written recommendations to the Department of Forestry. These recommendations are followed unless they would significantly impact the management objectives, create a hazardous condition, or represent an unacceptable economic burden. (Oregon Department of Forestry 1989)

Forest Health

Introduction

A healthy forest is one in which biological or non-biological influences do not seriously threaten management goals now or in the future (Smith et al. 1994). Two examples of biological influences are insects and disease pathogens; an example of a non-biological influence is drought. A healthy forest is generally characterized as resilient to disturbances, and rich in species and landscape diversity (Joseph et al. 1991; Monnig and Byler 1992). The level of damage from insects and diseases is often considered an indicator of the relative health of a forest, when compared to historical damage levels.

The current concept of forest health takes into account the ecological complexities that contribute to insect outbreaks, disease epidemics, and widespread forest declines or diebacks. Its study involves many disciplines, especially those concerned with the physiological condition of trees, the functioning of forest ecosystems, and the ecology of insects and pathogens (Kolb et al. 1994; Wagener 1994). Restoring or maintaining forest health is usually accomplished through silvicultural manipulation of the forest at the stand or landscape level. Such manipulations can help sustain healthy, productive forests and keep damage from pests to acceptable levels.

The Klamath-Lake District state forests are in relatively good health compared to other eastern Oregon forests that have been experiencing insect and disease epidemics. This subsection describes insect and disease situations that presently occur on the state forests, as well as forest conditions that could lead to unacceptable levels of damage. Pest problems are often related to overstocking and imbalances in species composition. These stand conditions are also discussed in Section III, under the heading "Forest Products — Timber."

The Oregon Department of Forestry is the lead agency in monitoring the health of Oregon's forests and developing integrated pest management strategies for use on state managed forests (ORS 527.310 and ORS 634.122). To fulfill these responsibilities, the Department conducts annual aerial surveys and special ground surveys to detect and map areas infested with insects and pathogens. It also provides technical assistance on pest management activities implemented on state owned forest land. Here's how this subsection is organized.

Major Headings	Topics
• Forest diseases	Root diseases, dwarf mistletoe, rust diseases, decays, foliage diseases, effects of drought, summary of important diseases by tree species
• Forest insect pests	List of commercial tree species, with information on the complex of pests affecting each species
• Management of forest health	General recommendations for managing forest health
• Management recommendations for diseases	Specific strategies, listed by tree disease
• Management recommendations for insects	Specific strategies, listed by insect

Forest Diseases

On the Klamath-Lake District state forest lands, the most important diseases affecting trees are caused by pathogens native to North America, with the exception of white pine blister rust. These native pathogens are an integral part of forest ecosystems, and have varying influences on forest vegetation. Pathogens kill trees, cause growth loss, decay wood, contribute to blowdown, increase susceptibility to insects and environmental stress, and significantly alter the species composition, tree cover, stocking, and structural diversity of stands (Baker 1988).

The effects of native pathogens on ecosystems can be viewed as positive, negative, or neutral depending on management objectives. Root diseases kill trees and reduce wood production, but the resulting canopy gaps may provide important wildlife habitat. Dwarf mistletoes decrease tree growth but provide food and habitat for certain animals, particularly birds. Wood decay fungi destroy wood, but the hollow trees provide habitat for numerous birds and mammals. A healthy forest is not necessarily one that is free of diseases or other pests, but one that fluctuates within a range of conditions that permits achieving overall ecosystem management goals.

Introduced pathogens, in contrast to native pathogens, may have a very unbalanced effect on forests. Because of the lack of co-evolved tolerance in host trees, introduced pathogens can have unusually dramatic effects on forests. An example is white pine blister rust, which has nearly eliminated western white pine from many western ecosystems (Scharpf 1993).

Although most diseases and the type of damage they cause are not new, the *amount* of damage they cause may well have changed since the turn of the century. Many current landscapes in the Klamath-Lake District reflect the effects of fire exclusion and harvesting practices on stand species composition, stand structure, and competition for nutrients and water. Several areas are dominated by shade-tolerant and fire-intolerant tree species, particularly white fir, which are generally more susceptible to diseases than seral species (Filip 1994). In addition to changes in

Key Terms

Host — An organism on or in which another organism (called a parasite) lives for nourishment or protection.

Inoculum — Material such as bacteria, viruses, or spores that implant themselves in another organism, infecting that organism and causing disease.

Pathogen — Any agent that can cause disease.

Saprophyte — Any organism that lives on decaying organic matter, such as some fungi and bacteria.

species composition resulting from fire exclusion and selective harvesting, the absence of fire has allowed an increase in the density of trees and shrubs. Because of their increased abundance, plants compete for limited site resources, which can induce stress or less than optimum growing conditions for trees. The recent drought conditions of the past eight years have exacerbated these effects.

Root Diseases

Armillaria Root Disease

Armillaria root disease, caused by *Armillaria ostoyae*, is by far the most damaging root disease on the Klamath-Lake District. *A. ostoyae* causes mortality, growth loss, decay, and loss of silvicultural options. It is particularly damaging in certain areas of Sun Pass State Forest.

All conifers can be infected by *A. ostoyae*, but there is considerable variability in resistance among conifer species. On the Klamath-Lake District, grand fir, Douglas-fir, and sugar pine all appear highly susceptible; but ponderosa pine, incense cedar, lodgepole pine, and hardwoods appear very resistant. Resistant species are killed occasionally by the pathogen, usually when inoculum levels are very high or other stresses (such as drought or nutrient imbalance) reduce resistance.

A. ostoyae is long-lived and can survive in roots or stumps of dead trees for decades. Sites remain infested until the fungus dies out or is mechanically removed. Factors that stress trees, such as compaction, drought, or root injury, increase the severity of armillaria root disease (Filip and Schmitt 1990; Shaw and Kile 1991).

A. ostoyae is a very efficient saprophyte, readily colonizing dead root systems. Stumps created during harvesting provide a food base from which the pathogen can grow and attack nearby uninfected roots. Small patches of salvage harvest often create the ideal situation for the fungus to spread into adjacent parts of the stand (Shaw and Kile 1991).

Sun Pass was surveyed by aircraft in 1988 to map location of armillaria root disease patches. The disease occurred in obvious patches in the mixed conifer climax cover type and was concentrated in the northwest corner of Sun Pass (maps are on file at the Klamath-Lake District office). Very little armillaria root disease has been observed in either the ponderosa pine or lodgepole pine cover types. The disease also occurs on scattered trees or small groups of trees throughout the forest, where it has not developed into expanding disease centers. The different behaviors can be related to variations within the fungus, population site factors, and stand composition (McDonald et al 1987; Shaw and Kile 1991).

Occurrence and severity of armillaria root disease has probably increased in recent decades for several reasons, listed below and on the next page.

1. Exclusion of fire has allowed a proliferation of shade-tolerant tree species, which are highly susceptible to the disease.
2. Selective logging of ponderosa pine has allowed an increase in susceptible tree species, particularly true fir.

3. Improper salvage logging on armillaria-infested sites has encouraged a build-up of inoculum.
4. Overstory removal (diameter limit cuts) has resulted in conversion to white fir and Douglas-fir, both of which are highly susceptible.
5. Overstocking has allowed more efficient root to root spread and a build-up of inoculum. There is also some evidence that fire, which is currently excluded, may have had a suppressive effect on *A. ostoyae* (Reaves et al. 1984).

The effects of *A. ostoyae* on timber production are generally negative. The disease also severely limits silvicultural options. Overall long-term productivity likely will be reduced even if resistant species are established, because they will experience some growth loss and mortality. Infested sites generally will have a higher silvicultural maintenance cost to keep the desired species composition and stocking levels, and may require additional monitoring efforts compared to uninfested stands.

Sites infested with *A. ostoyae* are characterized by an abundance of snags, down logs, and a generally open appearance, unless salvage logging has occurred. This structural and biological diversity might be considered a positive effect under certain objectives.

Several areas on Sun Pass that are infested with *A. ostoyae* have been harvested during the past ten years. These harvests removed susceptible trees and improved stand density, while favoring (or establishing) resistant species. Monitoring the effectiveness of these activities will provide a basis for future silvicultural decisions.

Annosum Root Disease

Annosum root disease is caused by the fungus *Heterobasidion annosum*. Two strains of the fungus occur in southern Oregon near the Klamath-Lake District: the s-group, and the p-group. The s-group attacks primarily true firs, and the p-group attacks primarily ponderosa pine (Hessburg et al 1994). Although the p-group has been documented on federal land in Klamath County, it has not been observed on the state forests. However, the s-group does occur on the Klamath-Lake District, and will be the focus of the following comments.

H. annosum has two means of spread: by growing from root to root across root contacts, and by windblown spores that germinate and grow into freshly cut stump surfaces or wounds that expose wood. Disease usually develops in a stand after harvesting when fresh stumps are colonized and the fungus grows throughout the root system and into neighboring trees via root contacts. The result is slowly expanding disease patches. Colonization of trunk wounds usually results in decay and not the development of disease centers.

Annosum root disease usually occurs at very low levels in unmanaged stands. Disease occurrence increases as the number of partial cut entries increase, particularly in mixed conifer stands (Schmitt et al 1984). On the Klamath-Lake District, Annosum root disease presently is not common and damage appears very low. However, continued partial cutting in true fir is expected to increase occurrence of this disease (Schmitt et al 1991).

Annosum root disease is strongly associated with the fir engraver beetle (*Scolytus ventralis*). During non-drought years, the beetles preferentially attack root-diseased trees, and the resulting mortality is considered a result of this pest complex. Increases in the occurrence of

annosum root disease could result in increased mortality from this complex, whereas the disease alone may not have caused a noticeable impact (Herter et al 1975; Lane and Goheen 1979; Miller and Partridge 1974). As with armillaria root disease, annosum root disease results in true fir snags and down woody material, and can be considered beneficial at certain levels. Because *H. annosum* is a decay fungus, butt logs often contain substantial decay, and infected trees often blow down.

Other Root Diseases

Schweinitzii root and butt rot, caused by *Phaeolus schweinitzii*, has been observed on the Klamath-Lake District in Douglas-fir, true fir, sugar pine, and ponderosa pine. It is most common in very old trees. The fungus causes a brown cubical decay of roots and butt in mature and overmature trees, and can predispose a tree to failure during heavy wind (Aho 1982). Hollow butts could provide habitat for certain wildlife species. Tree mortality from *P. schweinitzii* is rare on Klamath-Lake District, and the disease therefore is of minor concern.

Laminated root rot, caused by *Phellinus weirii*, is a regionally important root disease of conifers, particularly the true firs and Douglas-fir, but it has not been observed on Klamath-Lake District.

Black stain root disease, caused by *Leptographium wagnerii,* is very damaging to ponderosa and sugar pine in the Sierra range of California, and recently has been observed in ponderosa pine on the Malheur National Forest in Oregon. It has not been observed in or near Klamath-Lake District.

Dwarf Mistletoe

Dwarf mistletoes are parasitic seed plants in the genus *Arceuthobium* that infect many conifer species by means of forcibly discharged seeds. They cause tree mortality, growth loss, deformation of tree form and crown structure, and reduced seed production (Hawksworth and Wiens 1972). Infected trees are predisposed to damage from other stressors such as drought and bark beetles (Weir 1977). Dwarf mistletoes are probably responsible for the greatest tree growth loss on Klamath-Lake District. However, they can have positive effects by providing food and habitat for certain wildlife species (Sever et al 1991; Bull and Henjum 1990).

Dwarf mistletoes are very host-specific. Each dwarf mistletoe species usually causes significant damage only in a single tree species (with a few exceptions). Four species of dwarf mistletoe are known to occur on Klamath-Lake District. They are listed below, and discussed in detail in the next several pages.

1. Western dwarf mistletoe (*Arceuthobium campylopodum*): primarily infects ponderosa pine.
2. American dwarf mistletoe (*Arceuthobium americanum*): primarily infects lodgepole pine.
3. White fir dwarf mistletoe (*Arceuthobium abietinum f.sp. concoloris*) infects white and grand fir.
4. Douglas-fir dwarf mistletoe (*Arceuthobium douglasii*). Douglas-fir dwarf mistletoe occurs only in the Bear Valley tract.

A survey conducted by the Oregon Department of Forestry in 1976 indicated broad distribution of dwarf mistletoe throughout the ponderosa and lodgepole type islands, and a localized occurrence of white fir dwarf mistletoe. That survey also reported sugar pine dwarf mistletoe (*Arceuthobium californicum*) in one type island, but the validity of that observation has been questioned (Weir 1980). Red fir dwarf mistletoe *(Arceuthobium abietinum f.sp. magnificae)* likely occurs at the north end of Sun Pass near the Crater Lake National Park boundary, but this has not been verified.

Although limited long-distance spread occurs (Nicholls et al 1984), the most important type of spread of dwarf mistletoe is from infected overstory trees to susceptible understory trees. The severity of mistletoe infection increases most rapidly in single species overstocked stands with multiple canopy layers (Parmeter 1978; Scharpf and Parmeter 1976). However, in even-aged stands on good sites, where densities allow rapid height growth, infected host trees can grow vigorously, provided mistletoe is confined to the lower crown (Roth and Barrett 1985; Barrett and Roth 1985).

During the 1990 inventory of the Klamath-Lake District state forests , all trees tallied were given a Dwarf Mistletoe Rating (DMR) using the Hawksworth six class system (Hawksworth 1977). The amount of growth reduction depends on the amount of infection, and is correlated well with the DMR (Hawksworth and Johnson 1989). The Forest Vegetation Simulator, which was used to model stand growth on the Klamath-Lake District, uses the DMR to modify growth of infected trees and to simulate intensification of the disease over time.

Western Dwarf Mistletoe

Western dwarf mistletoe (*A. campylopodum*) occurs throughout the ponderosa pine type on Klamath-Lake District at various levels of intensity (Weir 1980). In areas with high levels of infection (DMR 5-6), pine volume growth could be less than 50 percent of normal, and significant mortality of older trees could be occurring (Hawksworth and Geils 1990). In addition, heavily infested stands may have a higher risk of catastrophic fire because infested trees are often short, and contain large brooms and pitchy branches that serve as fuel ladders to the canopy (Koonce and Roth 1980; Parmeter 1978). Heavily infected trees produce large brooms that may provide habitat for bird and animal species (Sever et al 1991; Bull and Henjum 1990).

Western dwarf mistletoe is very host-specific, and although it can infect some other conifer species, significant damage occurs only on ponderosa pine. This species of mistletoe thrives in stands with a dominant component of ponderosa pine. Spread and intensification of this dwarf mistletoe are highest in multi-storied stands of pine with infected overstory trees (Hawksworth and Scharpf 1984).

In some areas on Klamath-Lake District, damage from dwarf mistletoe has increased as result of selective harvesting without sanitation and the development of overstocked stands. However, current management includes sanitation and selection of resistant tree species during partial cutting or thinning, which should improve stand health in many situations.

Historically, western dwarf mistletoe was maintained on many sites because frequent low-intensity ground fires perpetuated its primary host, ponderosa pine. However, fires also reduced the amount of dwarf mistletoe as fires torched brooms in lower branches and killed heavily broomed overstory trees, which resulted in less inoculum in the overstory (Alexander and Hawksworth 1975). The exclusion of fire can allow intensification of dwarf mistletoe by allowing the survival of large numbers of susceptible understory trees that would otherwise have been killed by fire (Tinnin 1984).

High levels of resistance to mistletoe infection exist within native populations of ponderosa pine in Oregon, which may offer some future management opportunities (Scarpf and Roth 1992).

American Dwarf Mistletoe

The most severe infestations of American dwarf mistletoe occur in the northeast and northwest portions of Sun Pass State Forest (Weir 1980). Heavily infected trees suffer severe growth loss and produce dense brooms that may offer habitat to some bird or animal species. Clearcut harvests have reduced the dwarf mistletoe population in some areas.

In the lodgepole pine climax series, the amount of dwarf mistletoe is correlated with the bark beetle/fire cycles characteristic of the series. When fire patterns left scattered islands of infested trees, invasion of the new stand was rapid. After large intense fires (or large clearcuts), invasion was slower, and originated from the edge of the stand or from long distance transport of seeds by birds and mammals (Nicholls et al 1984; Hawksworth and Johnson 1989). The suppression of fire, coupled with bark beetle outbreaks that killed larger trees and left smaller infested trees, often created a stand structure conducive to dwarf mistletoe intensification (Alexander and Hawksworth 1975). Occurrence of American dwarf mistletoe should decrease as existing lodgepole stands come under management.

White Fir Dwarf Mistletoe

White fir dwarf mistletoe is less obvious than the other mistletoes because the plants are small and do not cause large brooms. However, the associated canker fungus, *Cytospora abietinum*, causes branch flagging, which can be highly noticeable (Filip 1984). White fir dwarf mistletoe is not widespread in Sun Pass, and is concentrated in the north-central portion (Weir 1980). It also occurs on the Yainax Butte tract.

White fir dwarf mistletoe causes significant growth loss in true fir (Filip 1984), and infested trees are more susceptible to attack by fir engraver than uninfested trees (Stevens and Hawksworth 1984). With continued fire exclusion and a proliferation of true fir, dwarf mistletoe occurrence is expected to increase in white fir.

Douglas-Fir Dwarf Mistletoe

Douglas-fir dwarf mistletoe occurs only in the Bear Valley tract. The pathogen causes large visible brooms that act as nutrient and water sinks, which can severely impact growth and survival of Douglas-fir. Heavily infested trees often exhibit top-kill and branch dieback. The large dense brooms offer habitat for birds and animals, providing nesting, roosting, and hiding cover (Bull and Henjum 1990). In this respect, Douglas-fir dwarf mistletoe might be considered beneficial and desirable.

Rust Diseases

White Pine Blister Rust

White pine blister rust is caused by the fungus *Cronartium ribicola*, which was introduced from Europe into British Columbia in 1910. By 1930 the disease had spread south through Oregon and into California. Because the pathogen did not co-evolve with white and sugar pines, it encountered little resistance and decimated both white and sugar pines throughout their range (Kimmey and Wagener 1961).

C. ribicola has a complex life cycle that involves five different spore stages and two different host plants. The primary hosts are the five-needle pines, and the secondary hosts are plants of the gooseberry family (*Ribes spp.*). Only spores produced on *Ribes* can infect pines.

The amount of damage sustained by sugar pine depends on several factors, including proximity to *Ribes* plants, microclimate, rainfall, and temperature. *Ribes* is commonly associated with sugar pine, and is particularly abundant in moist areas (DeNitto 1986). Rainfall and temperature exert strong influence on whether or not infection of pine occurs. Many years may pass without conditions suitable for infection, but in years where conditions are particularly favorable, infection and subsequent damage can be very high (Mo-Mei and Cobb 1991; Kimmey and Wagener 1961). Years in which high infection rates occur are often referred to as wave years. Based on observations of the occurrence of rust cankers and abundance of *Ribes*, it appears that rust hazard generally is very low on Klamath-Lake District state forests. However, moist stream bottoms likely offer a relatively higher hazard than other sites, and management activities and weather can significantly alter rust hazard (DeNitto 1986).

Resistance in sugar pine is attributed mainly to a single dominant major gene (referred to as major gene resistance, or MGR), although other mechanisms also exist. MGR is the most important mechanism because it is highly heritable, which allows propagation of resistant trees. However, this gene occurs very infrequently in the natural sugar pine population near Sun Pass and on other Klamath-Lake District lands, occurring in only 1 in 100 individuals (Kinloch 1992).

One race of *C. ribicola* that occurs in the vicinity of Happy Camp, in northern California, can attack and kill sugar pine that have major gene resistance. However, this strain has not been found in Oregon (Kinloch and Dupper 1987).

Although mature sugar pine may either escape infection or exhibit some age-related resistance, young sugar pine are particularly susceptible to the disease. As a consequence, replacing trees lost to natural causes or harvesting can be difficult, which jeopardizes the future of sugar pine as an important minor component of Klamath-Lake District ecosystems. Special measures such as hazard rating, pruning, and planting resistant seedlings will be necessary to ensure its continued presence in various ages and sizes.

In 1992, the Department of Forestry, in cooperation with the U.S. Forest Service Dorena Tree Improvement Center, established a study to assess the performance of sugar pine seedlings that have varying degrees of resistance to white pine blister rust. Information from this study

will also provide some information about how to assess rust hazard. The Klamath-Lake District has also collected seed from apparently rust-resistant forest trees on Sun Pass, and is having this seed tested for resistance at the Dorena Tree Improvement Center in Cottage Grove, Oregon.

Western Gall Rust

Western gall rust is a disease of two- and three-needle pines caused by the fungus *Endocronartium harknessii.* It damages trees by either killing seedlings directly, or by causing stem deformation, which can result in wind breakage or loss of wood quality. It is a native pathogen, and spreads directly from pine to pine by airborne spores.

On the Klamath-Lake District, lodgepole and ponderosa pine are affected, but the disease is most common on lodgepole pine. Infection rates tend to be highest on rapidly growing trees and damage is often greatest in even-aged, well-spaced plantations (Finck et al 1991). Because this is a native pathogen, some resistance exists within the population of pines.

Decays

Several decay fungi affect the tree species on Klamath-Lake District state forests. The most common and most important decay is rust red stringy rot, caused by the fungus *Echinodontium tinctorium*, often referred to as Indian paint fungus. It primarily affects white and red fir. Indian paint fungus spreads when airborne spores released from conks infect host trees through small branchlet stubs formed on suppressed understory trees. As the infected tree expands in diameter, the infections become encased and remain dormant for many years. The decay process is stimulated by mechanical injuries, frost cracks, or insect attacks that occur near the dormant infections (Filip et al 1983).

The highest rates of Indian paint fungus infection and decay occur in uneven-aged stands in which white fir develops under a closed canopy. Overstory removals and the exclusion of ground fires favor increased occurrence of the disease. Trees greater than 150 years old tend to have more decay than younger trees, and large wounds result in more decay than small wounds. Decay caused by this fungus can be stimulated by fir engraver beetle attacks.

Indian paint fungus is the primary cause of cull white fir trees on Klamath-Lake District, but decay in standing live trees and down logs also provides roosting and nesting opportunities for a variety of wildlife species. Frequency and amount of decay can be reduced through management. However, overly aggressive management could have a negative impact on habitat availability for certain wildlife species.

Heterobasidion annosum is the most common wound-invading decay organism in white and red fir. Its occurrence and severity is directly related to the amount of tree wounding that occurs in a stand. *Phellinus pini,* also called white speck or red ring rot, can be damaging in Douglas-fir, but occurs at very low levels on Klamath-Lake District. Brown cubical rot, caused by *Phaeolus schweinitzii,* causes a butt rot in most conifers, but appears to be of minor importance on Klamath-Lake District.

Foliage Diseases

Numerous foliar pathogens attack conifers on Klamath-Lake District state forests. However, most are of little economic or ecologic importance. These pathogens typically increase in abundance during years when conditions are conducive to disease development, then quickly subside. Some examples include *Lophodermium spp.* and *Lophodermella spp.* on pines, and *Rhabdocline spp.* on Douglas-fir.

One disease, Elytroderma needle blight of ponderosa pine (caused by *Elytroderma deformans*), can have a significant impact on tree growth because the pathogen grows into the twig, where it can persist and deform branches. The most noticeable symptom is compact upward-turning witches brooms at branch ends (Childs 1968).

On moist cool microsites that favor infection, *E. deformans* can cause growth reductions in excess of 50% in mature trees. Young trees can be permanently stunted and deformed. Heavily infected trees are also subject to bark beetle attack (Childs 1968). Although not clearly documented, there may be resistant individuals within the population of ponderosa pine.

Effects of Drought

The effects of drought on trees are cumulative. Several years of subnormal moisture can severely compromise tree vigor and the associated ability to withstand attacks by pathogens and insects. Similarly, the effects of overstocking will be magnified during drought years. As a result, tree mortality usually increases during and shortly after a drought period. An example of this is the current mortality on Klamath-Lake District state forests caused by the fir engraver, mountain pine beetle, and armillaria root disease.

Summary of Important Diseases, by Tree Species

White Fir

Across most Klamath-Lake District lands, white fir is currently the tree species most damaged by disease. It is highly susceptible to both armillaria and annosum root diseases. Indian paint fungus causes extensive decay, particularly in trees more than 120 years old. Dwarf mistletoe and the associated *Cytospora* canker are damaging in some locations. White fir is very susceptible to decay following mechanical injury. Periodic harvests that create stumps and wounds on residual trees would probably increase the amount of decay and the occurrence of annosum root disease in the future (Filip and Schmitt 1990).

Douglas-Fir

Douglas-fir appears very susceptible to armillaria root disease on Klamath-Lake District lands. In the Bear Valley tract, dwarf mistletoe is its most damaging disease. In trees older than 150 years, brown cubical butt rot (*P. schweinitzii*) and red ring rot (*P. pini*) may occur.

Sugar Pine

The most important diseases of sugar pine on Klamath-Lake District state forests are white pine blister rust and armillaria root disease. Sugar pine is highly susceptible to *Armillaria* and is severely damaged on infested sites. Although hazard for blister rust damage is generally low, damage during wave years could be severe, particularly in young trees. Sugar pine is sensitive to moisture stress (drought effects), and mortality from *Armillaria* and bark beetles appears to increase during drought years. Other diseases of sugar pine are of minor importance.

Ponderosa Pine

The disease most damaging to ponderosa pine on Klamath-Lake District lands is western dwarf mistletoe, which occurs throughout the pine type. The disease causes growth loss and mortality, reduces wood quality and seed production, and predisposes trees to bark beetle attack. In many areas past logging practices have allowed dwarf mistletoe to increase in severity, as infected trees were retained in the overstory and sites became overstocked. Recent activities have included sanitation thinning and well-reasoned tree selection, which have improved the situation in many areas.

Ponderosa pine is one of the conifers most resistant to armillaria root disease, and is favored in *Armillaria*-infested sites. However, it is occasionally damaged in *Armillaria* disease patches, usually when inoculum density is high, or when other stress occurs.

Numerous other diseases affect ponderosa pine, and some, particularly foliage diseases, can be very noticeable (Hepting 1973). However, none have been particularly important on the Klamath-Lake District.

Lodgepole Pine

The two most important diseases of lodgepole pine on Klamath-Lake District lands are American dwarf mistletoe and western gall rust. Lodgepole pine appears to have some resistance to armillaria root disease, and is a desirable species in areas infested with *A. ostoyae*.

Red Fir

Dwarf mistletoe and stem decay (particularly *E. tinctorium*) are the most important diseases of red fir. Although red fir is susceptible to annosum root disease, it has not been observed in red fir on Klamath-Lake District lands.

Incense Cedar

The most common and damaging disease of incense cedar is heart rot caused by *Polyporus amarus*, which can account for significant cull in logs. Other diseases, such as *Gymnosporangium* rust and leafy mistletoe (*Phoradendron sp*.), can be conspicuous, but are seldom damaging (Hepting 1971). Incense cedar appears resistant to armillaria root disease (Filip 1977), and therefore might have some utility in areas affected by root disease.

Black Cottonwood

The most important diseases of cottonwood are stem cankers and foliage diseases, which can be particularly damaging to young trees. Damage is most severe when stock is poorly suited to the local environment. Cottonwood is very susceptible to decay following wounding.

Quaking Aspen

Aspen is frequently decayed by *Phellinus tremulae*, which causes a soft yellowish decay of the central core of the trunk. Aspen is very prone to decay following wounding.

Forest Insect Pests

Aerial survey records spanning nearly fifty years indicate that bark beetles are the insects most commonly associated with tree mortality in eastern Oregon. Bark beetles act as natural thinning agents for overstocked stands (too many trees per acre), and they initiate the release of nutrients locked in fallen and diseased trees. Over the last decade in Klamath County, tree mortality from bark beetle attacks has increased dramatically (Oregon Department of Forestry, 1969-1994). The three figures on the next two pages depict the trends graphically. Factors predisposing stands to bark beetle outbreaks are overstocking, disease, weather damage, and drought. Recurring drought coupled with bark beetle outbreaks are the major natural disturbance affecting forest health in Klamath County (see "Climate" and "Biodiversity" earlier in Section III).

A human-made factor contributing to stand overstocking and bark beetle outbreaks is fire suppression on forest land. Fire control has increased the survival of all young trees and allowed tree species once excluded by fire to colonize drier sites (see "Vegetation" and "Biodiversity" earlier in Section III). Both drought and the cumulative effects of fire suppression are responsible for the major bark beetle outbreak now occurring in white fir stands. During the past decade, the level of white fir mortality in Klamath County has exceeded historic norms and developed into a major forest health problem, particularly from the standpoint of fuels build-up and the potential for catastrophic fire.

In addition to bark beetles, defoliating insects such as the Modoc budworm, Douglas-fir tussock moth, and black pine leaf scale also occur in Klamath County (Oregon Department of Forestry, 1969-1994). These insects feed on the foliage of conifers during outbreaks lasting several years. Typical defoliator outbreaks reduce tree growth, damage tree form, and in some instances cause tree mortality.

Each tree species has a complex of insects that may interfere with management objectives, particularly commodity production. These insects are often referred to as pests. On the pages following the three graphs, there is a list of the commercial tree species on Klamath-Lake District, with a discussion of the complex of insect pests affecting each species. Stand conditions that promote pest activity are also discussed.

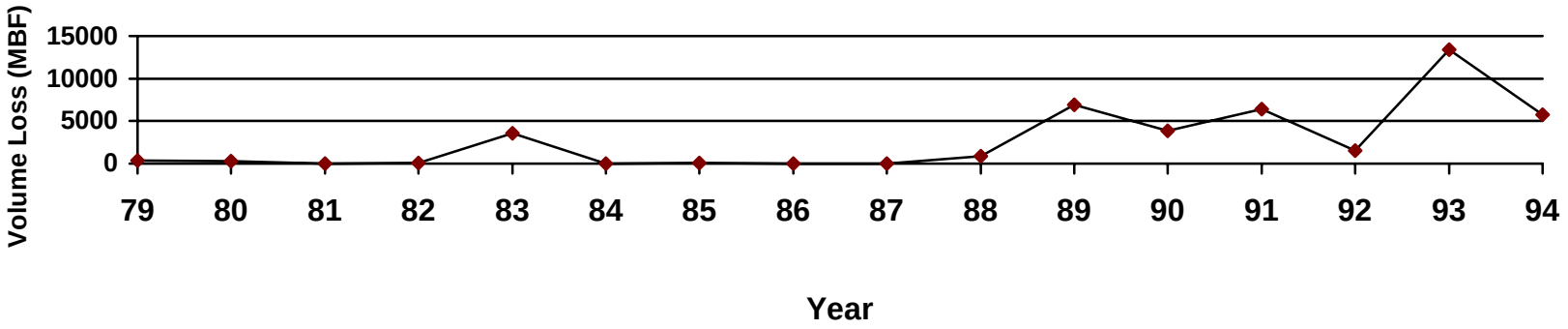

Figure III-5. Fir Engraver Damage to White Fir in Klamath County

The most important bark beetle attacking white fir is the fir engraver beetle (*Scolytus ventralis*).

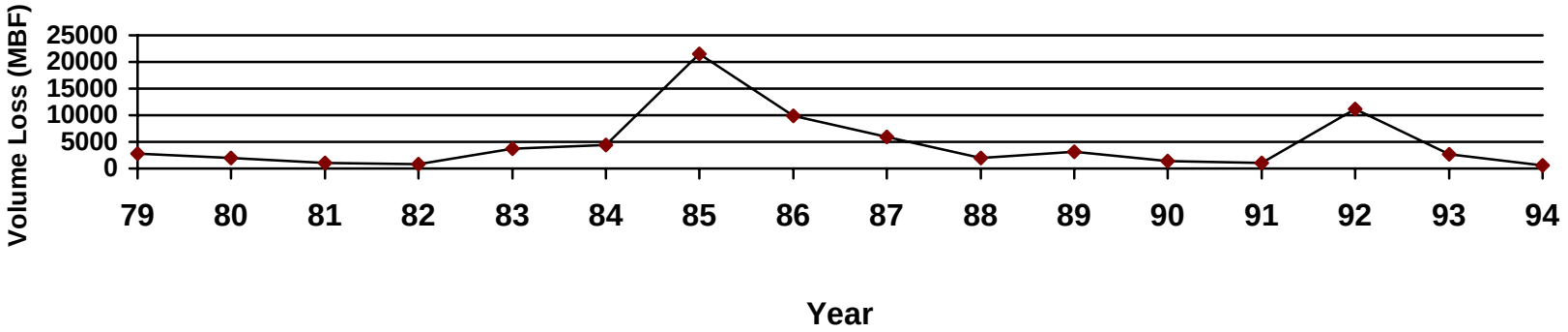

Figure III-6. Mountain Pine Beetle Damage to Ponderosa Pine in Klamath County

The mountain pine beetle (*Dendroctonus ponderosae*) is one of the three major bark beetles attacking ponderosa pine.

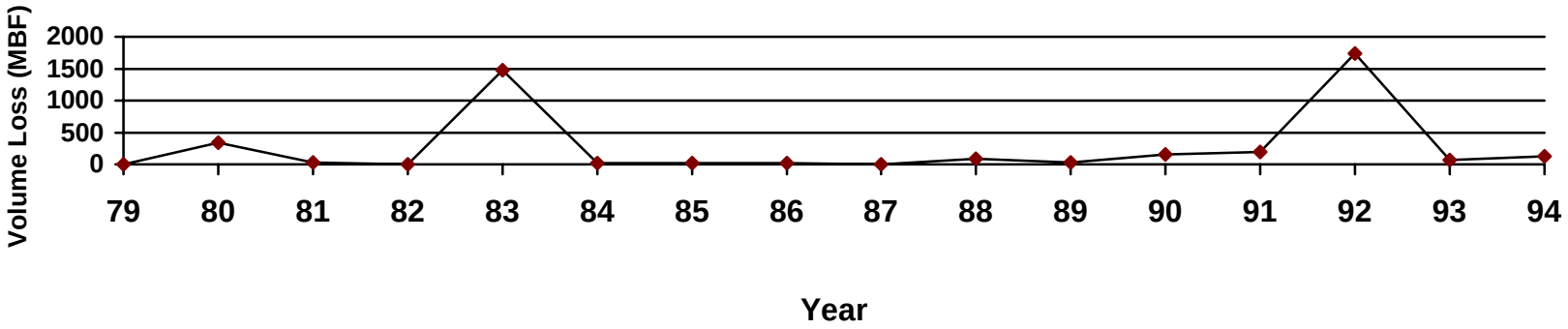

Figure III-7. Mountain Pine Beetle Damage to Sugar Pine in Klamath County

Mountain pine beetle (*Dendroctonus ponderosae*) is the most important insect pest of sugar pine.

Ponderosa Pine

Competition between trees for light, moisture, and nutrients is critical in determining the growth, vigor, and survival of pines. As trees increase in size, fewer and fewer can be supported by the resources available on a given acre of ground (Peet and Christensen, 1987). Before the turn of the century, fire acted as a natural thinning agent in young ponderosa pine stands (Weaver 1943). Without the benefit of periodic thinnings, ponderosa pine stands quickly increase in susceptibility to bark beetles (Eaton 1941, Sartwell and Stevens 1975). Tree diameter growth slower than 1.0 inches per decade is typical of ponderosa pine susceptible to bark beetle attack (Sartwell 1971). Studies in ponderosa pine stands have identified basal areas of 120-150 square feet per acre with a risk of bark beetle infestation (Sartwell and Stevens 1975, Larsson and others 1983, Schmid and Mata 1992). During drought, overstocked stands of ponderosa pine are also vulnerable to high levels of tree mortality from bark beetles (Miller and Keen 1960). Ponderosa pine is the major component of most pine stands occurring on state-managed forest land (see "Vegetation" earlier in Section III). At present, many of these ponderosa pine stands can be classified as overstocked and at risk from bark beetle infestations.

The major bark beetles attacking ponderosa pine are the mountain pine beetle (*Dendroctonus ponderosae*), the western pine beetle (*Dendroctonus brevicomis*), and the pine engraver beetle (*Ips pini*). The mountain pine beetle most frequently infests ponderosa pines with a DBH (diameter breast height) greater than 8 inches that are located in overstocked stands (Sartwell and Stevens 1975). Site class has a major influence on the character of tree killing by the mountain pine beetle (Sartwell 1971). See the "Background Information" box below for an explanation of site class. On Site Class III areas, mountain pine beetle infestations constitute a thinning from below. Tree killing is essentially indiscriminate in regard to diameter classes on Site Class IV areas. On Site Class V or poorer areas, however, beetle attacks act as a thinning agent from above.

Background Information

Site class is a measure of an area's relative capacity for producing timber or other vegetation. It is measured through the site index. The site index is expressed as the height of the tallest trees in a stand at an index age (King 1966). In this document, an age of 50 years is used. Site indexes for Klamath-Lake District state forests are given in Table III-2, on page III-12. The 5 site classes are defined below.

Site class I — 135 feet and up

Site class II — 115-134 feet

Site class III — 95-114 feet

Site class IV — 75-94 feet

Site class V — Below 75 feet

The western pine beetle has 2-3 generations per year in eastern Oregon and is a significant pest of pines with a DBH greater than 6 inches (DeMars and Roettgering, 1982). This beetle is noted for killing large old growth ponderosa pine and was responsible for much of the mortality in bald eagle nest trees around the shore of Klamath Lake from 1990-1993. Overstocked stands of ponderosa pine growing on harsh sites are considered at particular risk for western pine beetle infestations. High risk sites on Klamath-Lake District occur where ponderosa pine is growing in association with western juniper, incense cedar, or mountain mahogany. Western pine beetle outbreaks often develop during drought periods (Miller and Keen, 1960).

Like the other ponderosa pine bark beetles, the pine engraver beetle can act as a thinning agent in overstocked stands. Typically the trees attacked are sapling or pole-sized pine down to 2-8 inches in diameter; the trees may have been damaged by wind, snow breakage or fire. Pine engraver beetles are especially aggressive in drought years and kill the tops of older pines, while the lower boles are attacked by other species of bark beetles. Populations of this beetle can build up rapidly under favorable conditions since there are 2-3 generations per year (Sartwell and others, 1971). The pine engraver beetle can also be a pest in managed ponderosa pine stands. A problem develops when beetle populations breed in thinning slash and attack leave trees.

Defoliating insects have not been significant pests of ponderosa pine in Klamath County. However, there have been localized outbreaks of black pineleaf scale (*Nuculaspis californica*) and the pine needle scale (*Chionaspis pinfoliae*) in the vicinity of Keno and Klamath Lake. The repeated loss of older needles as a result of scale feeding causes the tree's crown to deteriorate. Eventually the effects of defoliation or bark beetle attacks kill badly infested trees. Scale outbreaks are often associated with environmental conditions that are detrimental to the scale's complex of natural enemies. These conditions include accumulations of dust on foliage from roads and insecticide drift from nearby vector control or orchard operations (Ferrell 1986a). Drought conditions may also favor scale outbreaks. Tree mortality from scale infestations often occurs in overstocked stands of pole-sized pines with poor live crown ratios.

White Fir

The current drought has been associated with a dramatic increase in white fir mortality on the Klamath-Lake District. Similar tree mortality on the nearby Modoc National Forest has been correlated with white fir growing on pine or pine-associated sites that receive 20-30 inches of annual precipitation (USDA Forest Service 1994). The most important bark beetle attacking white fir is the fir engraver beetle (*Scolytus ventralis*). During 1993 fir engraver infestations occurred on over 180,000 acres of Klamath County forest land (Oregon Department of Forestry, 1969-1994). Endemic fir engraver populations infest trees weakened by root disease or injury. Fir engraver outbreaks occur in the year following a period of subnormal precipitation or logging activity (Ferrell 1973). Logging activity increases the probability of fir engraver attacks because the beetles can breed in fresh slash and emerge the following year to attack leave trees with low vigor. Recent data suggests that stands with high basal areas and a large component of white fir suffer greater mortality

from fir engraver attack during periods of drought. In drought-related outbreaks it is often the dominant or codominant trees that are killed (Ferrell and others, 1994). Tree symptoms from fir engraver attacks are variable and include dead branches, top kill, and complete tree mortality (Ferrell 1986b). Fir engraver attacks that do not produce tree mortality cause scars that persist for years. Old attack scars are associated with defects such as stain, ringshake, and decay, which reduce the value of white fir for solid wood markets (Struble 1957). Pockets of white fir that are dead and dying from fir engraver beetle attack are scattered throughout Klamath-Lake District lands. Some mixed pine and white fir stands in the Yainax Butte area have high levels of white fir mortality.

The most common defoliating insect associated with white fir in Klamath County is the Modoc budworm (*Choristoneura viridis*). Between 1982 and 1987 a Modoc budworm outbreak defoliated up to 210,000 acres of white fir stands (Oregon Department of Forestry, 1969-1994). Defoliation was observed on state forest lands in the Yainax Butte area. Modoc budworm outbreaks normally last from 3 to 4 years. This insect's feeding is concentrated in the new foliage located in the tops of white fir. Impact studies indicate that about 10% of defoliated trees suffer top kill, and radial growth loss is confined to the upper bole where defoliation is taking place. White fir mortality from Modoc budworm infestations has not been detected (Ferrell, 1980a).

The Douglas-fir tussock moth (*Orgyia pseudotsugata*) is potentially the most serious defoliator of white fir, and it has a history of outbreaks in Klamath County. One historic outbreak area is located 20 miles north of Klamath Falls and east of Highway 97 on Chiloquin Ridge. The last tussock moth outbreak took place in 1978 on Bryant Mountain located east of Klamath Falls. State forest lands that are east of Highway 97 and have a large white fir component are at the greatest risk of infestation. Outbreaks develop explosively with both new and old foliage consumed, starting in the upper crown and working downward. Uneven-aged stands of white fir growing on pine or pine-associated sites are the most susceptible to damage (Wickman and others, 1981). Tree mortality, top kill, and a reduction in radial growth have been documented during the course of a four year tussock moth outbreak in white fir. In heavily defoliated areas, 50% of the understory trees (six inches DBH and under) were killed. Following the tussock moth outbreak, attacks by cambium feeders such as the fir engraver beetle often continue to cause mortality among damaged white fir trees. (Wickman 1963).

Lodgepole Pine

The largest bark beetle outbreaks in eastern Oregon involve the mountain pine beetle (*Dendroctonus ponderosae*) infesting lodgepole pine stands. Trees attacked during these outbreaks usually have a DBH greater than 7 inches. Drought is not important to the development of these outbreaks, and infested acres in Klamath County have actually declined during the current drought. Mountain pine beetle outbreaks are sustained by lodgepole pine stands having basal areas in excess of 100 square feet per acre and containing a high proportion of trees with a DBH greater than 8 inches (Mitchell and others 1983, Preisler and Mitchell 1993). Unlike the mountain pine beetle outbreaks in ponderosa pine, site class appears to make little difference in the pattern of tree mortality (Mitchell

1989). Only a small proportion of Klamath-Lake District state forests consist of the pure lodgepole pine stands old enough to be susceptible to mountain pine beetle infestations at this time.

Sugar Pine

Sugar pine is a small but significant component of mixed conifer stands found on Klamath-Lake District. By far the most important insect pest of sugar pine is the mountain pine beetle, *Dendroctonus ponderosae* (Struble 1965). Once trees reach a DBH of at least 6 inches they are susceptible to beetle attack. Some mortality is occurring in small diameter sugar pine on Sun Pass State Forest, mostly in overstocked mixed conifer stands. Trees infected with white pine blister rust are often killed by mountain pine beetle attack. Sugar pine is considered more susceptible than ponderosa pine to mountain pine beetle attacks (Mitchell 1989). Drought conditions in Klamath County have increased sugar pine mortality from beetle attack (Oregon Department of Forestry, 1969-1994). Since sugar pine is highly susceptible to mountain pine beetle infestation, maintaining large trees for seed production, wildlife benefits, and timber will require active stocking control.

Incense Cedar

The cedar bark beetles (*Phloeosinus* spp.) are the only significant insect pest of incense cedar. These beetles normally infest the limbs, tops, and boles of weakened and dying trees. However, during drought periods these beetles become more aggressive and kill apparently healthy cedar (Furniss and Carolin, 1977). Scattered mortality in incense cedar from bark beetle attacks has been reported in Klamath County during the current drought. In most cases tree mortality is occurring at elevations under 5,000 feet on poorer sites. Since incense cedar is a very minor component of stands on Klamath-Lake District, insects affecting this tree do not pose a significant threat to management objectives.

Douglas-Fir

Douglas-fir has a very limited occurrence in Klamath County and historically has few insect problems. It is likely that most tree mortality involving insects will be associated with conditions reducing tree vigor such as root disease or drought. Bark beetles that attack stressed trees include the Douglas-fir beetle (*Dendroctonus pseudotsugae*) and the Douglas-fir engraver (*Scolytus unispinosus*). The flatheaded fir borer (*Melanophila drummondi*) also attacks and kills apparently healthy Douglas-fir growing on dry sites (Furniss and Carolin, 1977).

Red Fir

Red fir is confined to high elevation areas of Sun Pass that receive more than 30 inches of precipitation per year. Trees that have poor crowns from dwarf mistletoe infections and the canker disease *Cytospora* are particularly vulnerable to wood borer attacks. Infestations by

the rounded fir borer (*Tetropium abietis*) and flatheaded fir borer were associated with 80% of the red fir mortality (Ferrell 1980b, Furniss and Carolin 1978). These insects mine the cambial area much like a bark beetle. Root disease and the shock that results when stands are opened up during harvest operations can reduce tree vigor and predispose trees to beetle attack. The fir engraver beetle also infests red fir, but less frequently than white fir occurring on drier sites.

Management of Forest Health

Strategies to improve or maintain forest health must consider all components of the forest ecosystem. Because soil, water, animals, vegetation, and human activities are interdependent, whatever affects one of these will also affect the others either directly or indirectly. Strategies to improve forest health and reduce impacts of pests must be based in the ecology of these systems, and must be tailored to individual stands, situations, and objectives.

Forest health is somewhat synonymous with forest insects and diseases. Unhealthy forests are characterized by dead trees, dead branches, loss of foliage, and numerous other symptoms of disease or insect damage. Insects and diseases are normal components of Klamath-Lake District ecosystems. These ecosystems have been altered by fire suppression and harvesting, and the role of insects and diseases has also been altered.

Much improvement in forest health can be achieved by applying existing silvicultural treatments and technologies. New approaches to management should be explored, and existing methods monitored closely to ensure that the best strategies are used.

Management objectives for Klamath-Lake District lands vary over the forest and often differ from one stand to the next. These objectives will influence the desired future condition. Some objectives could involve preserving or creating unhealthy trees or snags in order to provide wildlife habitat. This would increase biodiversity and create the stability and resilience that is needed to maintain the long-term health of the forest. However, even though stand objectives may differ, some general strategies form the basis of maintaining a healthy forest.

In the next few pages, general approaches are described for achieving forest health goals and solving forest health problems. Pest damage is considered to be an indicator of forest health. Therefore, the strategies to achieve forest health goals aim to keep the effects or impacts of pests to acceptable levels. It is expected that the levels of effects that managers find to be acceptable will vary over time and in different locations, as objectives and constraints change.

Integrated Pest Management

The Department of Forestry is mandated to employ Integrated Pest Management (IPM) as described in ORS 527.310 to 370. The law states that “The State Forester shall implement the Integrated Pest Management process as provided in ORS 527.315 on department-managed lands...” IPM is not a strategy, but a coordinated decision-making process that uses the most appropriate of all reasonably available means, tactics, or strategies, blended together to minimize the impact of forest pests in an environmentally sound manner to meet site-specific management objectives.

Components of the IPM process are listed below.

1. Define the management unit.
2. Define the site-specific management objectives.
3. Establish detection and monitoring systems for pests or damage.
4. Evaluate pest conditions in the management unit.
5. Establish pest population or damage thresholds, and take action only when exceeded.
6. Develop potential strategies and evaluate them with the following criteria:
   a) Effectiveness
   b) Operational feasibility
   c) Cost-effectiveness
   d) Ecological soundness
   e) Environmental impact
   f) Management objectives for the site
7. Implement the selected strategy.
8. Monitor and evaluate results of the activity.
9. Maintain current and accurate records.
10. Structure program so it can be adjusted to accommodate changes or varying situations.

Adaptive Ecosystem Management

Adaptive ecosystem management is a continuing learning process based on reiterative experimentation on a large scale that integrates biological, political, and social values (Everett et al 1994). It begins with designing, selecting, and implementing sets of actions based on current information. Subsequent steps include monitoring progress and evaluating results of the actions. The information gained is then used to adjust goals, redirect management, and redesign actions, which are then implemented and evaluated. A key point of this approach is that it deals with uncertainty by increasing the opportunities to redirect management as new information becomes available.

Decisions must be made despite rudimentary or incomplete understanding of the forest ecosystem. Understanding can be improved by monitoring the effects of silvicultural activities on forest health, using a predetermined set of criteria. These criteria could be mortality rates, growth rates, amount of defect, pest populations, etc.

Monitoring

Suggested monitoring items are listed below.

Aerial Surveys

Statewide aerial surveys for pest damage are conducted annually by the Department of Forestry's Insect and Disease section and the U.S. Forest Service. These surveys provide data on pest trends and identify potential salvage areas. Special surveys are conducted as needed. For example, a special aerial survey in 1988 mapped armillaria root disease patches. Aerial surveys allow planning and management at a scale larger than individual stands or sale areas.

Ground Surveys

Ground surveys are employed to quantify specific insect and disease concerns, usually at the stand level. Ground surveys are generally used for root diseases, which generally occur in discrete areas or patches. They may be used to provide early detection of potential pests such as black stain root disease, or to assess hazard for white pine blister rust.

Stand Exams and Resource Inventories

Pest information and damage is recorded as part of periodic stand exams. This information allows estimation of pest abundance, mortality rates, and tree survival. Information on specific pests such as dwarf mistletoes has been useful (Weir 1980), and provides stand level and forest-wide information. Information is also entered into simulation models that can incorporate certain pest effects. Periodic resampling allows evaluating the effects of management at the forest level. Continued determination of the causes of mortality will increase the chances of early detection of new pests.

Trapping

Trapping for certain insect pests, such as the Douglas-fir tussock moth, allows population trends to be monitored and provides early warning of outbreaks. The Klamath-Lake District has been monitoring the tussock moth population through trapping for many years. The district will cooperate with other agencies in detection trapping for potentially damaging exotic pests.

GIS (Geographic Information System)

An important part of monitoring is the long-term tracking of damage levels and pest populations. By incorporating pest-related information into the GIS, high hazard areas can be identified and silvicultural experiments monitored.

Silvicultural Treatments

Silvicultural activities are the principal tools for maintaining a healthy forest. Silvicultural treatments promote tree vigor, diversity, and long-term productivity.

- **Maintain appropriate stocking levels.**

Overstocking can result in high levels of pest-caused damage. Bark beetles in particular can devastate overstocked stands. Thinning can greatly reduce bark beetle losses, and should be done as stand improvement even if not a commercial operation. Similarly, tree stress associated with overstocking can increase susceptibility to and damage from diseases such as armillaria root disease and dwarf mistletoes. Thinning young stands promotes vigorous growth and is recommended in several situations where armillaria and/or dwarf mistletoes are present (Barett and Roth 1985).

- **Favor appropriate species.**

Prescribed burning, thinning, and selective harvesting can reduce the numbers of undesirable species. White fir that encroach onto pine sites because of fire suppression are often highly damaged by fir engraver beetles. White fir, Douglas-fir, and sugar pine are highly damaged in areas affected by armillaria root disease, while the resistant ponderosa pine, incense cedar, and lodgepole pine are favored on these sites. In multi-species stands with dwarf mistletoe, often only one species is damaged. Because each dwarf mistletoe is specific to one host, proper selection can prevent increasing damage, while improper choices can exacerbate the disease.

- **Maintain stand structure.**

Even when a stand has the desired species, stand structure can influence pest damage. Dwarf mistletoe damage increases most rapidly in multi-storied stands of a single tree species, particularly when the overstory is infested. However, if a stand can be manipulated into a relatively uniform layer with good stocking, damage can be mitigated by rapid tree growth and the inherent slow spread of the disease.

- **Maintain a diversity of tree species.**

In addition to favoring tree species that are resistant to pests, a diversity of species and genotypes within a species will offer some security from unknown pests or environmental extremes and reduce the risk of catastrophic losses. In general, a diverse forest will be better able to survive an unexpected extreme event than a single species forest.

- **Take advantage of genetic variation within tree species.**

Favor pest-resistant individuals during partial cuts, either as seed trees or leave trees. Unless diseased trees are desirable, which may be the case with either dwarf mistletoe or stem decay, remove them during partial cuts to favor individuals with some apparent resistance. For example, resistance to white pine blister rust and western gall rust are under strong genetic control, so long-term resistance in a stand can be improved by removing diseased individuals and allowing the more resistant individuals to remain in the natural breeding population.

- **Plant disease-resistant seedlings.**

Blister rust-resistant sugar pine seedlings are currently available in limited quantities and should be increasingly available as more resistant trees are located and propagated. Sugar pine planting should be done with resistant stock, particularly if local rust hazard is high. Pruning is also recommended to prevent the development of lethal cankers on sapling sugar pine.

- **Minimize injury to trees during stand management, by using appropriate logging systems.**

Direct mechanical injury to trees is a major contributor to stem decay, especially in true fir. Measures to reduce injury to trees during logging appear in the decay section detailed below.

- **Avoid damage to soils, which can cause tree stress and increase susceptibility to pests.**

Tree stress can be caused by soil compaction and other kinds of soil damage that injure tree roots, impede water infiltration, and inhibit gas exchange in roots. Several diseases, particularly armillaria root disease and canker diseases, can become damaging on stressed trees. Bark beetles such as the fir engraver also show preference to attacking trees under stress.

- **When planting, use seedlings that are well-suited to the site and avoid unnecessary planting stress.**

Improper planting can result in considerable stress and increase a tree's susceptibility to certain pests. Planted seedlings in many cases are more susceptible to armillaria root disease than naturally established seedlings. Poorly planted trees also show increased damage from armillaria root disease.

Preventing Build-Ups of Pest Populations

- **Salvaging / sanitizing infested stands.**

Harvesting dead and dying trees during the period from fall through early spring removes bark beetle populations along with the timber. Care must be taken not to exacerbate armillaria root disease in certain areas.

- **Managing slash accumulations from January to July.**

Whenever possible, avoid large accumulations of true fir and pine slash from January to July. Slash produced during these months provides breeding material for bark beetles that often attack leave trees. If slash accumulations are unavoidable, treat slash to promote rapid drying.

- **Stump treatments with Borax to prevent annosum root disease.**

Annosum root disease occurs at low levels on Klamath-Lake District. Treatment of conifer stumps greater than 12 inches in diameter immediately after falling can prevent the invasion of *H. annosum* into uninfested stands.

Hazard Trees

Tree failure in recreational areas poses a risk of personal injury or property damage to recreation users. Most tree hazards result from tree defects or soil conditions that contribute to tree failure. In developed recreation sites, tree hazard should be evaluated and managed to reasonably protect users.

Specific Management Recommendations for Diseases

The Department of Forestry's Insect and Disease section has recommended the following strategies to minimize the impacts of the most important diseases on Klamath-Lake District.

Armillaria Root Disease

Because *Armillaria* is an opportunistic pathogen that takes advantage of tree stress, stocking control to reduce density-related susceptibility is important. Stand management activities that reduce stress from moisture competition, logging injury, and site disturbance are encouraged and should reduce losses from *Armillaria*. There is some evidence that over the long run, ground-based harvesting systems will result in more losses to *Armillaria* than cable-based logging systems (personal communication, C.L. Schmitt, 1994). The probable explanation is that the root disturbance, soil compaction, and tree injury are greater with ground-based systems, and these conditions favor development of *Armillaria*. In root disease patches, salvage is not recommended unless the salvage includes treating the area to ensure adequate stocking of highly resistant species in the residual stand. Stumps created by harvesting infected trees allow a build-up of *Armillaria* inoculum, which can result in significant mortality in leave trees. When possible, favor natural regeneration over planting because planted trees appear slightly more susceptible to *Armillaria* than natural regeneration.

Currently, armillaria root disease is very damaging in a few areas on Klamath-Lake District. Many of these areas have been surveyed and mapped. Strategies for these areas are listed below and on the next page.

1. Locate and map diseased areas and place the information in a permanent database or GIS.
2. Favor the most resistant species, which on Klamath-Lake District are ponderosa pine, incense cedar, and lodgepole pine. Sugar pine , white fir, and Douglas-fir are highly susceptible to *Armillaria* on Klamath-Lake District lands. *Armillaria* varies in pathogenicity among sites, and although ponderosa pine is generally resistant on Klamath-Lake District, each situation must be evaluated to assess the best species for that situation.
3. Maintain adequate density to prevent stress, which favors development of armillaria root disease.
4. Minimize site disturbance and tree damage in partial cuts — the resulting stresses generally result in an increase in damage from armillaria root disease.

5. When regenerating openings, plant a mixture of resistant species and favor natural reproduction over planted trees, because planted trees tend to suffer more damage from *Armillaria* than naturals.
6. Avoid frequent small salvage harvests because stumps allow for an increase in inoculum and the site disturbance favors disease development.
7. Partial harvest only when a sufficient stocking of resistant species will remain — otherwise clearcut and plant resistant species.
8. Carefully evaluate objectives for the stand and consider diseased areas as potential wildlife habitat reserves.
9. Thin stands to promote good vigor of crop trees. Do not leave residual susceptible trees within about 30 to 50 feet of disease patches.
10. Use the FVS (Forest Vegetation Simulator — an updated version of Prognosis) western root disease model to compare alternatives.

Annosum Root Disease

Annosum root disease is currently at very low levels on Klamath-Lake District, but has a potential to cause losses in white fir and ponderosa pine. The strategy for this disease emphasizes prevention.

1. In white fir stands, avoid frequent commercial harvests because stumps provide a focus or starting point for the disease.
2. Keep white fir rotations less than 120 years.
3. Consider treating stumps of white fir and ponderosa pine with powdered borax to prevent colonization by *H. annosum.*
4. Map occurrence in both pine and fir, and monitor for trends in disease.
5. Use the FVS Annosum root disease model to evaluate management alternatives and estimate impacts of the disease on management.

Black Stain Root Disease

Black stain root disease is a potential problem on young ponderosa pine and possibly sugar pine. It is capable of long-distance spread by bark beetles and could appear suddenly (Harrington and Cobb 1988). Careful investigation of causes of mortality in young trees, particularly in thinning operations, should provide for early detection of this potentially damaging disease.

Decays

Most decays become damaging on Klamath-Lake District lands as a result of wounding during logging or fire injury. Older trees tend to have more decay than younger trees. Stress can be identified by using indicators of decay. Infected trees can either be selectively removed or retained, depending on objectives. The guidelines below and on the next page can help prevent excessive decay in stands (Filip et al 1983).

1. Keep rotations less than 150 years unless inspections reveal a very low occurrence of decay.
2. Maintain good tree vigor through stocking control — young vigorous trees have a strong ability to compartmentalize decay.
3. Select crop trees that have large crowns, few injuries or decay indicators, and a relatively high growth rate.
4. Do not manage understory white fir that is more than 50 years old. These old suppressed trees pose a high risk of developing rust red stringy rot (Indian paint fungus).
5. Minimize wounding by:
   a) restricting logging season to when bark is tight
   b) matching size of equipment to the situation
   c) designating permanent skid trails and leaving bump trees or cull logs along edges
   d) matching log length to leave tree spacing
   e) using directional falling
   f) limbing and topping trees before skidding, cutting branches flush to avoid injury to residuals during skidding
   g) removing slash near crop trees to prevent fire injury to bole, which can lead to decay

White Pine Blister Rust

Although rust hazard is low on Klamath-Lake District, wave years are possible. The blister rust strategy is to ensure an adequate supply of well-adapted rust-resistant seedlings, avoid high hazard areas, and prune sapling trees to reduce the number of lethal cankers. Collection of seed and screening for resistance gives us some bargaining power to exchange seed with BLM or U.S. Forest Service, thereby broadening the genetic base of sugar pine.

Dwarf Mistletoe

Strategies depend in a large part on management objectives. Recreation, wildlife, watershed, and visuals may need no action. Several strategies are appropriate if fiber production is a primary objective. Stands should be surveyed to assess severity of mistletoe infection (using the dwarf mistletoe rating, DMR) and the species present. Because dwarf mistletoes generally are host-specific, most strategies rely heavily on manipulation of stand species composition.

To reduce impacts on tree survival and fiber production, severely infested single species stands should be regenerated either by clearcutting or seed tree/shelterwood systems. Clearcuts must be “cleancuts”, removing all advanced reproduction (which may be infected). In seed tree/ shelterwood cuts in which overstory trees are infected, the overstory must be removed before the regeneration is 10 years old or 3 feet tall. Adjacent stands should be sanitized to within 50 to 100 feet of the harvest unit to prevent re-invasion.

In stands with moderate to light infection (DMR less than 3), selective thinning can maintain acceptable growth rates in crop trees. Thinning should target removal of the most heavily infected trees, and retention of non-host species. In general, trees should be retained only when the top half of the live crown is free of infection. In single species stands,

thinning to create an even-aged or even-canopied condition can reduce rate of intensification of dwarf mistletoe. On good sites that can support at least 10 inches of height growth per year, thinning even-aged moderately infested ponderosa pine stands is recommended (Barrett and Roth 1985). Underburning can be used to reduce the stocking of infected understory trees. If individual infected trees must be kept for wildlife trees, non-host trees should be encouraged within a 50 foot radius of the infected tree. Similarly, patches of infected trees can be isolated from other areas using physiographic features such as streams, canyons, outcrops, or roads.

Specific Management Recommendations for Insects

The Department of Forestry's Insect and Disease Section has recommended the following strategies to minimize the impacts of the most important insect problems on Klamath-Lake District.

Mountain Pine Beetle

The mountain pine beetle has several host trees on Klamath-Lake District state forests, including lodgepole pine, ponderosa pine, and sugar pine. Ponderosa pine is not susceptible to attack unless it is at least 8 inches in DBH, and lodgepole and sugar pine are only attacked after reaching 6 inches in DBH. For all these species the key to preventing beetle infestations is stocking control. With the exception of sugar pine, there are published guidelines on stocking levels that minimize the potential for beetle infestations.

For ponderosa pine, the most useful guidelines relate site to a maximum basal area above which significant beetle damage can be expected (Meyer 1961, Sartwell 1971, Barrett 1979). Severe damage by mountain pine beetle can be prevented by maintaining ponderosa pine stand densities under the maximum basal areas shown in the table below. See the "Background Information" box on page III-82 for an explanation of site class and site index.

Table III-5. Recommended Ponderosa Pine Densities for Minimizing Mountain Pine Beetle Damage

Site Class	Site Index	Maximum Basal Area[1]
III	110	160
IV	90	140
V	70	120

1. These maximum basal areas represent conditions where stand growth and vigor are already poor and are not guidelines for thinning.

Unlike mountain pine beetle outbreaks in ponderosa pine, site class appears to make little difference in the pattern of tree mortality in lodgepole pine stands (Mitchell 1989). Also, the basal area at which lodgepole stands become susceptible to beetle infestations is less clearly defined than for ponderosa pine. In general, lodgepole stands with basal areas of 44-100 square feet per acre have low susceptibility to mountain pine beetle infestations (Mitchell

and others, 1983; McGregor and others, 1987). In addition, Oregon State University has published thinning guidelines covering both lodgepole pine and ponderosa pine (Pitman and others, 1982). These guidelines use an average DBH after thinning and recommended distances, maximum and minimum, between trees of that size.

Sugar pine is highly susceptible to mountain pine beetle attack in overstocked stands. In the absence of specific stocking guidelines for sugar pine, it is recommended that the guidelines on maximum basal area for ponderosa pine on that site be used for determining the appropriate stocking of sugar pine.

While the threat of mountain pine beetle attack is obvious in pure pine stands, mixed conifer stands also require stocking control if the pine component is to be preserved (Eaton 1941, Miller and Keen 1960, Sartwell and Dolph 1976). To maintain the pine component in a mixed conifer stand on poorer sites, it is advisable to reduce the basal area to that recommended for a pure pine stand. On better mixed conifer sites, focusing management on trees other than pines may be the best strategy for capturing the site's capacity to produce wood (Mitchell 1989). Keep in mind that without periodic stand disturbance from fire or management activities, it is impossible to maintain a significant pine component in mixed conifer stands.

Either pine or mixed conifer stands with active mountain pine beetle infestations can benefit from immediate stocking reductions. By aggressively thinning stands with active beetle infestations, the microclimate of the stand is altered so that conditions are unattractive to the beetles. In recently thinned lodgepole stands, even trees with low vigor have a better chance of avoiding beetle attacks than in overstocked stands (Amman and others, 1988). While the data supporting this prescription were gathered in lodgepole pine stands, it is reasonable to extend this management recommendation to ponderosa and sugar pine. When thinning ponderosa or lodgepole pine stands, it is important to avoid accumulating thinning slash from January to June, in order to prevent a build-up of pine engraver beetle populations and possible attacks on leave trees.

An effective tool for reducing localized beetle populations is salvaging pines currently infested with mountain pine beetle before the beetle flight in July. Dead pines with red crowns do not contain developing mountain pine beetle broods. Currently infested trees, those containing beetle brood, will have green or yellow crowns and have numerous pitch tubes on the bole. Salvage operations for reducing beetle populations must remove the infested trees before the beetle flight in July. Salvage of infested trees is of short-term benefit, but reducing stocking levels is the only method of long term control (Amman and others, 1985).

Western Pine Beetle

Besides being a significant pest in old growth ponderosa pine, western pine beetle also attacks second growth trees from 6 to 18 inches in DBH. As with mountain pine beetle, stocking reduction is the key to preventing western pine beetle infestations (DeMars and Roettgering, 1982). There is only one published data set on the effects of thinning young

ponderosa pine to reduce western pine beetle infestations (California Pest Council, 1993). In this study, thinning reduced beetle attacks on 70-80 year old ponderosa pine growing on Site Class II or better locations. The study's recommendation is to thin pine stands to 55-70% of normal basal area. Normal basal area is defined as the basal area at which the stand is fully stocked with trees. In most cases the thinning recommendations for prevention of mountain pine beetle infestations should also provide protection from western pine beetle. Thinning stands to 55% of normal basal area is recommended on high risk sites, where ponderosa pine is growing in association with western juniper, incense cedar, or mountain mahogany. High risk sites with overstocked stands of ponderosa pine are very susceptible to western pine beetle infestations during drought periods (Miller and Keen 1960, Oregon Department of Forestry 1969-1994).

Salvage of beetle-infested trees may be beneficial when the area of tree mortality is small (DeMars and Roettgering, 1982). The salvage of infested trees is best accomplished between November and March, when there is a high likelihood that trees contain brood. Beetle flight and new attacks can occur any time between April and October. To be effective, all green trees with pitch tubes as well as trees with yellow or red crowns should be removed from the site. The pitch tubes produced by the western pine beetle are typically located in bark crevices and are much smaller and less conspicuous than those produced by the mountain pine beetle. Salvage of western pine beetle-infested trees may suppress beetle populations in the short-term, but the only long-term solution is to reduce tree susceptibility through stocking control.

Pine Engraver Beetle

The pine engraver beetle is attracted to and breeds in fresh ponderosa and lodgepole pine slash with a diameter greater than 2 inches. As engraver beetle populations are attracted to slash, adjacent crop trees are frequently attacked. Thinning operations can be conducted at any time in pine stands where trees are less than 3 inches DBH. However, to avoid leave tree mortality in stands where trees are more than 3 inches DBH, do not create slash from January to June (Dolph 1965, Sartwell and others 1971). If slash creation is unavoidable from January to June, the amount of suitable breeding material can be reduced by trampling slash with heavy equipment (knocking off the bark), or bucking up large diameter pieces (do not remove branches) and scattering them in open areas to facilitate rapid drying.

Fir Engraver Beetle

The fir engraver beetle sustains endemic populations by attacking trees in root disease pockets (Lane and Goheen, 1979). In areas where root disease is detected, beetle populations can be reduced by following root disease control strategies. Logging activity can contribute to fir engraver infestations by leaving true fir slash greater than 4 inches DBH, which provides breeding sites for the beetles (Ferrell 1973). When thinning predominantly fir stands, avoid creating slash from January to July, when it can provide

breeding material for fir engraver populations. Frequently the shock of opening up true fir stands temporarily lowers tree vigor and makes trees vulnerable to attack for several years. Perhaps the most important factor discouraging the active management of white fir on the Klamath-Lake District is its extreme susceptibility to fir engraver attacks during periods of drought (Ferrell 1973). One study has found that under the current drought, white fir growing on sites receiving 20-30 inches of precipitation annually can suffer high levels of tree mortality (USDA Forest Service 1994). There are no silvicultural prescriptions that can insure the survival of predominantly white fir stands on pine or pine-associated sites during periods of drought. For this reason white fir should remain a minor component of stands managed for timber production on the Klamath-Lake District.

Salvage of beetle-infested trees can be used to reduce local fir engraver populations. Dead and dying fir containing beetle brood should be removed before beetle flight begins in June. During a salvage operation, trees should be removed when they have a dead or fading top constituting 10% or more of the live crown. Trees with fading tops are usually infested by the fir engraver and have a high probability of dying in the near future.

Defoliators

Damage from defoliator outbreaks, such as top-kill, usually takes several years to develop and is more severe among intermediate and suppressed trees (Wickman 1963). Both aerial and ground surveys are useful in mapping the spread of an outbreak and predicting future levels of defoliation. A general strategy for mitigating the effects of a defoliator outbreak is to maintain vigorous growing stands of trees with healthy crowns. Healthy trees are more resistant to damage by defoliators and are quicker to recover when the outbreak subsides (Carlson and others, 1985).

A specific strategy for the Modoc budworm and the Douglas-fir tussock moth is to reduce the stocking of white fir, their primary host (Mason and Wickman, 1988). Keeping white fir a minor component of stands can virtually eliminate the negative impact of a defoliator outbreak on state forest lands. If necessary, defoliator outbreaks can be suppressed using one of several insecticides registered for use on forest land.

Outbreaks of black pineleaf or pine needle scale may occur over hundreds of acres of forest land, usually where pesticide from mosquito suppression projects drifts over ponderosa pine stands. If a scale outbreak persists for several years, trees are weakened to a point where they are susceptible to bark beetle attack. Salvage logging of trees with deteriorating crowns will be helpful in reducing the risk of bark beetle infestations. Scale infestations can also be treated with a well-timed insecticidal spray (Ferrell 1986a).

The Human Context

Land Use Classifications

The land use classification system applies to all the Klamath-Lake District state forest lands, regardless of ownership. The appropriate land owner, either the State Land Board or the Board of Forestry, must approve any significant land use reclassifications. Minor changes such as correcting boundaries or changing the land use subclassification do not require approval.

In addition, the Department of Forestry must comply with state-wide land use planning goals and acknowledged city and county comprehensive plans and land use regulations. (See Appendix C for more information about these goals and the definition of "acknowledged" plans.) When land use classifications are updated, the District Forester will review state forest land use designations with affected local governments and request their comments on the compatibility of land use designations with the comprehensive plan (OAR 629-20-040 (4)).

State forest lands are classified into two main categories: Production and Nonproduction. These are further subdivided into more detailed classifications. Tables III-6 to III-9 show the acreages by land use for all Klamath-Lake District state forest lands, and for each of the major blocks.

Production Lands

Production lands are those areas where timber production is the primary use.

Nonproduction Lands

Nonproduction lands are classified into three main categories: Special Use, Conservancy, and Noncommercial. In turn, each of these categories has several subclassifications. Timber production is not the primary use on these lands. Timber harvest may occur only under special circumstances, as noted in the discussion on the next page.

Special Use Lands — Timber harvest will occur in these areas when it does not interfere with the designated special use of these lands.

- **Service use lands —** Two research sites totaling 63 acres host plantations of genetically improved ponderosa pine. The Department of Forestry uses data from the plantations to produce genetically improved seedlings for tree planting.
- **Farm use lands —** These areas are nonforested areas mingled with forest land that have been included in grazing lease areas.
- **Extraction use lands —** This area is a rock pit in Sun Pass State Forest. The Department of Transportation has a permanent easement for the use of this pit.
- **Transmission use —** These are power and natural gas line right-of-ways.

Conservancy Lands — These areas have been determined to have a primary use that is non-revenue-producing.

- **Protective conservancy, critical wildlife habitat —** These are areas of high value to wildlife and fish. Timber harvest is not precluded, but will be done only to improve fish or wildlife habitat at the request of Oregon Department of Fish and Wildlife biologists. These areas are discussed in detail earlier in Section III, in the subsection "Wildlife and Fish."
- **Scenic conservancy —** One 40 acre parcel along Highway 140 adjacent to Upper Klamath Lake falls into this category. This parcel consists primarily of rock outcrop and talus slopes. Scenic values in these areas preclude timber production. Harvesting may be allowed in certain cases, such as salvaging, as long as scenic values are protected.

Extensive Management Lands — These are very marginal forest lands that are not included in the production land base, but which can be entered for salvage to correct some forest health problem.

Noncommercial Lands — These are non-forested areas that have had no commercial or other prevailing uses.

Table III-6. Land Use Classifications for Klamath-Lake District Lands		
Land Use	**Acres**	**Percent**
Production Lands	**31,590**	**95%**
Nonproduction Lands	**1,578**	**5%**
Protective conservancy — critical wildlife habitat	396	
Scenic conservancy — highway corridor	40	
Extensive management	43	
Noncommercial — dry meadow	18	
Noncommercial — noncommercial body of water	17	
Extraction use — rock	18	
Farm use — forest range	933	
Service use — tree improvement	63	
Transmission use — powerline	50	
Total Acres	**33,168**	**100%**

Table III-7. Land Use Classifications for North Block		
Land Use	**Acres**	**Percent**
Production Lands	**22,389**	**98%**
Nonproduction Lands	**458**	**2%**
Protective conservancy — critical wildlife habitat	359	
Noncommercial — dry meadow	18	
Extraction use — rock	18	
Service use — tree improvement	63	
Total Acres	**22,847**	**100%**

Table III-8. Land Use Classifications for Southwest Block		
Land Use	**Acres**	**Percent**
Production Lands	**4,462**	**94%**
Nonproduction Lands	**281**	**6%**
Scenic conservancy — highway corridor	40	
Extensive management	43	
Farm use — forest range	190	
Transmission use — powerline	8	
Total Acres	**4,743**	**100%**

Table III-9. Land Use Classifications for East Block		
Land Use	**Acres**	**Percent**
Production Lands	**4,739**	**85%**
Nonproduction Lands	**839**	**15%**
Protective conservancy — critical wildlife habitat	37	
Noncommercial — noncommercial body of water	17	
Farm use — forest range	743	
Transmission use — powerline	42	
Total Acres	**5,578**	**100%**

Forest Products: Timber

The Klamath-Lake District state forest lands contain 31,590 acres of land designated primarily for use as timber production land. As of 1993, it was estimated that the standing volume on these lands was approximately 302 MMBF, with approximately 263 MMBF on Board of Forestry land and 39 MMBF on Common School Forest lands. See the "Key Terms" box on the next page for the definition of MMBF and other terms used in this subsection.

Information relevant to the timber resource can be found in several other places in Section III. The "Geology, Topography, and Soils" subsection has information about site productivity. The "Vegetation" subsection describes climax forest vegetation and plant communities, and the "Biodiversity" subsection discusses how past and current timber management practices have shaped current habitat and biodiversity conditions. Finally, the "Forest Health" subsection discusses how forest insect and disease pests interact with the timber resource. The remainder of this subsection covers the four topics listed below.

1. The timber program and the basis for state forest management policies.
2. The current management plan.
3. Current timber management practices.
4. The timber inventory and timber management analysis conducted for this plan.

The Timber Program

Policies for managing state forests are based upon the Oregon Constitution and statutory direction. These legal and policy mandates are discussed in some detail in Appendix C. These policies are summarized by the following two statements for the two types of land we manage.

> **Common School Forest Lands** are managed "to generate the greatest amount of revenue in the long run for the Common School Fund consistent with sound techniques of land and timber management. Consideration is given to the need to protect soils, water, fish and wildlife habitat, recreational opportunities, and other forest values as long as this need does not significantly detract from the generation of revenue in the long run." (Oregon Board of Forestry 1995b)
>
> **Board of Forestry Lands** are managed "to provide a sustained contribution to the people of Oregon by the production of timber in a cost-effective and environmentally sound manner while providing recreational opportunities and considering soils, water, fish and wildlife habitat, and other forest values. A major portion of revenue derived from these lands is distributed to counties for further distribution to local taxing districts." (Oregon Board of Forestry 1995b)

The Klamath-Lake District's timber program has carried out these policies by generating revenue to benefit county governments, local taxing districts, and the Common School Fund. Timber production has been the main revenue-generating activity on the Klamath-Lake District state forest lands.

On Board of Forestry Lands, 36.25% of timber sale revenues are retained for Department management costs. The Department of Forestry manages Common School Forest Lands under a contract with the State Land Board. Timber sale revenues are placed directly into the Common School Fund, and management expenses are in turn paid from the Common School Forest Revolving Fund. The Department of Forestry's management services include timber sale preparation and administration, forest inventory, intensive forest management, and associated overhead costs.

The timber program is guided by the principle of sustained yield, which ensures that the Common School Fund, counties, and local taxing districts will benefit from a perpetual source of revenue from a managed forest.

Key Terms

Basal area — The area of the cross-section of a tree stem near the base, generally at breast height (4.5 feet above the ground) and including the bark. The basal area per acre is the total basal area of all trees on that acre.

Cohort — Within a stand, a group or a layer of trees that regenerated after a single disturbance, such as a fire or timber harvest; the group or layer of trees is an even-aged component of the stand.

GIS — Geographic information system; a computer system that stores and manipulates spatial data, and can produce a variety of maps and analyses.

MMBF — Million board-feet. A board foot is the amount of wood equivalent to a piece of wood one foot by one foot by one inch thick.

Stand — A term used in this plan to designate a contiguous area of land in the same vegetative series and having the same management history.

Sustained yield — A timber harvest level for the next decade that can be maintained or increased through future planning decades without significant declines. Sustained yield has been calculated on an acreage basis for this plan.

Current Management Plan

The Eastern Region State Forests are currently being managed under the 1978 Timber Resource Inventory, Analysis, and Plan for Eastern Oregon Area State Forests (Oregon Department of Forestry 1978), which was billed as a 30 year plan. This plan focused on timber management, but also considered wildlife and other environmental concerns. Under the 1978 plan, timber harvest is calculated by regulating the basal area per acre on a stand by stand basis, and is controlled on an acreage basis. In other words, annual harvest objectives are stated in terms of acres to be treated annually. Volume can vary annually depending upon the nature of the stands selected to be treated each year. The 1978 plan called for the harvest of 1,010 acres per year for the first decade, and 1,080 acres per year for the second decade. The plan assumed that these harvests would be primarily selective harvests using an uneven-aged system. Projected average harvest levels were 7.4 MMBF per year the first decade, and 7.7 MMBF per year the second decade.

During the recession of the early 1980s, prices and demand for timber were low, and state forest revenue projections indicated the need for cost cuts. In response, significant staff reductions were made in the Klamath-Lake District's state lands management unit. In addition, by the mid-1980s, it was recognized that the 1978 plan was becoming inadequate, and the harvest objective was reduced pending the development of a new plan. (See "The Eastern Region Planning Process" in Section I.) As a result, the harvest objectives have not been met since the earliest years of the plan. Over the past 7 years, an average of 564 acres per year have had harvest treatment. Another change during the early 1980s was the beginning of a major mountain pine beetle epidemic in the vast lodgepole pine stands of central Oregon. The decision was made to harvest the lodgepole pine stands in the Sun Pass area before the epidemic was projected to hit in the early 1990s. This decision represented a further departure from the 1978 plan, which assumed that most harvest would use the uneven-aged system.

Current Timber Management Practices

The state currently uses two silvicultural systems in managing the Klamath-Lake District state lands. In the ponderosa pine, Douglas-fir, and white fir forest zones, uneven-aged management is generally used. In the lodgepole pine forest zone, even-aged systems such as seed tree and clearcutting are used. These two systems are described below as currently practiced on the Klamath-Lake District. See the "Background Information" box on page III-107 for more information on these two silvicultural systems.

Uneven-Aged Management

Stands in the ponderosa pine and white fir forest zones are scheduled for treatment based on the level of stand density, with overstocked stands being scheduled first. The objectives of this treatment are listed on the next page.

1. Create a healthy, insect and disease-resistant stand by reducing stocking levels in all size and age classes and by altering species composition. Altering species composition usually means favoring a residual stand with a large ponderosa pine component, while retaining some level of all naturally occurring tree species for biodiversity.
2. Create or retain an uneven-aged stand structure capable of sustained timber output through periodic partial cut entries.
3. Establish a viable cohort of ponderosa pine regeneration.
4. Enhance wildlife habitat through sustained recruitment of wildlife trees, snags, down woody debris, and cover areas; and maintenance of early seral areas for forage production.
5. Maintain soil productivity through management of compaction and slash, woody debris, and the duff layer.

Treatment is accomplished in two stages. The first stage is a timber sale, which reduces density and alters species composition in the sawlog-size trees, and creates openings and understocked areas for new seedlings. Numerous small openings are formed as a result of group selections of less desirable species such as white fir and lodgepole pine, or group selections to treat insect and disease infestations such as bark beetle and root rot pockets. The openings range from less than a tenth of an acre, to a few openings as large as several acres. Even-aged groups of ponderosa pine, sugar pine, and Douglas-fir are usually thinned from below to provide good growth rates and resistance to insect attack. Groups of large trees of the desirable species are marked to leave individual trees based on tree quality, ability to survive and grow to the next entry, and need for seed trees and future wildlife trees. Large, high defect white firs are left whenever possible as present and future wildlife trees, snags, and down woody debris.

The second stage consists of post-harvest precommercial thinning and interplanting. The thinning has the objective of reducing density in the sub-sawlog-sized material and favoring healthy trees of desirable species. The larger openings are generally interplanted if it is felt that an insufficient number of desirable seed trees exist in the immediate vicinity to ensure adequate regeneration. In smaller openings with sufficient seed trees, natural regeneration is relied on.

A few mixed conifer stands scheduled for long-term uneven-aged management occasionally require special treatment in order to correct some silvicultural problem such as an insect or disease infestation, or a species composition imbalance. In this case, parts of these stands may meet clearcut definitions. However, this kind of intermediate treatment is viewed as necessary to return the stand to a healthy, uneven-aged condition. For example, there are currently some stands where nearly all trees of desirable species were removed in the past. The residual stands consist primarily of high defect white fir, and will require small patch clearcutting and interplanting to return them to a desirable condition. As another example, there is a large area in Sun Pass State Forest severely infected with *Armillaria* root disease (see “Forest Health” for details on this disease). Much of this area has a large component of species such as white fir and sugar pine that are highly susceptible to *Armillaria*. Ponderosa pine and lodgepole pine are the only two native conifer species resistant to this disease. In these root rot areas, it will be necessary to remove susceptible species, resulting in understocked areas, and then to interplant with resistant species.

Background Information
Even-Aged Vs. Uneven-Aged Management

Most of the Eastern Oregon Region's state forests have an "uneven-aged" structure with trees of many species, sizes, and ages. In limited areas where clearcutting or seed tree harvesting has occurred, the trees are mostly the same age, or "even-aged."

Selective harvesting, which is used to maintain or improve uneven-aged stand structure, has become the preferred silvicultural method in most areas of the Eastern Region state forests. Even-aged management is also a viable practice. However, its use has been limited to circumstances where ecological conditions, insects, or disease make selective harvesting less attractive.

There are numerous reasons for favoring uneven-aged management. The first is historic: prior harvesting practices left a stand structure that is easily adapted to uneven-aged management. (Refer to Section III, "Biodiversity", for a historical perspective.) The gentle terrain makes selective harvesting economical with ground-based equipment. Uneven-aged management has other advantages, which are listed below.

- Continuous site occupation by trees results in higher timber production.
- The continuous forest cover is visually pleasing, and has greater public acceptance.
- Reforestation costs are lower, and seedlings are sheltered from extreme conditions.
- Biodiversity and wildlife habitat are maintained.

However, successful implementation requires a commitment to staffing, training, and administration. Success depends on:

- Adequate staffing with foresters skilled in writing prescriptions, selecting trees for harvest, and supervising operations.
- Close attention to stand structure. Improper selection could create an imbalance of tree sizes and species, and has long-term implications for growth, regeneration, and forest health.
- Not allowing a dense understory of tolerant (shade-dependent) tree species to form. Small openings (¼ to 2 acres) are needed to regenerate intolerant species, and stocking control (thinning) is needed throughout the rest of the stand.
- Prevention of damage to residual trees. Accomplished through appropriate logging systems, incentives for loggers, and close monitoring of harvest operations.

Even-Aged Management

Even-aged management is most frequently practiced in the lodgepole pine forest zone. Both clearcutting and seed tree cutting have been used and are planned for the future. Because of the high levels of dwarf mistletoe in the natural lodgepole stands, uneven-aged management would not be appropriate. Both seed tree cuts and clearcutting would retain green trees and snags at least to the levels required by the Forest Practices Act. Klamath-Lake District state forest lands contain a total of 4,149 acres in the lodgepole pine forest zone, or about 12% of the district's total land base. So far 1,295 acres have been harvested out of the total 4,149 acres in the lodgepole pine forest zone. Currently, the mountain pine beetle epidemic discussed above has declined and is no longer the driving force in harvesting decisions in this forest zone.

Timber Inventory and Analysis for The New Plan

All Eastern Region state forest lands classified for timber production use have been divided into 243 stands based on past management and forest zone. These stands were inventoried for this plan between 1989 and 1992, using the Forest Service Pacific Northwest Region Stand Exam system. Twenty stands were randomly selected in Sun Pass State Forest to be permanent plot stands. The plots in these stands were established so that they can be relocated in the future. The remaining 223 stands were inventoried using a system of temporary plots.

The next two paragraphs describe how this inventory information was used to develop an information system useful for this planning process.

An analysis was done, using the Stand Prognosis Model, on representative stands in each block on the Klamath-Lake District. For the white fir, Douglas-fir, and ponderosa pine forest zones, where uneven-aged management is practiced, general harvest instructions were developed to simulate the uneven-aged cutting currently being conducted. The analysis was designed to further fine-tune the harvest instructions for the model by determining the residual basal area per acre and reentry period that would result in the ideal combination of timber volume production, financial return, and desired silvicultural conditions for each block. For the lodgepole pine forest zone, the analysis was designed to determine the rotation age that resulted in the ideal combination of timber volume production and financial return. The fine-tuned harvest instructions resulting from the above analyses were used as broad prescriptions for the purpose of developing Prognosis runs for the remaining stands. The process for developing stand-specific prescriptions for actual stand management practices is discussed in the timber strategies in Section V.

Prognosis runs were developed for 210 of the stands using the harvest instructions discussed above. The 33 stands without Prognosis runs are young plantations less than 6 years old for which inventory data was not collected. As these stands reach 6 years of age they will be inventoried and entered into this system. For each of the 210 stands, the first harvest decade was set to occur when the stand first reached a basal area per acre at least 30 square feet higher than the target residual basal area per acre. This Prognosis run was called the optimum schedule. Prognosis runs were also made to simulate the effects of delaying harvest one decade

and, where possible, accelerating harvest one decade. These were called, respectively, the delayed and accelerated schedules. Prognosis runs were done for the three schedules for the first six decades, and the information was entered into a Paradox database. The resulting database had many uses in the planning process, including balancing and scheduling harvests, estimating the sustained yield level, estimating revenues generated, and projecting future stand structures and species composition. A GIS system was developed that had the capability to display information from the database in map format.

The inventory and subsequent analysis revealed 47 stands totaling 7,819 acres in the ponderosa pine, white fir, and Douglas-fir forest zones that are overstocked (140 square feet or more of basal area per acre) and at high risk of severe bark beetle infestation. In addition, 7 stands totaling 1,541 acres were identified as having severe *Armillaria* root rot infestation. Five of the latter stands totaling 1,260 acres have not been treated.

Special Forest Products

Current Management

Special forest products are those forest products other than timber that are collected for personal and commercial uses. Many types of special forest products are harvested on the Klamath-Lake District. Firewood, mushrooms, and cones have been the most popular of the products available. To date, these products have had little value to forest managers and landowners, so development and management has been minimal.

The Klamath-Lake District's current management policy for special forest products is to respond to public inquiries and demands for these products on an individual basis. Any harvesting or taking of special forest products on state forest lands requires the acquisition of a free use permit, with one exception. During the summer of 1994 an experimental policy was tried for mushroom harvest, requiring a fee permit when harvest was for commercial use and a free use permit for personal use. Four free use permits were issued during the season, but no commercial permits. However, because the public had limited knowledge about the new permit system, the actual number of pickers is not known.

Special Forest Products on the Klamath-Lake District

To date, no inventory has been taken of all the special forest products available on the Klamath-Lake District. The public's past requests for free use permits give some indication of what current demands are. However, some people may be collecting special forest products without permits. The products for which free use permits have been issued in the past are listed below and on the next page.

Firewood

Firewood has been one of the most actively managed forest products on the district. For many people, the collection of firewood is an important project. Some people use firewood to reduce heating bills, and others enjoy the aesthetic value of a wood fire. On the Klamath-Lake District, firewood collection is allowed in recently harvested areas. It is a way to remove logging slash and to allow people to meet their fuel wood needs. Permits are required to remove firewood from the forest and have many stipulations. For instance, firewood may only be taken from designated areas and only fallen trees may be cut. Permits are issued for personal use only. However, due to increased wood utilization and the current practice of leaving down woody material for nutrient cycling, little wood is available for firewood use.

Edible Mushrooms

Recently, the harvesting of edible mushrooms has become very popular in the area because some mushroom species have high commercial value. The total annual value of edible mushrooms exported from Oregon exceeds 6 million dollars (USDA Forest Service, date unknown (a)). In the Klamath-Lake District area, most mushroom harvesting occurs on the Winema National Forest in northern Klamath County. In 1992, the Winema National Forest issued 2,338 commercial permits, resulting in revenues of $43,000 for the Forest Service (USDA Forest Service 1992). However, it is important to note that the Forest Service's administrative costs for the program were higher than the revenues from the permits.

Edible mushrooms are probably the most important special forest product on the Klamath-Lake District, in economic terms. It is believed that morel and matsutake mushrooms, the most valuable species, are present in Sun Pass State Forest. The mushrooms are continuing to increase in value, attracting larger numbers of people to the area, as harvesters (sellers) and buyers. With these people come both environmental and social concerns. In fact, the Winema National Forest staff receives training in gang-related issues, and there have been homicides that were attributed to the territorial conflicts of mushroom pickers. Also, very little is currently known about the environmental impact that mushroom harvesting has on the forest.

In response to the growing popularity and value of edible mushrooms, the Klamath-Lake District has implemented a trial permit system for the collection of edible mushrooms. For personal use, a free use permit is issued. For commercial use, the permit is issued at $100 per picker. The matsutake can only be taken as a commercial product. As stated before, only four free use permits were issued in 1994, and no commercial permits. These low numbers can be accounted for in three ways. First, there was little public knowledge of the district's permit system. Second, the dry winter and spring created a poor crop of mushrooms throughout the state in 1994. Finally, the permit closure in mid-August due to high fire danger denied access to all state forest lands in the district.

The table below lists the prices paid to the picker and wholesaler in 1991 for morel and matsutake mushrooms.

Table III-10. 1991 Mushroom Prices Paid to Harvester and Buyer

Mushroom Species	Harvester Prices	Wholesale Prices
Matsutake — fresh	$1.00-$40.00/lb.	$4.00-$70.00/lb.
Morel — fresh	$2.00-$8.00/lb.	$6.00-$20.00/lb.
— dry	$1.00-$4.00/lb.	$20.00-$55.00/lb.

Source: Elliott State Forest Draft Management Plan 1993

Other Special Forest Products

Cones and other assorted special forest products are also harvested in the Klamath-Lake District. However, there is very little demand at this time for them, except for occasional requests to harvest sugar pine cones. These cones are popular because of their size — cones can be as much as two feet long. The cones are generally used in decorative arts and crafts.

Between 1990 and 1992, the Winema National Forest completed an inventory of 43 botanicals used for an assortment of products (USDA Forest Service 1992). Because of the proximity and similar landscape, it can be assumed that most of these products are also available on state forest lands in the Klamath-Lake District. Appendix N list these products and their uses. Most products were used for decorative arts and crafts, landscaping, and food and beverages.

Future Demand for Special Forest Products

As population increases in the Klamath basin, demand for special forest products is likely to increase as well. Increased knowledge about these products will also increase demand. The increased demand for edible mushrooms is potentially the most important. As growing numbers of people harvest mushrooms on federal lands, the demand for mushrooms on state lands could increase. The increasing value of edible mushrooms will also encourage more people to harvest mushrooms commercially.

Economic Values of Special Forest Products

It is difficult to measure the economic values of special forest products collected for personal use. Commercially, special forest products can play a significant role in local economies. Special forest products, both raw and finished, are increasingly being sold on national and international markets. The U.S Forest Service has estimated that the special forest products industry employs over 10,000 people in the Pacific Northwest and generates an estimated 60-70 million dollars per year for the region (USDA Forest Service, date unknown (b)). Because special forest products make a valuable contribution to the state's economy, the Forest Service actively promotes the harvesting of special forest products on national forest lands.

Special Forest Products Committee

In response to growing popularity and demand for special forest products, the Oregon Department of Forestry has established a Special Forest Products Committee. The purpose of this committee is to develop state-wide policy on special forest products found on state-managed lands. This policy will be consistent on all state-managed lands. At this time, the committee is in the early stages of establishing the goals and objectives that will be used in drafting the policy.

Recreation and Scenic Resources

Recreation resources and use on the Klamath-Lake District state forests were assessed during the summer and fall of 1994. The information here is summarized from the complete report, which is available at the Klamath-Lake District office and the Salem headquarters (Schrader 1994).

Recreation in the Region

The Klamath-Lake District state forests are a small part of the total land base of Klamath and Lake Counties. Recreation resources on the state forests are part of the regional recreation resources. By understanding the regional role of state forests, managers can make better decisions about managing recreation on state forest lands.

Klamath and Lake Counties have many recreation providers, who offer a wide range of recreational opportunities. There are two national forests, eight state parks (two in the vicinity of Sun Pass State Forest), a national park, BLM-managed lands, and many private recreation providers.

All of these landowners have different philosophies about recreation, and provide different opportunities. Crater Lake National Park is managed under a preservation mandate and provides recreational opportunities that range from highly developed to backcountry activities. The national forests and BLM lands are managed with multiple use mandates and provide a wide array of opportunities from wilderness areas to developed campgrounds. The state parks provide semi-primitive to developed campgrounds, with the main emphasis on vehicle accessibility. Private recreation providers mostly supply developed recreation.

The state forest lands are bordered by the full variety of land ownerships in the area. Sun Pass State Forest is adjacent to Crater Lake National Park, Winema National Forest, Kimball State Park, and private land. The largest piece of land in the East Block, the Yainax Butte tract, is surrounded mostly by the Fremont National Forest. In the Southwest Block, the Bear Valley tract is adjacent to several BLM parcels, and near the newly established Upper Klamath Wild and Scenic River. There are also private lands next to the Yainax Butte and Bear Valley tracts.

Each recreation provider fills a niche in the region. The opportunities on other lands and the public's recreational demands affect the recreational use that occurs on state forest lands. Any changes in the region can dramatically alter recreational demand and types of use on state lands.

Current Situation

In the past, there has been very little formal recreation management in the Klamath-Lake District. Current recreation management consists of issuing fire danger regulations and permits required for large commercial groups. No staff or funds exist to actively manage recreation sites and users in the forest.

However, the lands in the Klamath-Lake District are relatively lightly used for recreation. The most common recreational uses are camping, hunting, fishing, and snowmobiling. Most use is informal dispersed recreation, which is defined as recreational use that occurs with little or no regulation or development. In this type of recreation, users are reasonably free to choose what activity they will participate in and the location where this activity takes place.

The majority of users on Klamath-Lake District state forests are local residents. They are attracted to state forest lands because the lands are primitive and unregulated, and few other people compete for favorite sites. Overall, the highest concentration of use occurs in elk and deer hunting seasons. These seasons extend from the last week of August through the month of November.

Camping

Most people who camp on district lands enjoy other activities like horseback riding and fishing while they camp. There are no developed campgrounds in the district, and all camping is dispersed and informal. The most popular time for camping in the district is from the beginning of July through the end of hunting season.

Most camping occurs on Sun Pass State Forest and is focused along the two streams, Sun and Annie Creeks. The campsites in these areas are the most developed in the district. They consist of a cleared area, a primitive fire pit, and vehicle access from the main roads. These sites vary in size and capacity. The most popular area is along Sun Creek and Road #3. There are campsites on both the east and west side of the creek. Both sites are large and can accommodate multiple vehicles and large groups of people. On Fourth of July weekend it is not uncommon to see groups of 20 people with 2 or 3 recreational vehicles.

Another, much smaller site, is located just to the south along Sun Creek and Road #6. This site can accommodate only a small group. In the past structures have been built at this site.

The other main area for camping exists along Annie Creek on the western border of the forest. Many individual sites exist along the stream. There is one large site that can accommodate a very large group. Historically, a large group used this site for an annual camping trip. However, because of the road closure (see “Wildlife and Fish” earlier in Section III), this group chooses not to use Sun Pass for their outing. Overall, these sites receive little use because a limited number of forest visitors know the area.

There is sparse evidence of camping in both the Yainax and Bear Valley tracts. These sites have most likely been used by hunters in the past. However, there is no concentrated use of these tracts for camping.

Hunting and Shooting

Most of the recreational hunting that takes place in the Klamath-Lake District occurs during the bow and rifle seasons, which extend from the last week of August through November. However, a small amount of poaching does occur outside of hunting season. Some hunters camp for extended periods, but most enter on a daily basis.

Sun Pass State Forest lies in the Oregon Department of Fish and Wildlife's Sprague Unit, Yainax tract is in the Klamath Falls Unit, and Bear Valley tract in the Keno Unit. Within the district there are controlled hunts for deer, elk, and bear. Elk and deer hunting are the most popular hunts in the district. Hunting is the highest concentrated use that occurs on the state forests during the year, but even this is relatively minimal.

Recreational target shooting occurs at a very limited level in the district. The rural nature of the region allows for this activity to occur at numerous sites. Because of this, shooters are not drawn to state forest lands to participate in this activity.

Snowmobiling

Snowmobiling is the most popular winter activity in the district. Most use occurs on Sun Pass State Forest. Currently in Sun Pass, there is a groomed trail that is part of a larger trail system that runs from Lake of the Woods to Diamond Lake (see the recreation map). It runs entirely on the west side of old Highway 232. The trail is groomed and maintained by local snowmobile clubs. The Chiloquin Ridgeriders, Winema National Forest, and Department of Forestry work together to manage this trail system.

Outside Sun Pass State Forest, there are no other groomed snowmobile trails on district-managed lands. It is likely that very minor amounts of snowmobiling do occur on most district-managed lands.

Other Recreation Uses

The majority of recreation in the Klamath-Lake District is confined to the activities already described. However, horseback riding is becoming more popular with users of Sun Pass State Forest. Some activities that occur to a lesser degree are hiking, sightseeing, and educational tours.

Sun Pass State Forest has one developed hiking trail. It runs along the eastern edge of Sun Creek from Road #3 to Crater Lake National Park. It was originally built in 1978, but currently receives no maintenance and little use. During the winter months, some crosscountry skiers venture on to district-managed lands. However, this use is minimal. Many skiers prefer Crater Lake National Park, wilderness areas, and roadless areas.

A few visitors enjoy sightseeing from the forest roads, mainly from Highway 232. This highway bisects the forest in a north and south direction, and has many scenic overlooks to the south and west.

Department of Forestry staff occasionally lead tours for people who are interested in the management of state lands. Participants are usually members of the timber industry or environmental organizations.

Highlights from User Survey

Over the summer of 1994, interviews were conducted with visitors in the forest and representatives of local user groups. Because of the limited use, the road closure in Sun Pass Forest (see "Fish and Wildlife"), and the permit closure for fire danger in mid-August, only 5 groups with a total of 47 people were actually interviewed in the forest. All were in Sun Pass and no visitors were seen or contacted in the other forest blocks. Four of the groups listed camping as their main activity and the other group listed fishing.

The results of the interviews show that the users of the group share common interests and backgrounds. All the people interviewed were from Klamath County with the exception of one Medford resident. For all, this was not a first visit to the forest. One family has camped regularly in Sun Pass since 1937. Group size ranged from 2-20 people staying for 1-4 days. Many visitors had been involved in the timber industry in the area.

User Preferences

Current users of district lands have expressed little desire for changes in recreation management and opportunities. The users contacted prefer the primitive and remote setting of district lands. The only change suggested by current users is the installation of restrooms at the Road #3 and Sun Creek campsites. About 50% of those interviewed suggested this improvement. The other 50% preferred not having these facilities in the forest.

The recreation demand may be different if visitors from outside the county and state are considered. These visitors typically prefer a more developed recreation setting. These opportunities will be met by other recreation providers in the region.

Recreation Demands and Opportunities in the Future

The Klamath-Lake District is facing many challenges as the face of natural resource management continues to change. New concerns have appeared that may influence the way the forest is managed, and changing recreation demand is one of them.

The Statewide Comprehensive Outdoor Recreation Plan (SCORP) shows that recreation demand for dispersed recreation will grow substantially in the future (Oregon State Parks and Recreation Department, 1988). According to the Winema National Forest Plan, the Forest Service estimates recreation demand will increase 30% on the Winema (USDA Forest Service, 1990b). The Fremont National Forest estimates that demand for dispersed recreation will increase 100% over the next 50 years on that forest (USDA Forest Service, 1989). The Klamath-Lake District has the potential to offer dispersed recreation.

Changes in population will also affect future demand for outdoor recreation, because demand for recreation increases at about the same rate as population. According to the Oregon State Employment Division, the population for Klamath County will increase 13% by the year 2010.

Statewide, outdoor recreation has increased dramatically over the past 20 years. A 1989 study by the Oregon Tourism Department reported a 30% statewide growth rate in travel and tourism-related business from 1975-1987. This trend has continued and is likely to do so in the future.

In light of the predicted increase in recreational demand, the Department of Forestry should monitor recreation use on the Klamath-Lake District. Valuable opportunities exist to inform the public about the nature of the working forest and the appropriate care and use of the recreational resource.

Future Recreation Opportunities

In the future, recreation use is likely to increase on Klamath-Lake District state forests. However, current use levels do not indicate the need for any additional recreational developments. Monitoring of use levels will help managers determine the right time to pursue recreational opportunities.

Currently, there is an opportunity in the realm of education. Different media could be used to inform the visitors of Sun Pass State Forest about the natural environment and what makes state forest lands unique. This information could be available at both the forest and at the district office in Klamath Falls.

Scenic Resources

Scenic qualities on state forest lands are very important to the public. For many people, this is their only contact with the forest and the agency, and the basis for their judgments about forest management. Scenic qualities are also an important part of recreation experiences.

Scenic Highways

Recently, the Oregon Legislature has established scenic regulations through the Forest Practices Act. These regulations establish scenic corridors along interstate and state highways.

On the Klamath-Lake District, these buffers have little effect. Only two parcels actually come within 150 feet of these scenic highways. The first is a 640 acre parcel in the northern section of the district. This piece is intersected by Highway 138, which is a designated Scenic Highway. The other parcel is the southwestern tip of Sun Pass State Forest near Annie Creek where it makes contact with Highway 62.

In addition, one forty acre parcel along Highway 140 in the Southwest Block has a scenic conservancy land use designation. See page III-99 for a discussion of this designation.

Uneven-aged Management

Scenic qualities are retained throughout the district, in addition to scenic highway buffers. Uneven-aged management is used on 80% of the Klamath-Lake District state forests, and as a result there are few clearcuts on the state forests. The uneven-aged management retains the continuity of the forest with no large gaps. It maintains the forest's scenic qualities for both background viewing (viewing from outside the forest), and foreground viewing (viewing from within state forest lands).

Much of the state forest land is visible in the distance from major highways. For example, from Highway 62, the south entrance into Crater Lake National Park, the entire west side of Sun Pass State Forest is visible. Although timber harvest has occurred in the past, the forest is still visually attractive.

From inside the forest, there is little evidence of timber harvest unless it is recent. After a year or two, when slash has been treated, the only visible evidence is the stumps. The standing trees left on the harvest unit allow the forest continuity to be left intact.

The management of the Klamath-Lake District state forests has maintained healthy forests with a natural appearance. The timber harvesting that occurs does little to disrupt the appearance of the forest. The forest's scenic qualities leave a positive impression about the agency and the forest with people driving through the area.

Cultural Resources

Cultural resources are objects, structures, or sites used by people in the past. They are fragile, irreplaceable, and nonrenewable. Objects that remain undisturbed in their original locations are especially significant. These objects are still in context with each other and their surroundings, and provide the most information about the culture that created them. They provide a meaningful record of past lifeways and cultures in Oregon, including past ecological conditions.

Cultural resources are valued for many reasons. Researchers value archaeological sites for the information they provide about ancient cultures. Many sites also have religious, historic, or associational values for American Indian communities. The Klamath Tribes prefer that sites remain in place undisturbed, especially those associated with burials or religious activities. Finally, some Oregon historic sites have been maintained as interpretive, recreational, or heritage sites. If interpretation of Indian history on state lands is involved, this activity would be coordinated with the Klamath Tribes.

Examples of cultural resources that might be found on state lands in eastern Oregon include railroad logging camps and equipment, seasonal use areas, lithic scatters (where stone tools were made), vision quest sites, or cremation or burial sites. See the "Key Terms" boxes on the next two pages for definitions of terms used in this subsection.

Applicable Laws

Both state and federal laws regulate management of cultural resources. Important Oregon laws include: Archaeological Sites and Historical Material; Archaeological Objects and Sites; Indian Graves and Protected Objects; and the State Historic Preservation Plan. The Oregon laws were amended and strengthened in 1993 by Senate Bill 61. Unlike federal law, Oregon statutes do not mandate archaeological surveys or mitigation of impacts by state agencies as part of conducting land management activities. However, artifacts and sites found on public lands, and in some cases private lands, must be protected from harm or removal. If a sacred object is found, the State Historic Preservation Office (SHPO) and appropriate group or tribe must be notified. American Indian cairns and graves are protected by state law anywhere in Oregon, on privately owned as well as public lands.

Information relating to the location of archaeological sites and objects is usually not released to the public unless the public interest requires the disclosure, or if the governing body of an Indian tribe requests the information.

The state and federal laws regulating cultural resource management are described in more detail starting on page III-122, following the next two pages of "Key Terms."

Key Terms

Archaeological and historical resources — Those districts, sites, buildings, structures, and artifacts which possess material evidence of human life and culture of the prehistoric and historic past.

Archaeological object — An object that is at least 75 years old; is part of the physical record of an indigenous or other culture found in the state or waters of the state; and is material remains of past human life or activity that are of archaeological significance, including, but not limited to, monuments, symbols, tools, facilities, technological by-products and dietary by-products. (ORS 358.905)

Archaeological site — A geographic locality in Oregon, including but not limited to submerged and submersible lands and the bed of the sea within the state's jurisdiction, that contains archaeological objects and the contextual associations of the archaeological objects with: each other; or biotic or geological remains or deposits. (ORS 358.905)

Burial — Any natural or prepared physical location whether originally below, on or above the surface of the earth, into which, as a part of a death rite or death ceremony of a culture, human remains were deposited. (ORS 358.905)

Cairn — Stones piled up as a memorial or as a landmark. (This term is not defined in Oregon law.)

Funerary objects — Any artifacts or objects that, as part of a death rite or ceremony of a culture, are reasonably believed to have been placed with individual human remains either at the time of death or later.

Grave — See "Burial."

Historic artifacts — Three-dimensional objects including furnishings, art objects and items of personal property which have historic significance. "Historic artifacts" does not include paper, electronic media or other media that are classified as public records. (ORS 358.635)

Historic property — Real property that is currently listed in the National Register of Historic Places, established and maintained under the National Historic Preservation Act of 1966, or approved for listing on an Oregon register of historic places.

Human remains — The physical remains of a human body, including, but not limited to, bones, teeth, hair, ashes or mummified or otherwise preserved soft tissues of an individual. (ORS 358.905)

Indian tribe — Any tribe of Indians recognized by the Secretary of the Interior or listed in the Klamath Termination Act, 25 U.S.C. 3564 et seq., or listed in the Western Oregon Indian Termination Act, 25 U.S.C. 3691 et seq., if the traditional cultural area of the tribe includes Oregon lands (ORS 97.740).

Key Terms

LCDC — Land Conservation and Development Commission of the State of Oregon, made up of seven lay citizens appointed by the Governor and confirmed by the Oregon Senate.

Lithic reduction site (lithic scatter) — A location where prehistoric stone tools were made, usually from obsidian. The tools and weapons were used locally or traded.

Object of cultural patrimony — An object having ongoing historical, traditional or cultural importance central to the native Indian group or culture itself, rather than property owned by an individual native Indian, and which, therefore, cannot be alienated appropriated or conveyed by an individual regardless of whether or not the individual is a member of the Indian tribe. The object shall have been considered inalienable by the native Indian group at the time the object was separated from such group. (ORS 358.905)

Petroglyph — Prehistoric rock carving.

Pictograph — Prehistoric rock painting.

Recognized Indian tribe — A tribe of Indians with federally acknowledged treaty or statutory rights. The federally recognized tribes in the Eastern Oregon planning region are the Burns Paiute, the Confederated Tribes of the Umatilla Indian Reservation, and the Klamath Tribe. The Klamath Tribe includes the Klamath, Modoc, and Yahooskin Band of Snake Indians.

Sacred object — An archaeological object that is demonstrably revered by any ethnic group, religious group or Indian tribe as holy; is used in connection with the religious or spiritual service or worship of a deity or spirit power; or was or is needed by traditional native Indian religious leaders for the practice of traditional native Indian religion. (ORS 358.905)

Site of archaeological significance — Any archaeological site on, or eligible for inclusion on, the National Register of Historic Places as determined in writing by the State Historic Preservation Officer, or any archaeological site that has been determined significant in writing by an Indian tribe. (ORS 358.905)

State Historic Preservation Office (SHPO) — Oregon's SHPO was created in 1966 by federal statute. It administers the Statewide Plan for Historic Preservation and submits Oregon's nominations for the National Register of Historic Places.

Unrecognized Indian tribe — A tribe of Indians that has never been recognized by the federal government, or whose federal relations were terminated by the Klamath Termination Act or the Western Oregon Indian Termination Act.

Vision quest site — In the Klamath region, these are sites used for seeking spiritual power, often on mountain tops, rimrocks, and other outcrops. They often contain constructed rock features ranging in age from prehistoric to contemporary.

Applicable Laws (continued from page III-119)

Archaeological Sites and Historical Material (ORS 390.235-390.240) — This law describes conditions for obtaining a permit from the State Parks and Recreation Department for excavation or removal of archaeological or historical material. It defines "qualified archaeologist."

Regulations adopted on January 3, 1995 establish procedures for issuance of archaeological permits on public and private lands (OAR 736-51-060 through 736-51-090). On public lands, a permit is needed to excavate or alter an archaeological site, to make an exploratory excavation to determine the presence of an archaeological site, or to remove any material of an archaeological, historical, prehistoric, or anthropological nature. A person who is considering a ground-disturbing project on public lands should contact the appropriate tribe to inquire about the presence of archaeological sites and objects in the project area.

Archaeological Objects and Sites (ORS 358.905-358.955) — This law contains important definitions pertaining to cultural resources (see the "Key Terms"). Archaeological sites and objects located on public land are to be protected and managed by the state as a public trust. The law prohibits knowingly and intentionally excavating, injuring, destroying, or altering an archaeological site; or removing objects without a permit. A person who "unintentionally discovers" an exposed object may retain it for personal use, except for sacred objects, human remains, funerary objects or objects of cultural patrimony.

Penalties (ORS 273.990) — Violation of ORS 390.235 (1)(a) or 358.920 is a Class B misdemeanor.

Indian Graves and Protected Objects (ORS 97.740-97.760) — American Indian cairns, burials, human remains, funerary objects, sacred objects, and objects of cultural patrimony may not be willfully removed, injured, or destroyed. If a cairn or burial site is disturbed inadvertently, e.g., by logging activities, the remains or funerary objects must be reinterred under the supervision of the appropriate Indian tribe. Any discovered human remains suspected to be native Indian shall be reported to the state police, the State Historic Preservation officer, the appropriate Indian tribe, and the Commission on Indian Services. Archaeological excavation of a cairn or burial can be undertaken with proper notice, a permit, and the consent of the appropriate Indian tribe. This is the only state law to list penalties for a violation, including payment of damages, attorney fees, or other equitable relief.

Classification of Historic Property; Historic Preservation Plan; Preservation of Property of Historic Significance (ORS 358.475-358.690) — These laws encourage the preservation, management, and enhancement of significant cultural resources in Oregon, in conformance with the federal National Historic Preservation Act of 1966. The law describes the duties of the State Historic Preservation Office (SHPO) and the State Advisory Committee on Historic Preservation. Real properties of historic significance are administered by the Secretary of State with consultation with the State Historic Preservation Office.

Statewide planning goals — Four of Oregon's 19 state-wide planning goals refer to historic preservation: Goal 5 (open spaces, scenic and historic areas, natural resources and cultural resources); Goal 8 (recreation); Goal 15 (Willamette River Greenway); and Goal 17 (coastal shorelands). These policies apply to city and county land use planning. Under the State Land Use Planning Law, local governments are required to inventory the location, quality, and quantity of their historic resources, including archaeological sites. The Oregon Land Conservation and Development Commission coordinates planning by state and federal agencies with city and county comprehensive plans.

Federal laws — Federal laws apply to federal land and agencies such as the U.S. Forest Service, and to federally licensed or funded activities. For example, if an access road is constructed across federal land, federal cultural resource laws would be followed. Significant federal laws include the National Historic Preservation Act of 1966, the Archaeological and Historic Preservation Act of 1974, the Archaeological Resources Protection Act of 1979, and the American Indian Religious Freedom Act of 1978. The Native American Graves and Repatriation Act of 1990 governs the protection of burials and associated grave artifacts. In 1992 the Applegate Trail, a portion of the California Trail in southern Oregon, was included in the California National Historic Trail by the National Trails Act.

Federal agencies must seek and identify tribes having aboriginal or historic ties to the land, and determine the location and nature of specific sites of cultural or religious importance. Federal landowners must conduct archaeological surveys before any ground-disturbing activities, and must consider the effects of the activities on archaeological sites. Notice must be given to the appropriate American Indian tribe before excavating any site. Up to 1% of project funds may be used for recovery or preservation of archaeological resources.

The American Indian Religious Freedom Act requires that archaeological excavations on federal properties consider American Indian concerns about land, sites, and sacred objects. Federal laws, policies, and practices need to protect and preserve the inherent right of American Indians to practice their traditional religions. However, federal administrative rules do not explicitly guarantee the right to visit a sacred site; to gather plants for use in medicine, crafts or religious practices; or to hunt on federal lands for religious purposes — for example, to hunt threatened or endangered species, or out of season. The question of whether the American Indian Religious Freedom Act is binding upon state and local governments has not been tested in the courts (Commission on Indian Services 1991).

Cultural Resources on Klamath-Lake District State Forests

The following description is based on an assessment by Winema National Forest Archaeologist, Elizabeth E. Budy, done for the Klamath-Lake District (Budy 1994).

A review of information available from the Winema National Forest, Fremont National Forest, BLM, and the State Historic Preservation Office reveals the kind of cultural resources likely to be found on state lands.

Some Klamath-Lake District state forest lands are located on former Klamath Indian Reservation lands and on lands ceded by the three treaty groups — Klamath, Modoc, and Yahooskin Paiute — in 1864. Cultural resources in the vicinity of state forest lands include villages, camps, rock shelters, cremation piles and burials, obsidian quarries, stone tool making sites, peeled trees, petroglyphs, pictographs and vision quest sites. Two American Indian sites are known to be located on state forest lands. Both contain numerous rock features that represent vision questing and spirit power seeking by Klamath Indians in the ancient past, and continuing today.

Mountain tops, rimrocks, and other bedrock outcrops are likely to contain vision quest rock features, especially on the west side of Sun Pass State Forest. Klamath tribal members are especially concerned that vision quest sites be protected and that the rock features remain as they were originally placed. Like most archaeological sites, vision quest site locations must be kept confidential.

No pictographs or petroglyphs have been found on state forest lands. Rock paintings and carvings by ancient artists probably served a variety of purposes, such as marking an important resource like a spring. Some may be associated with sacred locations, and would be especially protected under state law.

No burial or cremation sites are known to be located on state forest lands. The protection of such sites is of considerable importance to American Indians, and the sites are protected by both state and federal laws.

Winter villages and seasonal hunting and plant gathering camps can sometimes be found near streams and springs and along meadow edges. Peeled trees may be found near winter village sites. Ponderosa and other trees were traditionally stripped in late winter or early spring to access the inner cambium layer for food. Sun Pass State Forest is not far from winter village sites along Wood River.

Historic sites in Klamath and Lake Counties relate to early exploration and land surveys, military actions, Indian treaties and reservations, homesteading and ranching, communication systems, fire suppression, railroad logging, stream navigation, and recreation. Historic sites known to be present or that may be found on state lands include early explorers' trails, wagon roads, features and artifacts relating to Fort Klamath, early land survey markers, and railroad logging grades, camps, features, and artifacts.

Early Euro-American explorers used several routes through the area, including the Applegate Trail and the Old Klamath Indian Trail. The Applegate Trail was used by settlers in 1846 and 1847 to cross southern Oregon. Part of the trail runs across state forest land in Bear Valley. It is now part of the California National Historic Trail. The Old Klamath Indian Trail was later developed into the Huntington and Old Fort wagon roads. Blazed trees marking the route followed by early explorers could be present in some isolated parcels of state forest lands or in Sun Pass Forest. See "History" in Section I for more information on these explorers and the historical events mentioned in the next several paragraphs.

In 1863 soldiers started construction of Fort Klamath, a military post in the Wood River Valley not far from the present-day Sun Pass State Forest. The fort was abandoned in 1889, and none of the original buildings remain today. Trash scatters and isolated artifacts are likely to be found on state lands bordering the fort, especially along Annie Creek and in the southern part of Sun Pass. Two blazed trees mark the boundary of the military hay reserve on national forest land, and similar markers may be found in Sun Pass.

In the 1860s and 1870s the army blazed and constructed a number of military roads in the area. In the fall of 1867, Lindsay Applegate built a road over the old Klamath Indian Trail north from the Indian Agency to the present town of Bend. Blazed trees, wagon ruts, or old road beds may be preserved on state lands along Annie Creek, in Sun Pass, or in some isolated land parcels. Blazed trees and early survey monuments may be found on state forest lands, dating to the 1871 Mercer survey or to the Thiel survey of 1886.

Railroad logging took place from 1910 to the late 1940s throughout the area, including the Klamath Indian Reservation. Railroad logging grades, with ties in place, are known to occur on state lands, with associated artifacts and machinery.

Cultural Resource Assessment

Known settlement patterns and land uses in this area can be used to predict the most likely locations of cultural resources on state lands. Potential site areas would include stream bottomlands, river terraces, and stream benches as sites of villages, camps, or resource gathering and processing. Lake shores, marsh edges, lake terraces, and benches may have been used for summer or winter villages. Lithic scatter sites and other artifacts may be found on flat or gently rolling terrain within 150 meters of a water source, such as a spring, seep, pond or wet meadow.

Canyon rimrock, bedrock ledges on ridges, rock outcrops, and mountain tops, especially with open views to the horizon, are possible sites for religious power seeking. Rock features built by the power seekers may be associated with these sites.

Scab-rock flats and dry meadows, usually on flat or open ground, with non-forest vegetation, are sources of economically useful food plants (roots and seeds) and forage for game animals. Lithic scatter sites reflect short-term hunting and gathering. Rock features might also be present.

Any natural obsidian source might have been used for manufacture of stone tools. Important obsidian sources on the Winema National Forest involve eroded surface exposures of scattered pebble or cobble-sized nodules.

Fire Management

Wildfire poses a threat to many of the forest resources discussed in this plan. Timber, wildlife and fish, recreation, special forest products, and scenic qualities are some of the forest resources that are affected by wildfire. The Klamath-Lake District tries to minimize the negative affects of wildfire through two separate programs. These two programs are the Protection from Fire Program and the State Lands Program.

Protection from Fire Program

The Klamath-Lake District protects all state forest lands and private forest lands in the district. The district also protects various other county, municipal, and state-owned lands; and, under a contract, all BLM-managed land west of Highway 97. The goal of the Protection from Fire Program is to minimize the total cost and loss resulting from fire, in terms of suppression cost and damage to timber and other forest resources. To meet this goal the district responds aggressively to wildfires, suppresses fires rapidly, and reduces fires and the associated damage through various preventive programs.

The driving force behind the Protection from Fire Program is ORS Chapter 477. This statute declares preservation of forests and conservation of forest resources through the prevention and suppression of forest fires to be the public policy of the State of Oregon, and recognizes the need for a complete and coordinated forest protection system.

Essential elements of the Protection from Fire Program include: planning, prevention, detection, mobilization, initial attack, smoke management, and fuel management. Fuel management will be discussed later in this subsection under the heading “State Lands Program.”

Protection from fire is paid for by the protected landowners. Landowners pay an assessment per acre of protected forest land. The State Lands Program pays the above assessment for all lands managed by the department. The funds generated by the assessed lands in the Klamath-Lake District provide for the local base level of fire protection as well as contributions to the Emergency Fire Fund, Retardant Availability Program, and Staff and Administrative Support.

Fire protection in the Klamath-Lake District is divided into two protection units: the Klamath Unit and Lake Unit. The Klamath Protection Unit is made up of a unit forester who oversees a protection supervisor, one full-time forest officer, 26 seasonal firefighters, 4 seasonal lookouts, a seasonal dispatch coordinator, one seasonal dispatcher, a forest management specialist responsible for prevention programs, and one equipment operator. The Lake Protection Unit is headed by one unit forester, a protection supervisor, 15 seasonal fire fighters, a seasonal unit dispatcher, and a seasonal dispatcher. These two protection units also work closely with other local fire protection agencies and landowners to insure a complete and coordinated protection system.

The Klamath-Lake District Protection from Fire program also works closely with the Klamath Forest Protection Association (KFPA). This local association, made up of forest landowners in the district, provides input on the budget, advice on the protection level, program direction, and local coordination between the Klamath-Lake District and its protected landowners.

State Lands Program

While the Protection from Fire Program prevents and suppresses wildfires, the State Lands Program also works to minimize fire impact on district-managed lands by managing fuel levels. This objective is accomplished in many ways.

The uneven-aged management practiced on most of the district reduces fire hazard. The stocking reduction associated with standard uneven-aged management reduces fire hazard and fuel levels in several ways. First, decreased stocking levels increase forest health. This reduces the presence of insects and disease, which can lead to severe mortality. Second, uneven-aged management practices simulate low-intensity fire by thinning the understory and selectively removing fire-susceptible species.

A variety of tools are used to treat slash created during harvest and precommercial thinning. Our timber sale contracts usually require whole tree yarding of smaller trees, which concentrates post-harvest residue at landings where it can be burned or chipped. Occasionally, unacceptable slash accumulations still remain after whole tree yarding, and machine piling and burning is necessary in spots. Broadcast burning is frequently used after even-aged harvests in the lodgepole pine forest zone. A “slashbuster” machine has been used to crush and scatter slash after precommercial thinning. Chip/biomass sales have been used in several stands over the past few years in place of precommercial thinning. In these sales, most of the slash is used instead of being left on site. The viability of these sales is dependent on chip prices, which are volatile. Underburning has not been used on the district, but may be used in the future to meet fuel management and silvicultural objectives for certain sites.

The State Lands Program also salvages stands with severe mortality, in order to reduce fire hazard. Large stands of dead and dying material can increase fuel levels drastically. Salvage occurs to capture the value of this material as well as to reduce fire hazard. Dead trees are also left to provide wildlife habitat (see “Wildlife and Fish Strategies” in Section V).

Grazing

Livestock ranching is an important part of Eastern Oregon's economy. Both public and private lands are used for grazing. These lands vary in character, quality, and value. They often have other natural resources such as timber, water, wildlife, recreation, and minerals. State forests are managed primarily for timber, so where grazing occurs these may be thought of as "forested rangelands."

Public lands have historically supplemented the forage available to private livestock ranches. Grazing has been permitted, but not actively managed on the Klamath-Lake District and the Eastern Oregon scattered tracts. Most of these state grazing leases have been associated with federal grazing allotments. In developing a grazing policy through this long-range plan, the Department of Forestry must satisfy its fiduciary obligations and stewardship responsibilities while meshing with the rangeland programs of the Division of State Lands, the U.S. Forest Service, and the Bureau of Land Management (BLM).

Background Information

Grazing on State-Owned Lands

Grazing occurs mostly on Common School Lands that are managed by the Division of State Lands (DSL). DSL manages over 600,000 acres of rangelands in eastern Oregon. Most of these are Common School Lands located primarily in Lake, Harney, and Malheur counties. Some of DSL's grazing leases are on Common School Forest Lands (CSFL). The CSFL lands have been designated for the primary use of timber production. See the "Key Terms" box on the next page for definitions. The Department of Forestry is the primary land manager for CSFL lands, but DSL is responsible for grazing leases.

Grazing occurs on Board of Forestry (BOF) lands to a lesser extent. The Department of Forestry manages grazing as well as timber on BOF lands.

This plan addresses grazing on BOF and CSFL lands in the Klamath-Lake District. Currently, all leases are for cattle grazing. There has been some sheep grazing in the past.

Extent of Klamath-Lake District's Rangeland Resource

As measured by the Department of Forestry's land use classifications — In the Department of Forestry's land use classification system, most BOF and CSFL acreage is classified for the primary use of timber production. However, in the Klamath-Lake District, 787 acres of BOF land and 146 acres of CSFL are classified as "farm/rangeland use." This classification method indicates how much land is better suited to farm/rangeland use, but it does not reveal how much grazing could also occur on timber production land.

As measured by current grazing usage — A better estimate may be given by current grazing leases. In 1994, there were 2,397 acres of BOF and 3,164 acres of CSFL under lease in the Klamath-Lake District, for a total of 5,561 acres.

Key Terms

Definitions followed by "RMAR" are from the Division of State Land's Rangeland Management Administrative Rules.

Allotment — Block of land granted to a permittee for exclusive grazing use.

Allotment management plan (AMP) — A plan covering a specific federal grazing allotment, developed by the federal agency managing the allotment; the AMP outlines various aspects of range management.

Animal Unit — An animal unit typically consists of one cow; or one cow and a calf less than six months old; or 1.4 yearlings; or one horse; or five sheep. (RMAR)

Animal Unit Month (AUM) — The amount of forage (approximately 800 pounds of air-dried forage) necessary to feed one animal unit for one month. (RMAR)

Common School trust lands — State lands owned by the State Land Board; the primary goal in managing these lands is the generation of the greatest amount of income for the Common School Fund over the long-term, consistent with sound techniques of land management. Common School trust lands that have been listed by the State Land Board for the primary purpose of timber production are called Common School Forest Lands (CSFL). Other Common School trust lands are designated as rangelands or for other uses.

Exchange of use — An agreement between a rancher and the BLM or Forest Service that gives the rancher permission to graze livestock on federal land in exchange for allowing the federal agency to regulate and control grazing on the rancher's owned or leased lands that are adjacent or intermingled with the federal lands.

Isolated parcel — A parcel that is either largely surrounded by land not owned by the state, isolated from larger state-owned tracts and/or difficult or uneconomical to manage.

Livestock — Livestock are domestic animals such as beef and dairy cattle, horses, sheep, and goats kept or produced primarily for farm, ranch, or market purposes. Livestock also may include bison, llamas, emus, ostriches, and other species approved for use on a leasehold by the Division of State Lands. (RMAR)

Open range — An area wherein livestock may lawfully be permitted to run at large. (ORS 607.005(6))

Rangeland — Rangeland is state land designated and managed by the Division of State Lands for livestock grazing and/or conservation use, determined by the Division to be appropriate to the subject leasehold(s) and consistent with applicable local, state, and federal laws.

Rangeland management plan (RMP) — A written document prepared and approved by the Division of State Lands, in consultation with the lessee and other affected agencies and interests, indicating how a particular leasehold shall be managed during a specified term of a rangeland lease. (RMAR)

Quality of Rangelands and Economic Importance of Grazing

In general, Eastern Oregon's rangelands are considered to be in fair to good condition, although there is much variation in quality. The importance and benefits of grazing in the eastern Oregon state forests are fairly insignificant except where larger blocks are involved or where a smaller parcel may be an integral part of a Forest Service permit. Such a parcel may be quite important for access, meadow land, or stock water availability. Benefits will most likely require a case-by-case determination (Majors 1994).

Livestock ranching has been supported by federal public policy for many years. This policy has promoted community stability and the livelihood of ranchers who are dependent on federal rangelands (personal communication, Julie Bolton, 1994).

Grazing leases on CSFL and BOF lands are generally issued as a result of open range grazing. Financial returns to the state have been minimal. In 1994, the Klamath-Lake District's five grazing leases on CSFL and BOF lands generated about $630 gross revenue.

Mandates and Policies for Grazing and Rangeland Management

State of Oregon Lands

Board of Forestry Lands

The Department of Forestry manages forests and grazing on property owned by the Board of Forestry. Any income from grazing leases is shared with the county where the land is located. By statute, the State Forester may permit domestic livestock grazing in order to secure the greatest permanent value to the state, as long as this use is not detrimental to the best interest of the state. (ORS 530.010; 530.030; 530.050) There are no administrative rules to regulate livestock grazing on BOF land.

Grazing leases for BOF lands are issued by foresters at the Klamath-Lake District office in Klamath Falls. Leases have been issued for as long as ten years. The leases have specified the maximum allowable AUMs and the annual rental, calculated most recently at $2.50 per AUM. The standard lease form includes general conditions, but not specific range management requirements. Usually, the BOF lands where grazing occurs have been encircled by federal grazing allotments. The Department of Forestry has generally issued grazing leases to the federal permittees. Details on current leases are given later in this subsection, under the heading "Current Situation — Grazing Leases."

Common School Forest Lands

Common School Forest Lands are those Common School lands that have been designated for the primary use of timber production. The Department of Forestry (ODF) is the primary land manager under a contract with the State Land Board. However, grazing and

mineral leases are managed by DSL. The December 20, 1993 contract spells out the roles of ODF and DSL.

The State Land Board holds CSFL lands in trust to benefit the Common School Fund. The Land Board has a constitutional obligation to obtain the greatest amount of revenue over the long-term for the use of this land, consistent with conservation of the lands under sound techniques of land management (Division of State Lands, 1994b). A July 24, 1992 legal opinion by Oregon Attorney General Charles S. Crookham states that forests and rangelands are among the many natural resources that may offer revenue for the Common School Fund. See the heading "Attorney General's Opinion" in Appendix C for more information on this legal opinion.

DSL is currently working on an asset management plan that will determine the best management direction for all Common School lands, including the CSFL lands.

Until July 29, 1994, DSL had no administrative rules for the rangelands they managed. Their management was based on applicable Land Board policies, Attorney General opinions, statutes, and the experience of the Division's range managers. On July 29, 1994, the State Land Board approved a set of administrative rules that apply to all rangelands managed by DSL. The new rules were designed to promote and maintain rangeland health while fulfilling the state's fiduciary responsibility to maximize long-term revenue from Common School Lands and their resources. Grazing fees were raised for the first time since 1979, and the rules provided for competitive bidding among ranchers and others who want to lease the lands for conservation use (Division of State Lands, 1994b). However, on February 14, 1995, the State Land Board voted to reconsider the rules and competitive bidding was later rescinded.

DSL issues leases for grazing on Common School Forest Lands. Their grazing program is administered and monitored by four resource coordinators out of DSL's Eastern Region office at Bend. Leases have been issued for an extended number of years and some leases have had renewal rights. The leases have specified the maximum allowable AUMs and the annual rental, calculated most recently at $2.50 per AUM on most lands. DSL's leases have generally been associated with federal allotments. Details on current leases are given later in this subsection, under the heading "Current Situation — Grazing Leases."

Open Range and Federal Allotments

Allotments

State and privately owned lands are often intermingled within Forest Service or BLM grazing allotments. Most allotments are for cattle grazing, although some are used for sheep. In order to hold a grazing permit, a rancher must generally own livestock and/or base property that is tied to the permit. These conditions ensure that the permittee is in the business of ranching, promote long-term land stewardship, and prevent speculative transactions in grazing permits.

Allotments are managed in accordance with the agency's forest plan standards and guidelines. In addition, some allotments may have an allotment management plan (AMP). The AMP outlines various aspects of range management such as grazing schedules, rangeland improvements (e.g. fences, corrals, water), and resource protection measures. Forest Service and BLM grazing allotments must meet NEPA (National Environmental Policy Act) requirements. Existing AMPs are currently being updated to meet NEPA criteria. Forest plan standards and guidelines that are used in lieu of an AMP must also meet NEPA requirements.

Open Range

As a general rule, all lands except incorporated cities and exempted livestock districts are considered open range under Oregon statutes. (Several provisions in Chapters 607 and 608 of the Oregon Revised Statutes, taken together, constitute Oregon's open range law.) In open range, livestock may lawfully be permitted to run at large. The owners are not liable for trespass unless their livestock injure property enclosed by an "adequate fence". In livestock districts, the legal framework is reversed: ranchers have the burden of fencing their land to prevent their livestock from trespassing on to other lands (Cook 1994).

Open range laws have been an important part of grazing policy because they provide a system for managing trespass where federal and non-federal lands are intermixed (personal communication, Bill Lindsey, 1994). Although the state's open range law allows livestock from a federal grazing allotment to run at large onto non-federal land, the opposite situation is not legal. Livestock that stray from state or private land on to federal land without a permit are in trespass.

The state Attorney General's office has supplied the following information about how open range affects the leasing of Common School lands. The vast majority of state-owned land is open range. Where a state-owned parcel is bordered (or surrounded) by lands owned by the rancher who currently leases the state parcel, that lessee has no reason to fence the state land he or she leases. However, if the state now leased such a parcel to someone else, it must be fenced. Under the open range law, unless that state parcel is enclosed by an adequate fence, the neighboring rancher lawfully could allow his or her livestock to graze the state parcel without a lease. On Common School lands, this would be contrary to the state's trust responsibilities as well as the interests of the new lessee (Cook 1994).

Sun Pass State Forest is adjacent to private pastures, but it is not in a livestock grazing district. The nearest livestock districts are south of Modoc Point and around Sprague River and Beatty (personal communication, Rodger Huffman, 1994).

Exchange of Use

BOF and CSFL lands in the Klamath-Lake District tend to be relatively small, isolated parcels. Many of the parcels are enclosed by federal grazing allotments, and because there are no fences, allotment livestock may lawfully run at large.

A person who applies for a federal grazing permit generally obtains leases for state and private lands within the allotment boundary. Proof of these leases is shown when applying for a permit. In essence, the permittee's personal land and leased grazing rights comprise the privately held portion of the allotment. The federal permit accomplishes two things. First, it waives the private lands to the federal agency. In other words, it adds these lands and their grazing capacity (AUMs) to the allotment. Second, it enables the permittee's livestock to enter federal land without trespass.

The signed agreement between the federal agency and the permittee is the Exchange of Use Grazing Agreement (BLM) or Term Private Land Grazing Permit (USFS). The state does not sign the federal permit, having transferred grazing use of its land to the permittee through a lease. In spite of provisions that require the permittee to comply with various laws, regulations, and conditions on all lands in the allotment, there is no clear obligation for a federal agency to administer the allotment or enforce the terms of the permit on the non-federal lands.

If the state stopped leasing its land to the permittee, this action would effectively cancel the waiver (i.e. exchange of use arrangement). The use of state land might continue under the open range law, although it might be with a smaller herd.

Term Private Land Grazing Permit (USFS) — This document is the master permit for Forest Service grazing allotments that include state or privately owned land. It waives private lands identified in the permittee's application to the United States for grazing use and gives the U.S. exclusive and continuous possession of the waived lands for livestock grazing during the term of the permit.

The permit may be suspended or canceled "for conviction for failure to comply with federal laws or regulations or state and local laws relating to livestock control and to protection of air, water, soil and vegetation, fish and wildlife, and other environmental values." Supplemental provisions may be attached in the form of an allotment management plan (AMP).

Annual adjustments to the permit can be made in accordance with forage conditions. Forest Service officials may order livestock to be removed from Forest Service-administered lands before the designated grazing season expires if further grazing would damage the resource. Fundamental changes in the allotment, such as the number of livestock or the period of use, require a one-year notice.

Exchange of Use Grazing Agreement (BLM) — The Exchange of Use Grazing Agreement allows the Secretary of Interior to exercise the same regulations and controls on both private (i.e. owned and leased) and BLM lands under the permit. In exchange, the permittee is allowed to graze livestock on BLM lands that are intermingled and adjacent to the owned and leased lands.

BLM uses two additional documents: (1) the BLM grazing lease allows grazing on BLM land; (2) the annual grazing license specifies the number of livestock and AUMs on both BLM and all other lands.

The BLM documents are considerably shorter than the Forest Service versions, and do not refer to any specific conditions or allotment management plans. The Taylor Grazing Act, Federal Land Policy and Management Act, and the Public Rangelands Improvement Act are specifically mentioned.

Current Situation — Grazing Leases

The next several pages provide information on all Klamath-Lake District grazing leases and federal grazing allotments that enclose state lands. The information is organized under the East Block and Southwest Block. Under each block, the information is summarized by allotment, with information about ownership provided under each allotment.

The following acronyms are used in the grazing lease summaries:

AUM	Animal Unit Month	DSL	Division of State Lands
BLM	Bureau of Land Management	ODF	Oregon Department of Forestry
BOF	Board of Forestry	USFS	U.S. Forest Service
CSFL	Common School Forest Lands		

East Block

Yainax Butte Allotment **Agency: USFS** **Size: 118,000 acres**

State Leases and/or Land Associated with Allotment

- 3,044 acres of CSFL lands (120 AUMs) under lease to James Rodgers.
- 876 acres of BOF land (21 AUMs) under lease to James Rodgers.

Management Status

Of the allotment total, 82,000 acres are USFS lands and 9,000 acres are the permittee's lands. State lands are listed above. The Yainax Butte Coordinated Resource Management Plan (CRMP) is recognized as the allotment's management plan. Participants include Weyerhaeuser Company, DSL, ODF, ODFW, OSU Extension Service, USFS, SCS (Soil Conservation Service), BLM, and the permittee. The Forest Service is currently updating the plan in order to meet NEPA requirements. According to the CRMP, cattle are wintered in California, spend a short time on the headquarters ranch, then rotate between pastures on the allotment. The plan has a four-year schedule for 1,000 cows and bulls, requiring 6,500 AUMs.

The CRMP also includes: (a) objectives by participant and for the group as a whole; (b) major problems and concerns; (c) management plans for livestock grazing, irrigated cropland, forestry, wildlife, fisheries, T&E species, recreation, cultural resources, and watershed; (d) information about forage management, livestock control, special improvements, and livestock management. Grazing schedules are reviewed annually to adjust for range condition and any concerns that the participants might have.

In addition to the CRMP, DSL keeps a Rangeland Inventory of the CSFL lands in the Yainax Allotment. The inventory contains information about the range, improvements, water features, wetlands, threatened and endangered species, cultural resources, and recreation. Vegetative inspection reports are cited.

Horsefly Allotment

Agency: USFS **Size: Over 100,000 acres**

State Leases and/or Land Associated with Allotment

- 120 acres of CSFL land (12 AUMs) under lease to Newman Enterprises; this lease also includes 93 acres of non-forest trust lands managed by DSL, for a total of 213 acres (21 AUMs).
- 160 acres of BOF land that is not under lease — grazing could be occurring on these 3 parcels due to open range.

Management Status

An allotment management plan was written in 1984.

Traphouse, Horseglades, and Reservoir Creek Allotments

Agency: USFS

State Leases and/or Land Associated with Allotment

- 364 acres of BOF land leased to Rocking AC Ranch; this lease also includes 35 acres of BOF land in an isolated parcel that is not inside a Forest Service allotment, for a total of 399 acres (40 AUMs).

Management Status

Horseglades is roughly 12,000 acres. Traphouse and Reservoir Creek are each less than 800 acres. Management standards and guidelines are set by the Fremont National Forest Land and Resource Management Plan.

Southwest Block

Chicken Hills Allotment

Agency: BLM

State Leases and/or Land Associated with Allotment

1,126 acres of BOF land (60 AUMs) leased to Lee Harrington.

Management Status

BLM currently lists the allotment as having 114 cattle (20 BLM and 94 exchange of use). In terms of forage, the allotment totals 465 AUMs (82 BLM and 383 exchange of use). The base property is 1,800 acres, which the permittee leases from Bart Hadwick. The AUMs are a reasonable estimate based on the number of cattle that were granted to the exchange of use. The 383 AUMs includes BOF lands (1,126 acres and 60 AUMs) and Boise Cascade (37 AUMs). The remaining 286 AUMs presumably account for the Hadwick pasture. Weyerhaeuser Company has canceled its exchange of use.

Chase Mountain Allotment

Management Status

The Bear Valley tract has previously been leased in connection with the BLM's Chase Mountain allotment. Both the lease and the BLM allotment are currently inactive. Weyerhaeuser Company, which owns the base property, has canceled its exchange of use. On the books, the allotment has 8,823 acres (195 AUMs) of BLM land and 19,680 acres (895 AUMs) of state and private land. The Klamath-Lake District's Bear Valley tract (approximately 2,000 acres BOF land) is inside the allotment.

North Block

The North Block's satellite parcels near Chemult are not within a Forest Service allotment and are not under lease (personal communication, Willis Albin, 1994). The parcels near Crescent are within vacant sheep allotments. However, these allotments are considered infeasible due to scarce water (personal communication, Helen McGranahan, 1994. Sun Pass State Forest is not within any Forest Service allotment. All Chiloquin Ranger District allotments are east of Highway 97 (personal communication, Ken Woodman, 1994).

Resource Management Information

Range

General management — Grazing needs to be conducted on a planned schedule of graze and rest treatments that substantially meets the requirements of vegetation, soil, and animals that are affected by such grazing. Numerous aspects of grazing can be beneficial to these elements if conducted properly. The diverse levels of forage off-take and conditioning aspect of forage plants can be quite important to fire management (Majors 1994).

Information and data — DSL has basic information on numbers of livestock, season of use, and AUMs of use on issued leases. Additional information that would be desired would be better records of fence locations, water resources, possible opportunities to develop better water, who is grazing land that is not under lease, and better inventory of key areas such as meadows and riparian areas (Majors 1994).

Yainax Butte — The Yainax Coordinated Resource Management Plan cites a number of concerns including pasture size, fences, water sources, and noxious weeds. A four-year grazing system has been charted in the plan, starting from September 1993. Past forage inventories include: (a) an SCS ecological site survey for the original CRMP in 1974; (b) Forest Service stand exams; (c) Forest Service range analysis in the early 1980s; (d) Forest Service utilization survey in 1985-1986.

Timber

Livestock have damaged the Department of Forestry's forest plantations at Yainax Butte. Recently, it was necessary to protect seedlings with vexar tubing. The damage is in the vicinity of a heavily used livestock pond (personal communication, Craig Leech, 1994).

A properly applied grazing program may have silvicultural benefits. Weyerhaeuser Company has permitted livestock to graze forest plantations in the past to control competing vegetation. More recently, the program has been cut back because the stands have grown older and there are concerns about riparian impacts (personal communication, John Monfore, 1994).

Watershed

Stream water quality is impacted primarily when livestock intrude into riparian areas. Upland impacts, such as an increased risk of soil erosion, are considered minimal on most eastern Oregon soils (personal communication, Keith Mills, 1994).

Damage to stream side vegetation can be minimized by excluding livestock during certain months and by managing the concentration of animals. Fencing is the best solution for sensitive riparian areas. However, it is not certain which types of streams need to be protected. The Forest Practices Act's stream classification system and water protection

rules do not address livestock grazing. There are no grazing practices rules or grazing BMPs analogous to the Forest Practices Act.

The Yainax Butte Coordinated Resource Management Plan (CRMP) acknowledges "damage to some water resources and adjacent riparian areas which affects water quality (sanitation), channel stability, and watershed condition." (USDA Forest Service, et al., 1993c) The availability and distribution of water is a problem because cattle tend to linger around wet meadows and livestock ponds. On state land, the pond in Section 34, T37S, R12E holds water throughout the summer even during drought years. It is difficult to ascertain whether the intermittent stream's riparian functions have been degraded by grazing, but the dam itself has interrupted stream flow and impacted the immediate site.

Tamarack Spring and Cold Spring are heavily used by livestock. Wet meadows and forested wetlands surround Tamarack Spring. The Department of Forestry classifies the 37-acre site as "Protective Conservancy — Critical Wildlife Habitat" for forestry uses. However, the Division of State Lands manages grazing on this site. Eight acres were fenced to protect the spring itself in a project sponsored by DSL, the Audubon Society, the Oregon Hunter's Association and the Rocky Mountain Elk Foundation. A watering trough still attracts cattle to the wet meadow outside the fence. Cold Spring is not impacted as much because it is on a hillside, and a fence protects most of the immediate area. Water drainage in the meadows surrounding Tamarack and Cold Springs has been altered by various ditches and dikes.

With regard to the broader impacts of grazing, federal agencies are concerned about how the Yainax CRMP relates to their efforts to benefit the endangered shortnose sucker. But according to a BLM fish biologist (name not cited in the CRMP), the Gerber Reservoir population is believed to be stable, even under widely fluctuating pools. The Yainax Butte CRMP does not cite any evidence that land management is having adverse effects on the sucker or the quality of water reaching Gerber from the Dry Prairie area. Dry Prairie is a good buffer for potential water problems in the upper watershed. In order to improve riparian habitat that may impact the sucker, the CRMP prescribes certain protective measures with regard to Ben Hall Creek and Horse Canyon. (USDA Forest Service et al., 1993c)

A better understanding of watershed conditions will come out of current studies that will bring the Yainax CRMP up to NEPA requirements. The revised CRMP will include a biological opinion on the Forest Service grazing program in the entire Lost River watershed (personal communication, Julie Bolton, 1994).

Subsurface Resources

The economic value of minerals and natural gas produced in Oregon each year is high. The benefits of mineral exploration and development include lease receipts and royalties paid directly to the state, as well as high-paying jobs in the rural areas.

The Division of State Lands (DSL) leases oil, gas, and minerals on state-owned lands. They lease by auction for 40 acres or more, or through negotiation on less than 40 acres of land. DSL handles the leases on both Common School Forest lands and Board of Forestry lands, but must get the approval of the Department of Forestry on Board of Forestry lands. DSL also issues prospecting permits and permits for surface disturbance, such as seismic lines.

The Department of Geology and Mineral Industries (DOGAMI) regulates gas, oil, and mineral exploration, development, and reclamation/abandonment throughout Oregon. DOGAMI routes applications for drilling permits to all state natural resource agencies, which then have 21 days to respond. Additional statutes and regulations apply to exploration and development, and various permits and licenses are required. The various laws, regulations, and permits address issues such as air quality, water, threatened and endangered species, fish, explosives, and mine issues. They are enforced by various state and county agencies.

Energy & Mineral Potential of Klamath-Lake District State Forests

Few detailed geological studies have been conducted in the Klamath-Lake District state forests. Therefore, much of the information in this assessment is based on a review of literature in DOGAMI's Portland library and a search of that agency's mineral occurrence database. Prospecting permits were also examined; these were issued by DSL to California Energy Corporation for geothermal exploration in the Sun Pass area. Geologists familiar with the state lands were interviewed to provide information about the results of past exploration activities and the potential for future discoveries. No field investigations were conducted to confirm the validity of the information. This assessment was done by Jeff Kroft, of DSL. His full report is on file at the Salem headquarters, and is summarized here (Kroft 1994).

No significant mineral resources are known to occur on Klamath-Lake District state forest lands. There are indications of natural gas resources and diatomite deposits (see "Key Terms" box on the next page) on the Bear Valley and Yainax Butte tracts, and also of pumicite deposits on the Yainax Butte tract. However, it is unknown if these resources will ever be of commercial value. All of the major blocks of state forest land contain deposits of material suitable for road base and traction material. A number of these deposits have been occasionally mined. The mineral resources of the Klamath-Lake District lands are described in more detail on the following pages.

North Block

The underlying geology of the Sun Pass area consists mainly of interlayered Quaternary and Tertiary basalt and basaltic andesite flows and ejecta of varying thickness. These layers have been cut by numerous, often steeply sloped, faults. See "Geology, Topography, and Soils" earlier in this chapter for details on Sun Pass's geology.

Several small quarries and pits exist in the vicinity of Sun Pass State Forest. There is one rock pit in Sun Pass State Forest. The Department of Transportation has a permanent easement for this pit (DeBlander 1994). The material removed from these operations is used primarily as road base and traction material.

No known metallic or industrial mineral occurrences have been identified on Sun Pass. There is no evidence to indicate that there have been any recent explorations for minerals on or adjacent to Sun Pass.

In the early 1980s, California Energy Company (through its subsidiary CE Exploration Company) obtained leases from DSL for much of Sun Pass State Forest, and from the federal government for nearby federal lands, in order to determine the area's geothermal potential. Two holes were drilled. One hole was on the southeast corner of Mt. Scott, east of Crater Lake National Park and outside Sun Pass State Forest; it was 4500 feet deep. The other hole was drilled near Annie Creek, near the state forest; it was 1000 feet deep. Although both holes encountered some evidence of geothermal wallrock alternation and thermal water, the drilling results were not sufficiently encouraging to warrant further exploration.

Key Terms

For definitions of basalt, ejecta, Miocene, and Pliocene, see the Key Terms box under "Geology, Topography, and Soils" earlier in this chapter, or see Appendix A.

Andesite — A common volcanic rock; it occurs as lava flows, ash deposits, and accumulations of angular debris.

Cinnabar — A heavy, bright red mineral; it is the principal ore of mercury.

Dacite — A volcanic rock; it is a mixture of quartz and other minerals.

Diatomite — Diatomaceous earth; when dry, it forms a fine powder used as an abrasive, pottery glaze, etc. Diatoms are microscopic algae that are rich in silica; their fossils form diatomaceous earth.

Igneous — Formed by volcanic action or great heat.

Olivine — A silicate of magnesium and iron; found as green crystals in many rocks, and used as a semiprecious stone.

Perlite — A glassy volcanic rock with a pearly luster; it is a form of obsidian.

Pumice, pumicite — A lightweight, spongy, porous volcanic rock; pumice is used in solid or powdered form for removing stains, smoothing, and polishing.

During the time that CE Exploration Company held the leases, considerable controversy arose concerning the possible impacts that geothermal development could have on the clarity and quality of Crater Lake. This debate may have helped to discourage any additional geothermal exploration in the area.

East Block

The underlying geology of the East Block consists of Miocene-Pliocene olivine basalt flows. Information is not available about the extent of faulting in this area. No metallic or industrial mineral occurrences have been identified on the state forest lands in this block. However, diatomite, pumicite, perlite, and cinnabar have been found nearby.

Diatomite has been identified in well cuttings approximately one mile to both the northwest and southeast of Yainax Mountain. Samples of a perlitic glassy dacite were taken north of Bly Mountain Pass, about six miles west of the state forests. Pumice and pumicite outcrops up to ten feet thick reportedly occur north and east of the state forests. Some pumice was removed from deposits twelve miles east of Yainax Butte in the 1940s and 1950s, but the commercial value of these deposits today is unknown.

An occurrence of rock containing cinnabar was located about six miles north-northeast of Yainax Butte. An assay of samples taken from this occurrence, called the Given Ranch prospect, indicated sixteen pounds of mercury per ton of host rock.

Some geothermal exploration has been conducted in the vicinity of Yainax Butte. At least two geothermal wells have been drilled several miles to the south of Yainax Butte. Reportedly, these were shallow wells and they did not encounter significant geothermal resources.

At least three oil wells were drilled in the 1920s to 1930s, approximately six miles west of the state forest lands. Two of the wells hit warm water, with temperatures of 200 degrees Fahrenheit reported for one and 85 degrees for the other. No commercial production was reported from any of the wells.

Some geologists believe that the Upper Cretaceous Hornbrook Formation underlies much of the southern end of the county, perhaps including the state forest lands in the East Block. This formation is suggested as being correlative with natural gas-producing formations in California's Sacramento Valley. Therefore, the possibility exists that natural gas resources could lie under the state forests.

Southwest Block

The underlying geology of the Southwest Block consists of interlayered Quaternary and Tertiary basalt and basaltic andesite flows, typical of the High Cascade igneous rock series. The area's topography is dominated by a series of northwest trending normal faults.

Several quarries and pits are located in the vicinity of the state forest lands. These operations are small and are used for road base and traction material.

Many wells have been drilled on or near the state forest lands in this block, with the majority of wells for water. Reportedly, several wells have been drilled in the vicinity in search of geothermal resources, but little information is available about these wells. Approximately one mile east of Chase Mountain, a water well drilled on state land for the U.S. Air Force first encountered basalt 26.5 feet below the surface. The basalt extended all the way to the bottom of the well, at 1305 feet.

No metallic or industrial mineral occurrences have been identified on these state lands, although some minerals have been reported in the general vicinity. Minor amounts of cinnabar are reported to occur in the Klamath Hills, about two miles east of the state forests. Diatomite has also been reported in outcrops and well cuttings within a mile to the northeast of the state forests.

No producing oil or gas wells are known to have been drilled in Klamath County. However, some geologists believe that the Upper Cretaceous Hornbrook Formation underlies much of the southern end of the county. This formation is suggested as being correlative with natural gas-producing formations in California's Sacramento Valley.

Social and Economic Resources

Although the Klamath-Lake District is closely identified with the Klamath Falls area, resource outputs from the district affect the economies and social structures of many communities and Oregon as a whole. This subsection reviews the current uses of forest resources and discusses the social and economic implications of resource management.

As Oregon's economy has matured, it has evolved from being quite dependent on the use of natural resources to a more diversified economy. Oregon's forests are still as important as ever to the state's economic health. But in addition to producing timber, they are now also expected to provide recreation, clean water, and healthy populations of fish and wildlife.

The Department of Forestry's stewardship responsibilities for state forests include generating revenue as well as conserving and protecting natural resources. The land's social and economic values are maintained over the long-term, even as current income is produced.

"Social and economic" describes the relationship between people and the forest. Economic resources include the ways that resource outputs contribute to schools, government entities, industry, and employment. Social resources include community stability and quality of life. The state forests contribute to quality of life in many ways, such as providing open space and recreational opportunities, contributing revenues to schools, and helping to provide secure employment. By making Klamath County a desirable place to live, the state forests may help attract other industries to the area.

Economic Trends

Although lumber and wood products employment has always been important to Klamath, Lake, and adjacent counties, changes have been occurring in the structure of local economies and in the lumber and wood products industry itself (Oregon Employment Department 1993; Oregon Employment Department 1994).

Klamath County has 2.6 million acres of forest land, and 750,000 acres of farmland. Most of Lake County is grass-shrub rangeland, with about 15% (800,000 acres) forested. Lumber and wood products and agriculture (particularly livestock) are major sources of employment in both counties. Transportation (railroads) and recreation, e.g. Crater Lake National Park, are also important in Klamath County. Government is another source of income in the area, and is the largest source of payroll income in Lake County. Government employers include the U.S. Forest Service, the Bureau of Land Management, Oregon Institute of Technology, and others.

Klamath County is a major timber producer, usually ranking among the top three Oregon counties in volume of timber production. In the 1970s, the industry provided employment for almost 5,000 workers. By 1993, employment in lumber and wood products in the county had dropped to about 2,750. This decline was caused by lower timber harvests from federal land, a highly competitive market situation, and continuing automation. Although some mills dependent on old growth ponderosa pine have closed, capital investments in remanufacturing plants using wood products (chips or fiber) are leading to some recovery in this industry in both counties — and in Oregon as a whole. The net result of this trend is that a million board feet harvested today produces more jobs than in the 1980s, in spite of technological improvements and automation.

Future growth potential in the area depends on increasing economic diversification. Efforts to attract new industry have been successful, especially in attracting firms in electronics-related fields and manufacturing. Relatively low living costs and a pleasant environment provide prospects for attracting new manufacturing to a favorable location serving California and Asian markets. Local economic development strategy includes developing Kingsley Field into an international and industrial trade center.

In addition, retirees from out of state have been drawn by the area's low real estate costs and livability. Employment in trade, services, and government helps stabilize the local economy and offsets market fluctuations for lumber and wood products. However, lumber and wood products will continue to be a dominant element in Klamath and Lake Counties.

The economic trends described have resulted in the replacement of high-paying jobs in manufacturing, transportation, and utilities, held mostly by men, with low-paying jobs in trade and services, which employ a higher proportion of women and youths. Unemployment rates have tended to be higher than the state as a whole due to the seasonal nature of employment in forestry, logging, and agriculture. Unemployment peaked in Klamath County at 14% in 1982, during a recession that especially affected the timber industry. Unemployment is currently decreasing, with 1993 unemployment rates at 10.5% in Klamath County and 9.2% in Lake County.

Regional wage rates are low. Some of the factors affecting wage levels are the small size of most local firms, a labor surplus created by limited employment opportunities for women and young people, and mechanization of agriculture, with increasing numbers of Hispanic workers filling the available jobs.

Transfer payments have increased to become the largest source of personal income in Klamath County, accounting for 22% of the total, compared to the statewide average of 17%. Transfer payments include retirement, unemployment, and public assistance programs. The rapid rise has been primarily caused by gains in social security, Medicare, veterans' benefits, and government retirement, due to the influx of retirees. In Lake County, government, transfer payments, and investment income are the largest contributors to private income.

Funding of Schools and Local Government

Revenues produced from the Klamath-Lake District state forests directly benefit schools and local government. Income from Common School Forest Lands is added to the state's Common School Fund. Interest generated from this fund is used for schools statewide. Income from Board of Forestry lands is distributed to the county where the income was generated, although ultimately a portion of this income benefits all Oregon schools, as explained below. See "Location and Ownership of Eastern Region State Forests" in Section I and guiding principle 4 in Section II for more information about land ownership and legal mandates for state forests.

Over a 5-year period (1988/1989 through 1992/1993), the distribution from Board of Forestry lands to Klamath County averaged $296,887 per year. This money is used for schools (grades K-12, community colleges, educational service districts) and non-school taxing entities (such as county government, rural fire districts, port authorities). About 70% of these funds usually go to schools and 30% to non-school uses (Bowling 1994).

Even though these funds are distributed to the county, the portion for schools has effectively become a state-wide resource. This happened as a result of voters' approval of Measure 5 (property tax limitation) in 1990 and subsequent changes to the State School Fund statutes by the Legislative Assembly in 1991. The statutes attempt to equalize funding among school districts and prevent local school funding from rising or falling when revenues from Board of Forestry lands fluctuate. Each school district is now entitled to a grant from the State School Fund, which is part of the state's General Fund. In computing this grant, income from Board of Forestry lands is counted as "local revenue" that offsets grant money. In essence, any fluctuations in local revenue will affect all schools in the state that receive payments through the State School Fund (Bruce 1994).

To put Board of Forestry lands in perspective, in the 1991-1993 biennium these lands generated $37.6 million state-wide for distribution to counties. Of this, about $26 million went to schools. This sum was 1% of the total schools' budget of $2.6 billion (Bowling 1994).

Similarly, timber harvested from all Common School Forest Lands managed by the Department of Forestry has produced over $230 million state-wide for the Common School Fund over the past twenty years (Oregon Department of Forestry 1993).

Review of Resource Outputs

Timber Sales

Timber harvested from the Klamath-Lake District supports employment in logging, millwork, and service industries in Klamath County and its neighbors.

Klamath and Lake Counties are among nine Oregon counties that were designated in 1992 by the Oregon Department of Economic Development as "severely affected" by declining timber harvests. These counties have a high unemployment rate in comparison with the rest of Oregon, have had declining timber industry employment, and are likely to show severe economic decline (Seidel 1993).

The amount of timber harvested from federal lands has declined, so Klamath-Lake District state forests are relatively more important to regional timber supply and employment. Not all of the jobs are filled by local residents. State timber sales are often purchased by mills outside of Klamath County.

Grazing

Klamath-Lake District state forests are a minor player in the livestock ranching industry. Only 5,561 acres of the district's state forests were leased for grazing in 1994. The gross revenue generated by these leases in 1994 was about $630. Most of the leased lands are associated with larger federal grazing allotments, and thus contribute to ranching employment and community stability.

Recreation, Scenery, and Wildlife

Klamath-Lake District state forests are used mostly by local residents for informal dispersed recreation. These residents enjoy activities such as camping, hunting, fishing, horseback riding, and snowmobiling in an undeveloped setting. The state forests have not attempted to provide developed forms of recreation, which are in ample supply on nearby state parks, federal lands, and private facilities. The forest's aesthetic quality is maintained by uneven-aged management and other management considerations. Sun Pass State Forest is visible to tourists traveling to the south entrance of Crater Lake National Park.

Recreation does not directly contribute revenue to the Common School Fund or Klamath County, but the cost of providing dispersed recreation has been minimal. There are some opportunity costs associated with providing diverse habitat for game and non-game animals. However, this kind of forest management maintains the long-term value of the land and meets social and biological needs.

Water

Water from the state forests does not generate revenue directly, but it does have a number of other social and economic benefits. Sun Pass State Forest produces water for irrigation as well as aquatic habitat. The Yainax tract has several watering locations for livestock grazing. Riparian and wetland habitats in the forests are recognized as important resources. The greater emphasis being given to watershed planning is an indication of the

value of healthy watersheds. Water resources are a vital element in the livability and economy of the Upper Klamath Basin.

Subsurface Resources

The past development and potential future development of subsurface resources is very limited. There has been occasional mining of road base and traction material. No other significant mineral resources are known to occur. There are indications of natural gas resources, diatomite deposits, and pumicite deposits, but it is unknown whether these occurrences will ever be of commercial value. There has been exploration for geothermal energy, but it is doubtful whether there will be further exploration or development.

Cultural Resources

The Klamath-Lake District may have sites that have historical significance or social importance to the Klamath tribe. Forest management activities are planned and conducted with sensitivity to the inherent value of these resources and the need to protect them.

Air Quality

Smoke from prescribed burning or wildfire can affect visibility in Crater Lake National Park and wilderness areas. When added to woodstove pollution, smoke from forest lands can also affect human health in the Klamath Falls urban area. To protect air quality, the Klamath-Lake District manages fuels, follows smoke management procedures, and suppresses any wildfires that do occur.

Special Forest Products

Special forest products such as mushrooms have not produced revenue for the Common School Fund or Klamath County. Free harvesting permits have been issued for personal use, but no permits have been sold. The local community has voiced support for personal use harvesting. There are many social and economic concerns about the future development of a special forest products program. It is not certain that the benefits of a commercial program would outweigh those of personal use harvesting. A program would need to be analyzed in terms of returns to schools and government, local employment, environmental impacts, and administration.

Investments in Forest Management

Administration and maintenance of the state forests contributes to employment in Klamath County. The Department of Forestry employs people to manage state forests, and offers service contracts for labor-intensive activities such as precommercial thinning and tree planting. (Some workers on these contracts live outside Klamath County, so some contract money leaves the county.)

Section IV

Management Goals

This section describes the management goals for each resource on the Klamath-Lake District forests that will be actively managed. Goals are general, non-quantifiable statements of direction. The goals describe what we would like to achieve with respect to the resources of the Klamath-Lake District forests. The goals were used to guide the development of the management strategies in Section V. The strategies describe how we will attempt to achieve the goals. Compliance with all applicable laws will be ensured through the goals and strategies. If the laws change, then the goals and strategies will be modified to ensure consistency with the new laws.

A detailed explanation of how the goals and strategies were developed is given in Section I under the heading "The Eastern Region Planning Process."

Resources are listed in alphabetical order. The following acronyms are used in this section of the plan.

DSL	Division of State Lands
OAR	Oregon Administrative Rules
ODF	Oregon Department of Forestry
ORS	Oregon Revised Statutes
USFWS	U.S. Fish and Wildlife Service

Air Quality

A. Contribute to maintaining air quality that meets National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) standards established by the Environmental Protection Agency under the federal Clean Air Act.

B. Comply with the following State Implementation Plans (SIPs):

   a) The Oregon Smoke Management Plan (Oregon's SIP for prescribed burning), including the Special Protection Zone (SPZ) requirements for Klamath Falls.

   b) The Visibility Protection Plan for Class I wilderness and national park areas.

C. Maintain compatibility with Oregon's Statewide Planning Goal 6 (Air, Water, and Land Resources Quality) direction to maintain and improve the air resource of the state through compliance with local comprehensive plan direction. (Oregon Statewide Planning Goals 1994 Edition, Oregon Department of Land Conservation and Development)

Cultural Resources

A. Preserve and protect any archaeological sites or archaeological objects in accordance with state law (ORS 97.740 to 97.760; 358.905 to 358.955; and 390.235).

B. Conserve any historic artifacts and real property of historic significance in accordance with state law, in consultation with the State Historic Preservation Office (ORS 358.653).

C. Maintain compatibility with Oregon's Statewide Planning Goal 5 (Open Spaces, Scenic and Historic Areas, and Natural Resources) through compliance with local comprehensive plan direction related to historic areas. (Oregon Statewide Planning Goals 1994 Edition, Oregon Department of Land Conservation and Development)

Fire Management

A. Suppress wildfires and minimize the risk of their occurrence in the interest of conserving forest resources and protecting public safety.

B. Mitigate the effects of excluding natural fires from the forest ecosystem.

Forest Health

The goal for forest health is to maintain or restore diverse, productive, resilient, and sustainable forest ecosystems.

Grazing

The overall management goal is to maximize long-term revenues to the Common School Fund and to produce income for counties, schools, and local taxing districts through cost-effective, sustainable, and environmentally sound grazing practices. Specific goals that apply to each land ownership are given below.

A. **Common School Forest Lands —** Grazing on Common School Forest Lands is managed by the Division of State Lands. ODF's management goals for grazing are to:
   a) Ensure that grazing is managed in accordance with legal requirements, policies, and ODF planning goals for the protection and management of all forest resources.
   b) Ensure that the grazing leases issued by DSL provide for the continuation of the primary purposes for which Common School Forest Lands have been dedicated, in accordance with ORS 530.490 (3).
   c) Comply with the administrative rules for rangeland management on Common School trust lands.

B. **Board of Forestry Lands —** Grazing on Board of Forestry Lands is managed by the Department of Forestry. The specific goals vary, depending upon whether or not these lands are located inside grazing allotments administered by federal agencies.
   a) For Board of Forestry lands associated with federal grazing allotments, management goals are to:
      - Comply with open range laws.
      - Produce income for counties, schools, and local taxing districts.
      - Ensure that all resources on state lands inside the allotment are adequately managed and protected.
   b) For other Board of Forestry Lands, management goals are to:

   Manage grazing to produce income for counties, schools, and local taxing districts on all lands suitable for such activity, with the following exceptions:
      - Lands designated in the forest inventory and approved by the Deputy State Forester as having a land use that precludes grazing.
      - Lands that will produce another commodity with a higher contribution than grazing to the long-term production of revenue. If production of the other commodity is compatible with grazing, both will occur.
      - Lands where grazing would conflict with legal requirements, policies, or goals for the protection or management of other forest resources.
      - Lands where income from grazing would not exceed direct and indirect costs to the state as well as environmental costs.

Land Base

A. Increase the efficiency and economic feasibility of intensive forest management through exchanges, purchase of inholdings, or sale of lands.

B. Conserve the forest land base to produce abundant commodity and non-commodity resources.

C. Comply with Oregon's Statewide Land Use Planning Goals and the Oregon Land Use Act (ORS 195, 196, and 197; OAR Chapter 660).

Recreation and Scenic Resources

Recreation

A. Establish consistent and coordinated recreation management within the framework of the working forest.

B. Provide opportunities for dispersed recreation.

C. Manage recreational use of the forest to minimize adverse impacts on other resources, such as wildlife and water quality.

D. Manage recreational use of the forest to accommodate a wide variety of existing uses while minimizing conflicts among user groups.

E. Maximize efficiency and diversify funding of recreation management by cooperating with user groups, neighboring landowners, and other agencies.

F. Supplement available recreation opportunities within the region, rather than duplicate existing services.

G. Interpret the history of the forest and present day management.

Scenic Resources

A. Meet the scenic protection requirements of the Oregon Forest Practices Act for visually sensitive corridors associated with designated scenic highways (ORS 527.755).

B. Minimize the visual impacts of forest management activities in a manner that is consistent with the primary use of the land and the context of a working forest.

C. Maintain compatibility with Oregon's Statewide Planning Goal 5 (Open Spaces, Scenic and Historic Areas, and Natural Resources) through compliance with local comprehensive plan direction related to scenic protection. (Oregon Statewide Planning Goals 1994 Edition, Oregon Department of Land Conservation and Development)

Social and Economic Resources

Forest resources are an important component of Klamath County's economy. This plan's resource management goals, as a whole, will promote the social and economic well-being of Klamath County by providing employment in forest industries, providing raw materials to meet the demands of consumers, contributing toward a quality living environment, and generating revenues for schools and local government.

Soils

Maintain the long-term productivity of the land to produce abundant commodity and non-commodity resources.

Special Forest Products

The overall management goal is to maximize long-term revenues to the Common School Fund and to produce income for counties, schools, and local taxing districts through a cost-effective, sustainable, and environmentally sound special forest products program.

Special forest products will be grown and harvested on all lands suitable for such activities, with the following exceptions:

- Lands designated in the forest inventory and approved by the State Land Board (Common School Forest Lands) and the Deputy State Forester (Board of Forestry Lands) as having a land use that precludes the harvest of special forest products.
- Lands that will produce another commodity with a higher contribution than special forest products to the long-term production of revenue. If production of the other commodity is compatible with special forest products production, both will occur.
- Lands where the harvest of special forest products would conflict with legal requirements, policies, or goals for the protection or management of other forest resources.
- Lands where income from special forest products would not exceed direct and indirect costs to the state as well as environmental costs.

Subsurface Resources

A. The Division of State Lands is the managing agency for all subsurface resources on Common School Forest Lands and Board of Forestry Lands. The management goal for subsurface gas, oil, mineral, and geothermal resources is to maximize long-term revenues to the Common School Fund, and produce income for counties, schools, and local taxing districts from the Board of Forestry lands while minimizing impacts to surface resources. If lands are identified where development of one or more of these subsurface resources is expected to generate the highest long-term revenue, such lands will be managed accordingly, with the following exceptions:

- Lands designated in the forest inventory and approved by the State Land Board (Common School Forest Lands) and the Deputy State Forester (Board of Forestry Lands) as having a land use that precludes the development of subsurface resources.
- Lands that will produce another commodity with a higher contribution than subsurface resources to the long-term production of revenue. If production of the other commodity is compatible with subsurface resource development, both will occur.
- Lands where income from subsurface resources would not exceed direct and indirect costs to the state as well as environmental costs.
- Lands where such development would conflict with legal requirements for the protection of other resources.

B. Maintain compatibility with Oregon's Statewide Planning Goal 5 (Open Spaces, Scenic and Historic Areas, and Natural Resources) through compliance with local comprehensive plan direction related to mineral and aggregate resources. (Oregon Statewide Planning Goals 1994 Edition, Oregon Department of Land Conservation and Development)

Threatened, Endangered, and State Candidate Plants

A. The management goal for threatened and endangered plants is to comply with the requirements of the state's Endangered Species Act for plants (ORS 564.100 through 564.135; and OAR 603-73-005 through 603-73-100) and the federal Endangered Species Act.

B. The management goal for State candidate plants is to contribute to the prevention of further listings.

Timber

A. The overall management goal is to maximize long-term revenues to the Common School fund and to produce income for counties, schools, and local taxing districts through a cost-effective, sustainable, and environmentally sound timber program.

Timber will be grown and harvested on all lands suitable for such activities, with the following exceptions:

- Lands designated in the forest inventory and approved by the State Land Board (Common School Forest Lands) and the Deputy State Forester (Board of Forestry Lands) as having a land use that precludes the harvest of timber.
- Lands that will produce another commodity with a higher contribution than timber to the long-term production of revenue. If production of the other commodity is compatible with timber production, both will occur.
- Lands where harvest of timber would conflict with legal requirements for the protection of non-timber resources.
- On the Scattered Tracts, forest management activities will focus on protecting asset value.

B. Produce a sustained yield of timber from the Klamath-Lake District state forest lands while allowing decade-to-decade harvest volume fluctuations that may be necessary to achieve other goals.

C. Promote the growth of forest trees and stands by using appropriate silvicultural techniques.

Water Resources

Water Quality

A. Maintain water quality at levels sufficient to support beneficial uses of the waters of the state, including propagation of fish and aquatic life, wildlife, domestic, agricultural, industrial, municipal, recreational, and other legitimate uses (ORS 468B.015(2)).

B. Meet the requirements of the Forest Practices Act. The “Best Management Practices” that are incorporated into the FPA’s administrative rules are designed to comply with state water quality standards and the federal Clean Water Act.

C. Maintain compatibility with Oregon’s Statewide Planning Goal 6 (Air, Water, and Land Resources Quality) through compliance with local comprehensive plan direction. (Oregon Statewide Planning Goals 1994 Edition, Oregon Department of Land Conservation and Development)

Water Supply

A. Maintain healthy watershed conditions to support the beneficial uses of the waters of the state.

B. Enhance watershed storage capacity through natural processes using non-structural means (Water Resources Commission Policy on Water Storage).

C. Protect the water-related functions of riparian lands (Water Resources Commission policy on Protection of Water Resources on Public Riparian Lands).

D. Comply with state laws that establish and regulate water rights.

Wetlands

A. As consistent with the Oregon Forest Practices Act (OAR 629, Divisions 645 and 655), maintain the functions and attributes of wetlands over time and ensure that forest practices do not lead to resource site destruction or reduced productivity of water quantity and quality, fish and other aquatic organisms, and wildlife.

B. As consistent with the National Wetlands Goals and with Oregon's Benchmark for wetlands, ensure that no net loss of wetlands occurs in comparison to the 1993 wetland resource base.

C. Maintain compatibility with Oregon's Statewide Planning Goal 5 (Open Spaces, Scenic and Historic Areas, and Natural Resources) through compliance with local comprehensive plan direction related to wetlands. (Oregon Statewide Planning Goals 1994 Edition, Oregon Department of Land Conservation and Development)

Watershed Management

A. Manage state forests in a watershed context, contributing to the maintenance or improvement of watershed health.

Wildlife and Fish

A. Provide habitat for game and non-game fish and wildlife species appropriate to the pine-dominated ecosystem, while managing the forest for the primary use of the land.

B. Manage habitat for both game and non-game fish and wildlife in a regional context.

C. Meet the requirements of the federal and state endangered species acts.

D. Maintain compatibility with Oregon's Statewide Planning Goal 5 (Open Spaces, Scenic and Historic Areas, and Natural Resources) through compliance with local comprehensive plan direction related to fish and wildlife areas and habitats. (Oregon Statewide Planning Goals 1994 Edition, Oregon Department of Land Conservation and Development)

Section V

Management Strategies

Management strategies are specific actions that will be taken to achieve the management goals described in Section IV. The forest plan is implemented by carrying out management strategies. The plan's success can be measured in part by the degree to which the management strategies are successfully implemented. The plan will be implemented using an adaptive management approach. This approach is described in Section VIII.

A detailed explanation of how the goals and strategies were developed is given in Section I under the heading "The Eastern Region Planning Process."

Strategies are given for the resources that were listed in Section IV, "Management Goals." The list of resources follows the same alphabetical order that was used in Section IV, except for social and economic resources. The goals for social and economic considerations will be met through implementation of the strategies for the other resources.

The individual strategies are presented in the following format.

1. **Strategy: The strategies under each resource heading are numbered. The strategy statement is printed in bold.**

   a. Details of the strategy are listed underneath, using an a, b, c format.

   Analysis: The analysis provides a short explanation of why the strategy is needed, and how the strategy will contribute to achieving the goals in Section IV. The analysis also describes briefly the effects and outcomes that are expected to occur when the strategy is implemented. The outcomes are described in either a qualitative or quantitative way.

The following acronyms are used in this section of the plan.

BLM	Bureau of Land Management
DOGAMI	Department of Geology and Mineral Industries
DSL	Division of State Lands
OAR	Oregon Administrative Rules
ODA	Oregon Department of Agriculture
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ORS	Oregon Revised Statutes
USFWS	U.S. Fish and Wildlife Service

Air Quality

1. **Strategy: To protect visibility in Class I wilderness and national park areas:**
   a. Do most prescribed burning outside the restricted July 1 to September 15 period.
   b. Consult ODF's meteorologists whenever a prescribed burn is being planned during the restricted period.

   Analysis: Visibility protection in Class I areas is mandated by the federal Clean Air Act. The strategy describes how ODF will comply with the Visibility Protection Plan, which is Oregon's plan for protecting visibility in these areas.

   The Visibility Protection Plan specifies the visibility protection period as July 1 through September 15, and implements protection measures through the Smoke Management Plan. Its short-term strategies apply mostly to prescribed burning in western Oregon and affect certain designated Class I areas. To ensure that the Eastern Oregon Region complies with the standards of the Visibility Protection Plan, ODF's meteorologists will be consulted before burning during the restricted period. However, for the most part, burning will not coincide with the restricted period. These strategies will prevent smoke intrusions that do not comply with the Visibility Protection Plan.

2. **Strategy: Comply with the Smoke Management Plan by continuing to participate in the Klamath County voluntary smoke management program.**

   Analysis: The Smoke Management Plan is Oregon's SIP for prescribed burning. Its goal is to meet federal clean air standards. The Smoke Management Plan has established a Special Protection Zone to protect the city of Klamath Falls from prescribed burning smoke during the winter months.

   The Department of Forestry will comply with the Smoke Management Plan's requirements by participating in the Klamath County voluntary program. From November 15 to February 15, prescribed burning will occur in the Special Protection Zone only when permitted by the ODF meteorologist. No new ignitions will occur on any "red day" between December 1 and February 15. Refer to Section III for the procedures of the voluntary program and the requirements of the SPZ.

3. **Strategy: Notify DEQ of changes in prescribed burning that might significantly increase the total yearly amount of smoke emissions.**

   Analysis: Under the Clean Air Act's PSD (Prevention of Significant Deterioration) standard, increases in PM-10 emissions are measured in comparison to the 1977/1978 base years. PM-10 is the pollutant of most concern in wood smoke. Because of changes in slash treatment and wood utilization, there has actually been a 40 percent reduction in fuels burned on Eastern Region state forests since the 1970s. (See discussion in Section III, under "Air Quality" and "Fire Management.") The trend should remain fairly level or continue to decrease through implementation of this long-range plan. To ensure compliance with the PSD standard, ODF will notify DEQ of any significant changes in burning practices that might increase total smoke emissions. An example would be the use of underburning on a regular or widespread basis.

4. **Strategy: As an alternative to prescribed burning, use methods such as mechanical slash disposal, chip/biomass sales, or leaving untreated slash in the woods.**

   Analysis: This strategy contributes toward meeting the air quality goals by providing alternatives to prescribed burning.

   Prescribed burning and alternative methods are also discussed in the resource description and strategies for Fire Management. These are prescribed on a site-specific basis. Smoke reduction is not always the primary reason for using the alternative methods. There may be other reasons, such as protecting residual trees from fire, or offsetting precommercial thinning costs by using leftover wood. In any case, smoke is reduced because these methods are frequently used. Prescribed burning still remains the preferred method to reduce fuel accumulations in many situations.

5. **Strategy: Reduce the risk of wildfires, which would produce uncontrolled smoke. (Fire prevention, fire suppression, and management of fuel build-up are discussed in the strategies for Fire Management.)**

   Analysis: Wildfires produce amounts of smoke that could exceed federal clean air standards or impair visibility in Class I areas. This strategy provides air quality protection not covered by the Smoke Management Plan or the Visibility Protection Plan.

Cultural Resources

1. **Strategy: Comply with state laws to preserve and protect American Indian sites and objects, as well as historic non-Indian cultural resources.**
   a. ORS 358.920(1)(a) The Department of Forestry will not knowingly or intentionally excavate, injure, destroy or alter an archaeological site or object, or remove an archaeological object. An archaeological object is at least 50 years old, comprises the physical record of an indigenous or other culture, and is material remains of past human life or activity that are of archaeological significance. An archaeological site contains archaeological objects and the contextual associations of the objects with each other or with biotic or geological remains or deposits.
   b. ORS 390.235 The Department does not intend to excavate, alter or disturb any archaeological sites. If a previously unknown site should be discovered to be inadvertently disturbed during road construction, fire suppression, or other forest management activity, the Department will immediately consult the Klamath Tribes (if the site is American Indian), and the Director of the Oregon State Parks and Recreation Department, and will obtain a permit if needed, for example to allow for salvage of material from unavoidable destruction.
   c. ORS 97.740 If a native Indian cairn or burial, funerary object, sacred object or object of cultural patrimony is inadvertently disturbed, the Department will immediately notify the Klamath Tribes. If human remains are discovered which are suspected to be native Indian, this will also be reported to the state police, the State Historic Preservation Officer, and the Commission on Indian Services. American Indian

human remains or funerary objects may be required to be reinterred at the Department's expense under the supervision of the Klamath Tribes.

Analysis: Descriptions of archaeological sites and objects that may be found on state forest lands managed by the Klamath-Lake District are in Section III, under "Cultural Resources." Definitions of archaeological terms are also found in this section.

Protection measures will be considered on a case-by-case basis. The Klamath-Lake District will preserve and protect archaeological sites found on state forest land by site-specific management plans, which may include protective buffers, or location of timber sales and routing of roads to avoid sites.

If historic, non-Indian sites are deemed to be of interest to the public, can be displayed without damage to the resource, and can be safely accessed by the public, the Department may work with appropriate specialists to develop a plan for interpreting and displaying the site. For example, people may be interested in traveling the route of the historic Applegate Trail.

2. **Strategy: Identify and assess cultural resources on state forest lands.**

   Analysis: Cultural resources likely to be found on Klamath-Lake District managed forest lands are described in Section III under "Cultural Resources." State law does not require archaeological surveys of land prior to forest management activities. However, the Department of Forestry is committed to preserving and protecting cultural resources. Location and assessment of archaeological sites is necessary to avoid damage to the sites.

   Some areas have been identified that have a relatively high likelihood of containing cultural resources. The Klamath-Lake District plans to contract with a qualified consultant with archaeological expertise to inventory the cultural resource sites in those areas. Any person hired to conduct surveys will be required to seek the assistance and expertise of the Klamath Tribes. For historic, non-Indian trails, such as the Applegate Trail, it may be possible to contract with qualified consultants and volunteers to locate and mark the trail.

3. **Strategy: Maintain confidentiality pertaining to the location of American Indian sites and artifacts. This information will be disclosed only to the Klamath Tribes and to appropriate state officials, except where other disclosure is required by law.**

   Analysis: Vandalism and theft are recognized risks to any cultural resources that remain on the land. In addition, it is the expressed wish of the Klamath Tribes to preserve Indian sites and objects in place with as little disturbance as possible.

   Confidentiality is not required by law, but it is standard policy. American Indian sites on state forest land in the Klamath-Lake District will not be considered for interpretive or recreational use, or for archaeological excavation.

Fire Management

1. **Strategy: Prevent and suppress wildfires on state forests and other protected lands by supporting ODF's Protection from Fire Program.**

   Analysis: Uncontrolled wildfire is not permissible due to resource damage and public safety concerns. This strategy is an essential element of protecting forest resources, and is consistent with Oregon public policy as expressed in ORS Chapter 477.

   The Protection from Fire program is described in Section III. All state and private forest lands, and some BLM lands in the Klamath-Lake District, are protected through this program. This program should continue to be successful in preventing and limiting the size of natural and human-caused wildfires.

2. **Strategy: Manage fuel build-up using the tools listed below.**
   a. Prescribed burning.
   b. Alternatives to prescribed burning, such as mechanical slash disposal and chip/biomass sales.
   c. Implementing silvicultural prescriptions to control species composition and stocking levels.
   d. Salvaging dead timber from areas where the concentration is high enough to constitute a fire hazard, as consistent with the goals and strategies for wildlife and fish.

   Analysis: Fuels accumulate when light, frequent natural wildfires are not allowed to occur. Hazardous fuel levels increase the risk of an intense, uncontrollable wildfire. This strategy gives several approaches for mitigating fuel buildup. It also contributes toward maintaining a healthier forest ecosystem in the absence of a natural fire regime.

   Prescribed burning and alternative methods are prescribed on a site-specific basis. Decisions are based on many factors, such as silviculture, fuel loads, fire risks, chip markets, and related planning goals (e.g., long-term soil productivity, air quality).

   Silvicultural prescriptions that control species composition and stocking levels are a fundamental aspect of this strategy. These prescriptions are discussed in other contexts throughout the long-range plan (e.g. in the resource descriptions and management strategies for Biodiversity, Vegetation, Soils, Wildlife and Fish, Forest Health, and Timber). Taken as a whole, the strategies for the various resources will mitigate and take advantage of changes that have occurred in the forest ecosystem as a result of excluding natural fires.

   The Department of Forestry does not have a plan for "prescribed natural fire" under which naturally ignited fires could be allowed to burn within certain predetermined conditions. This has been used by federal agencies to manage fuels and achieve ecosystem management goals.

Forest Health

1. **Strategy: Forest health will be maintained or improved primarily through silvicultural treatments.**

   Analysis: This strategy is based on the premise that a diverse, productive, resilient, and sustainable forest ecosystem can be achieved through silvicultural methods. Human intervention is needed to mitigate undesirable forest conditions that tend to result from excluding natural fires.

   The silvicultural approaches outlined in "Forest Health" in Section III will generally be followed. (These approaches are found under the headings "Management of Forest Health" and "Specific Management Recommendations for Insects/Diseases" in the "Forest Health" subsection of Section III.) Forest health also underlies the silvicultural approaches that are detailed in the strategies for Timber, Fire Management, Soils, and Wildlife and Fish.

   Most treatments will be done in conjunction with timber harvesting and post-harvest activities. The forest health status of individual stands is the major consideration in setting priorities for timber harvesting. Site-specific silvicultural methods will be articulated in pre-sale plan reports. ("Forest Health" in Section III describes stand conditions that increase vulnerability to insects and disease, and outlines various treatments. Analytical methods for timber harvest planning are discussed under "Timber" in Section III.)

   Basically, this strategy is a refinement of the silvicultural systems that have kept the Klamath-Lake District healthier than most eastern Oregon forests. ODF's insect and disease staff, as well as specialists in the other forest disciplines, have been consulted to develop a comprehensive approach. Insect and disease problems will not be eliminated, but should be held to reasonable levels. In fact, a certain number of dead or unhealthy trees may have to be encouraged in order to enhance biodiversity and resilience of the forest ecosystem. This strategy is expected to maintain long-term productivity and revenue generation, and will be compatible with the goals for all forest resources.

2. **Strategy: Continue to monitor insect and disease damage levels through aerial surveys, ground surveys, stand exams, insect trapping, and other methods.**

   Analysis: Insect and disease levels are an indication of forest health. Monitoring is done to detect and evaluate problem situations and to analyze trends. As an element of adaptive management, monitoring is used to evaluate the results of forest health strategies. Monitoring methods are discussed in "Forest Health" in Section III.

3. **Strategy: Where monitoring has determined that damage is occurring above threshold levels, prescribe appropriate treatments in accordance with the Integrated Pest Management (IPM) law as described in ORS 527-310 to 370.**

   Analysis: Integrated Pest Management is a decision-making process that promotes environmentally sound pest management activities. The "Forest Health" subsection of Section III has specific details about IPM.

The management strategies for forest health and other resources already incorporate IPM processes. For example, site-specific management objectives are well-defined, detection and monitoring systems are in place, and pest conditions are periodically evaluated. The basic silvicultural systems (uneven-aged and even-aged management) and related strategies for insects and disease are designed to handle problem situations that are normally encountered. (See strategy 1.) Some examples are the root disease pockets or scattered insect-attacked trees that are found in mixed conifer stands, and the high mistletoe levels in lodgepole pine stands. Strategies have been articulated to handle these situations.

Under IPM, when damage exceeds an established threshold level, some type of special action may be needed. For example, it may become necessary to consider aerial insecticide applications or animal damage control measures. Any proposed actions would be developed, analyzed, implemented, and monitored using IPM procedures. ODF's insect and disease specialists would be consulted for technical advice.

Grazing

1. Strategies for Common School Forest Lands:

a. Review DSL's rangeland management plans to ensure that there is an adequate plan for each DSL leasehold on Common School Forest Lands, consistent with the goals of this long-range plan.

b. Work with DSL to resolve any problems or concerns having to do with DSL grazing leases or federal grazing allotments associated with these leases.

Analysis: ODF and DSL have overlapping land management responsibilities on Common School Forest Lands. These strategies define their roles in livestock grazing, based upon applicable statutes and interagency agreements.

The responsibilities of ODF and DSL are spelled out in a contract that was approved by the State Land Board (Oregon Division of State Lands and Oregon Department of Forestry, 1993). Although DSL is assigned the authority and responsibility to manage grazing leases, ODF is responsible for the overall management, control, and protection of Common School Forest Lands. The contract makes ODF responsible for preparing long-range management plans that govern grazing management in addition to the other forest resources. Consequently, ODF will rely upon DSL's expertise in grazing and will regard DSL's grazing management plans as extensions of the long-range plan. ODF will actively review grazing plans such as the Yainax Coordinated Resource Management Plan. ODF will also rely upon DSL to administer grazing leases and to coordinate with federal agencies with regard to grazing allotments and exchange of use. DSL's management of grazing must comply with the current administrative rules for rangeland management on Common School trust lands.

2. **Strategies for Board of Forestry Lands that are associated with federal grazing allotments:**
   a. Continue to issue grazing leases as requested by federal permittees.
   b. Review the fee structure for grazing leases as part of plan implementation.
   c. Seek the cooperation of federal agencies (USFS and BLM) to ensure that the holders of federal grazing permits comply with allotment management plans on all state, private, and federal lands in the federal allotments. Emphasize compliance with applicable laws such as the Clean Water Act.
   d. Actively participate in the development and maintenance of coordinated management plans for federal grazing allotments that include Board of Forestry lands. Make sure that these plans provide for proper grazing stewardship on Board of Forestry lands.
   e. Examine ODF leases and revise as necessary to ensure proper grazing stewardship.
   f. Ensure that grazing leases do not interfere with land ownership goals (e.g., trading or selling land).
   g. Within 2 years of plan approval, request assistance from DEQ, NRCS (Natural Resource Conservation Service), ODA, USFS and/or BLM, and grazing leaseholders to develop environmental guidelines for grazing on Board of Forestry lands. Use this information to develop strategies c, d, and e above.

   Analysis: The Department of Forestry is responsible for grazing leases on Board of Forestry lands. This subset of Board of Forestry lands is located inside federal grazing allotments. The strategies address the open range situation, ODF's relationship to the federal allotments, and ODF's mandates to produce income and protect natural resources.

   ODF chooses to comply with the open range laws by allowing grazing and maintaining a relationship with the federal permittee and the federal agency that is responsible for the allotment. The alternative, which is to exclude cattle by fencing, is not practical. Before leases are granted, ODF will make sure they do not conflict with land base goals, for example by becoming an encumbrance that could interfere with the sale or exchange of the property.

3. **Strategies for Board of Forestry Lands outside federal grazing allotments:**

   Sun Pass State Forest

   ODF will not pursue grazing leases on these lands. Ranchers will be asked to remove livestock that stray onto the state forest, and problems will be handled on a case-by-case basis. Any person who requests a grazing lease will be responsible for preparing a rangeland management plan. Among the concerns that must be addressed by the plan are:
   a. Suitability and carrying capacity of range for grazing.
   b. How livestock will be kept out of areas where land use designations preclude grazing (i.e., conservancy areas along Sun Creek and Annie Creek).

c. How grazing will be managed to protect or be compatible with timber production, recreation, cultural resources, fish and wildlife, soils, special forest products, and water resources.
d. How livestock will be prevented from trespassing onto federal lands.

ODF must determine that the plan adequately addresses all concerns and that ODF's share of revenues generated under the plan will cover the costs of administering the plan, before the plan would be approved.

Other Parcels

Most of these parcels are in open range. Lease requests will be considered on a case-by-case basis. Any resource problems caused by open range grazing without a lease will be handled on a case-by-case basis as well.

Analysis: The Department of Forestry is responsible for grazing leases on Board of Forestry lands. This subset of Board of Forestry lands is in open range, but not within federal grazing allotments. (No lands are known to be in livestock districts.) The strategies address how ODF will deal with open range grazing that may occur, and what criteria will be used to issue leases.

The strategies are consistent with the planning goals. The burden of preparing a rangeland management plan for Sun Pass lies with the lease applicant because ODF does not have the necessary resources. Neighboring ranchers currently do not want their livestock to graze on Sun Pass because they would be in trespass if they wandered onto nearby federal lands. Therefore, grazing probably will not occur at Sun Pass unless a lease and rangeland management plan are formalized. Grazing leases for the other Board of Forestry lands would not be likely to generate enough revenue to offset the cost of issuing the lease.

Land Base

A. Scattered Tracts

See "Location of Eastern Region State Forests" in Section I, for a definition of the scattered tracts; and Appendix L for a detailed discussion of the scattered tract situation.

1. **Strategy: Evaluate each parcel for exchange potential that would result in blocking these lands on the Klamath-Lake District or other districts with state lands management staff.**

2. **Strategy: Make recommendations on land exchanges and sales to DSL. On lands with no exchange or sales potential, work with DSL to decide the best course of action to remove these tracts from the Common School Forest Land list.**

   Analysis: As currently located and distributed, these lands are very inefficient to manage. These two strategies will increase efficiency by blocking land where the management staff exists, and by removing the remaining lands from the Common School Forest Land list. Removal from the list takes the lands from ODF's management responsibility.

3. **Strategy: During the evaluation and exchange of these lands, manage the lands only to prevent losses in asset value.**

   Analysis: This strategy is aimed at keeping the value of these lands as high as possible until the time of exchange. Management will occur only to prevent loss of value.

B. Klamath-Lake District Lands

1. **Strategy: The long-term strategy is to exchange the satellite parcels for forest lands that are in or adjacent to the three major tracts. (See "Location of Eastern Region State Forests" in Section I, for a definition of satellite parcels.)**

   Analysis: The satellite parcels tend to be small and surrounded by lands not owned by the state. For these reasons they tend to create access problems and inefficiencies during intensive management operations. However, because there is local management of the satellite parcels, their management is not as inefficient as the scattered tracts. For this reason, this strategy is a lower priority than the strategy for the scattered tracts. This strategy will result in increased efficiency of intensive forest management.

2. **Strategy: Private lands mostly or wholly surrounded by state forest lands (inholdings) will be a high priority for acquisition through exchange or purchase.**

   Analysis: Inholdings can cause significant access problems. In addition, management objectives of inholding landowners can be incompatible with state forest management objectives. This strategy will result in increased efficiency of intensive forest management.

3. **Strategy: Follow the procedures in ORS 197.180 and OAR 660-30, 660-31, and the Department's State Agency Coordination Program, OAR 629-20, to assure that the Klamath-Lake District's land use programs comply with Statewide Land Use Planning Goals and are compatible with acknowledged city and county comprehensive plans and land use regulations; while carrying out Board of Forestry and Department of Forestry statutory responsibilities.**

   Analysis: All state agencies must comply with the Statewide Planning Goals, by assuring that land uses are compatible with acknowledged local government comprehensive plans and land use regulations. The Department of Forestry's State Agency Coordination Program at OAR 629-20 describes the procedures to be followed. OAR 629-20-000 states that "it is not the intent of these rules to prevent either the Board of Forestry or the Department of Forestry from carrying out their statutory responsibilities."

   In the case of the Eastern Region Forest Management Plan, the District Forester has followed the specified procedure by notifying local government that the forest plan is being developed and by requesting their review and comment on the compatibility of the draft forest plan with the local government's comprehensive plan. The procedures in OAR-629-20 will also be followed in order to ensure that the following elements of the State Forest Land Management Program are compatible with acknowledged city and county comprehensive plans and land use regulations:

a. land use designations
b. long range plans, block plans, annual operation plans, and transportation plans
c. land acquisition, sale, or exchange
d. forest uses not regulated by the Forest Practices Act
e. non-forest uses

Recreation and Scenic Resources

Recreation

1. **Strategy: Make state forests available for "informal dispersed recreation." (See Appendix A for definition of this term.)**
2. **Strategy: ODF will not actively promote increases in recreational use.**
3. **Strategy: Monitor recreation use and adjust the level of management and development over time in accordance with changing recreational demands and patterns of use.**

   Analysis: The three strategies above form ODF's overall strategy for recreation. The recreation resource assessment in Section III determined that the current users value the type of informal dispersed recreation currently available in Sun Pass, and do not want to see major changes. In addition, surrounding agencies and private landowners are providing a full spectrum of more developed recreation opportunities, as well as more primitive wilderness opportunities. ODF has not at this time noted significant resource impacts or damage from the current level and type of use. On the contrary, current users have taken very good care of the higher use sites. In addition, ODF does not have the levels of funding needed to take on a significant recreation program. For these reasons, ODF believes that the general strategy above defines our overall role in providing recreation opportunities.

   Strategy 3 provides for adaptive management over the long term. Recreational use and impacts will be noted during routine visits to the forest. Unless a change is detected in recreational use, demand, or impacts, additional user surveys will probably not be necessary until the next revision of the long-range forest plan.

4. **Strategy: Provide the following information through tools such as brochures, signs, tour opportunities, and contact with schools.**

   a. Forest rules and regulations.
   b. Recreational and camping etiquette.
   c. Education about the working forest.

Analysis: Providing this information will have many benefits, including the following.

- Inform users about current fire regulations, camping rules, length of stay policies, etc.
- Inform users about ways to accomplish low impact camping, including human waste disposal, garbage disposal, resource protection, and etiquette around other users. Providing this information should help prolong the workability of the informal dispersed recreation role that we see for ourselves. Facilities such as restrooms and garbage cans will not be provided because of the dispersed pattern of camping and limitations in staffing and budgeting.
- Inform users about the state forest land's role as a working forest and explain many of the signs of forest management they will see as they recreate in the forest.

Providing this kind of information will help us achieve several of our goals, including:

- Minimizing adverse impacts on other resources.
- Accommodating a wide variety of uses while minimizing conflicts between users.
- Interpreting the history of the forest and present-day management.

5. **Strategy: Correct problems at recreation sites (e.g. trampling, soil erosion, vegetation loss) as needed to achieve the planning goals for water quality, scenery, wildlife, and other forest resources.**
6. **Strategy: Control access to sensitive areas of the forest, such as critical wildlife habitat or cultural resource sites. Some ways to control access are seasonal road closures, putting existing roads to rest, and carefully routing trails.**

   Analysis: Strategies 5 and 6 provide additional ways of minimizing adverse impacts on other resources.

7. **Strategy: Develop a policy on fees and permits within 4 years of the adoption of the long-range plan.**

   Analysis: Permits and fees may be required for commercial recreation and may be required for large groups and for certain types of recreation. As a general rule, individuals, families, and small groups will continue to have free access without permits. This strategy will help establish consistent and coordinated recreation management.

8. **Strategy: Work with user groups, neighboring landowners, and other agencies that approach ODF and are interested in planning, developing, maintaining, and/or funding specialized recreation that is compatible with Land Use Designations and other resource goals.**

   Analysis: This strategy will help maximize efficiency and diversify funding of recreation management.

Scenic Resources

1. **Strategy: Meet Forest Practices Act requirements along designated scenic highways.**

   Analysis: Only one parcel of timber production land is adjacent to a designated scenic highway. This parcel is in a lodgepole pine plant association and is therefore scheduled for even-aged management. In this parcel, the scenic protection strategy will be to follow the

Forest Practices Act standards for designated scenic highways (ORS 527.755). These standards specify how scenic values will be protected along designated highways.

2. **Strategy: In high public use areas scheduled for timber management, logging systems will be designed to minimize visual impacts.**

   Analysis: An example of one way to do this would be to locate logging roads, skid trails, and landings away from the sensitive area. Actual methods will depend on site-specific conditions. This strategy will help minimize the visual impacts of forest management activities in a manner consistent with the primary use of the land.

Soils

Strategies for All Soils

1. **Strategy: Comply with all Oregon Forest Practices Act requirements for soil protection.**

   Analysis: OAR 629-24-442 has general provisions for protecting forest soils during forest operations; e.g., adapting the logging method and type of equipment to the given slope, landscape, and soil properties in order to minimize soil deterioration. The water protection rules (OAR 629, Divisions 635 through 660) protect long-term soil productivity and hydrologic functions within riparian management areas and wetlands.

   This strategy, combined with the following soils strategies, will adequately protect long-term soil productivity during forest operations. Site-specific details are given in pre-sale plan reports and in written plans (as required) for riparian management areas. Timber sale operators must comply with the administrative rules during harvesting operations.

2. **Strategy: Maintain quantities of organic material in the soil (e.g., duff and litter).**
   a. Conduct prescribed burns under conditions that minimize the impact to soil organic materials. For example, take into consideration the amount and distribution of fuels, fuel moisture, weather conditions, and topography.
   b. During harvesting activities, use logging systems that minimize disturbance to the existing duff, litter, and woody debris, except where disturbance is desirable to facilitate natural regeneration. Retain logging residue (limbs, tops, cull logs, etc.) while not creating an unacceptable fire hazard.

   Analysis: This strategy recognizes the importance of maintaining duff and litter. Organic materials increase soil fertility, retain moisture, slow water run-off, and prevent erosion. On water-repellent pumice and ash soils, organic materials also help to reduce erosion during intense thunder showers. The strategy also contributes to biodiversity by providing habitat for small creatures.

Long-term soil productivity will be enhanced as duff and litter accumulate to higher levels than under a natural wildfire regime. The amounts will vary from one place to another because logging debris, fire intensity, and other disturbances will be distributed unevenly. Fuel treatment strategies (e.g., prescribed burning and alternative methods) will offset the risk of damaging the soil's organic content during an intense wildfire. Carefully executed prescribed burns will not cause undue damage.

Additional Strategies

1. **For ash and residual soils:**
   a. Restrict ground-based logging to the dry season.
   b. Plan a permanent system of skid trails that occupies no more than 10% of the area.

   Analysis: Ash and residual soils are susceptible to compaction by ground-based equipment such as skidders. This strategy mitigates the effects of ground-based equipment on long-term soil productivity. Ash and residual soils are less susceptible to compaction when they are dry. The amount of ground area exposed to compaction will be limited.

2. **For pumice soils: Allow operations to occur when these soils are wet or frozen.**

   Analysis: Pumice soils are difficult to compact, even when wet. Soil displacement and dust can be a problem when pumice soils are dry. This strategy will permit the year-round scheduling of operations. Allowing operations to occur in either summer or winter will not cause any appreciable change in long-term soil productivity.

Soil Erosion

The above strategies address soil erosion as it relates to long-term soil productivity, but water quality can also be affected by sediment produced by soil erosion. Erosion from roads and skid trails is a problem that may affect water quality more than long-term soil productivity. This type of erosion is discussed in the strategies for water resources.

Special Forest Products

1. **Strategy: Participate in the Department of Forestry's Special Forest Products Committee, whose task is to develop a state forests policy for the management and marketing of special forest products. Once the policy is in place, reevaluate the Klamath-Lake District's approach to special forest products.**

   Analysis: The Department of Forestry currently does not have a department-wide policy. The purpose of the committee is to create overall policy for individual districts to use in managing and marketing special forest products.

   Some of the issues that will be addressed in the Department's policy include marketing, environmental concerns, conflicts with other resources, and program administration. Within the framework of the statewide policy, each district will be able to develop a program suited to local circumstances.

2. **Strategy: Until a department-wide policy is developed, the Klamath-Lake district will:**
   a. Continue to develop a permit system for mushrooms.
   b. Continue to provide opportunities for personal use firewood cutting in harvested areas, where compatible with management strategies for post-harvest residues.
   c. Continue to respond to requests for other special forest products on an individual basis.

   Analysis: This strategy addresses the current demand for special forest products. Specific strategies are given for the two products that are currently in demand; mushrooms and firewood. (Refer to "Special Forest Products" in Section III for details.) The experimental system for mushrooms allows both commercial and personal use harvesting. It may be modified as experience is gained. Firewood permits are issued on a site-specific basis, with consideration given to the strategies for soils, air quality, fire management, and timber. Feedback from this interim strategy will be useful for developing the department-wide special forest products policy.

Subsurface Resources

1. **Strategy: DSL and ODF will coordinate to provide for the exploration and development of subsurface resources while providing needed protection of surface resources. ODF will:**
   a. Review DSL's plans and leases for the exploration and development of subsurface resources to ensure that they are consistent with the goals of this long-range plan.
   b. Work with DSL to resolve any problems or concerns.

   Analysis: The Division of State Lands is the managing agency for all subsurface resources on both Common School Forest Lands and Board of Forestry lands. This strategy clarifies the relationship between DSL and ODF, based upon applicable statutes and interagency agreements.

   ODF manages, protects, and controls surface resources on Common School Forest Lands and Board of Forestry lands. DSL, acting on behalf of the State Land Board, is the managing agency for subsurface resources. ORS 273.780 gives the Land Board authority for mineral and geothermal rights on most lands owned by the state of Oregon. The net proceeds from these rights are distributed to the Common School Fund or the counties, depending on the land ownership.

   For Common School Forest Lands, the responsibilities of ODF and DSL are spelled out in a contract that was approved by the State Land Board (Oregon Division of State Lands and Oregon Department of Forestry, 1993). The contract makes ODF responsible for preparing long-range management plans that govern minerals management in addition to the other forest resources. Consequently, ODF will rely upon DSL's expertise and will regard DSL's subsurface resource management plans as extensions of the long-range plan. ODF will also rely upon DSL to administer leases.

   For Board of Forestry lands, ODF will similarly rely on DSL's expertise to prepare management plans and administer leases.

Permits and leases contain the terms, conditions, and operating instructions for exploration and development. The Department of Forestry, as surface owner, signs these agreements. As it stands, these documents constitute DSL's plans for exploration and development. The current resource description indicates that there is little known potential for development (see "Subsurface Resources" in Section III). Therefore, a more comprehensive plan does not appear to be needed at this time.

This strategy is consistent with ODF's planning goals for subsurface resources as well as for timber and other surface resources.

2. **Strategy: Any data that the Department of Geology and Mineral Industries (DOGAMI) obtains involving exploration in or near the Klamath-Lake District state forests will be reviewed by DSL for its applicability to management of these lands.**

   Analysis: Companies conducting gas, oil, or mineral exploration are required to provide DOGAMI with information on their findings.

   DSL will review new information to update management plans for the forests. The resource description in Section III was based largely on research done at DOGAMI's library. So far, no commercially viable energy or mineral deposits are believed to occur on the state forests.

3. **Strategy: If development occurs:**

   a. DSL will ensure that mining and drilling are carried out by state-of-art methods to ensure that the Common School Fund, counties, and local taxing districts receive maximum revenues.
   b. DSL will develop working guidelines, in cooperation with other state agencies (such as DOGAMI, ODFW, Department of Environmental Quality, etc.) for permitting gas, oil, and mineral development using environmentally sound techniques.
   c. If potential conflicts exist between development of subsurface resources and protection of surface resources, DSL will confer with DOGAMI and ODF to find solutions that allow development while providing needed protection.

   Analysis: This strategy describes how various state agencies will interact when mineral or geothermal development occurs.

   DSL, as the managing agency, works closely with DOGAMI as well as other affected agencies. DOGAMI is the regulatory agency for the exploration, development, and reclamation/abandonment of subsurface resources. The resource description has additional details about the regulatory processes (see "Subsurface Resources" in Section III). This strategy is consistent with the planning goals for subsurface resources, as well as for timber and other surface resources that might be impacted by mineral or geothermal development.

4. **Strategy: DSL will cooperate with DOGAMI to develop a set of geologic maps aimed at specific mineral commodity locations on the Klamath-Lake District. For example, it may be appropriate to conduct a geologic investigation directed to locating occurrences of quarry rock.**

   Analysis: This strategy further develops DSL's role as the managing agency for subsurface resources.

   Geologic maps will be an aid to future planning. The strategy is consistent with the planning goals since it identifies lands where exploration and development might occur, and where development may increase the long-term production of revenue.

Threatened, Endangered, and State Candidate Plants

1. **Strategy: If plants on the base list become listed under the State of Oregon Endangered Species Act, develop an assessment methodology for each species in consultation with the Oregon Department of Agriculture (ODA).**

   Analysis: A two-phase process for complying with OAR 603-73-090 (5)(a) is described in the "Vegetation" resource description in Section III. A base list has already been compiled for the Klamath-Lake District. It consists of two species that are proposed to be listed as threatened or endangered. In case either species becomes listed, this strategy will fulfill the second phase in the process for complying with the administrative rule.

   The objective of the assessment methodology is to allow ODF to screen specific activities in specific locations for potential conflicts with listed species. ODF will seek technical advice from ODA to develop methodology that is appropriate for each species or management activity. The two agencies have no prior experience working together to develop this methodology, so the outcome of this strategy is uncertain. For the two species that are proposed for listing (*Astragalus peckii* and *Botrychium pumicola*), assessments would probably be limited to specific habitats inside the lodgepole pine zone, which occupies 4,149 acres, or about 18% of the North Block.

2. **Strategy: Apply the assessment methodology to determine if a conflict exists between a proposed activity and a listed species. If ODF determines that a conflict exists, follow the procedures outlined in OAR 603-73-090 (5)(b) - (5)(h).**

   Analysis: This process is in compliance with the statutes for the protection and conservation of listed plants. The specific statutes are ORS 564.105 (3) and ORS 564.115. ODF, in consultation with ODA, must determine whether the forestry activity is consistent with ODA's conservation program for the species. If no conservation program is in place, ODF must determine whether the activity has the potential to "appreciably reduce the likelihood of survival or recovery of any population of any plant species that is listed as threatened or endangered." If so, ODF must recommend reasonable measures to minimize any potential adverse impacts of the activity. ODA's role is to review ODF's proposal and recommend alternatives if necessary. In deciding whether or not to implement ODA's

alternatives, ODF may weigh the benefits of the proposed forestry activity against the harm from failing to implement the alternatives.

At this time, ODA has not developed conservation plans for any listed species. Until conservation plans are developed, ODF will make determinations on the relationship between forest management activities and listed plant species as described in the preceding paragraph. So far, ODF has not had any need to work through this process. Therefore, the potential effect on forest management activities in the Klamath-Lake District is uncertain.

3. **Strategy: To contribute to the prevention of further listings of candidate plants as threatened or endangered, ODF will consult with ODA on protection measures for any known population of state candidate species on state forest land. ODF will determine whether to implement any of ODA's recommendations.**

   Analysis: There is no legal requirement to follow this strategy, but it is considered prudent to prevent plants from becoming listed if possible. Protection measures will be considered on a case-by-case basis. The decision to implement these measures may take into consideration the legal mandates, policies, and planning goals for all forest resources.

4. **Strategy: If plant species become listed under the federal Endangered Species Act:**
   a. For those listed as "endangered", no action is required other than to comply with state laws and regulations, unless specific federal regulations have been issued.
   b. For those listed as "threatened" or "endangered", ODF will comply with any specific regulations issued by the Secretary of the Interior.

   Analysis: Appendix E lists the plant species of concern that are suspected or documented in the Klamath-Lake District. None of these plants are currently listed under the federal Endangered Species Act. In case any plants are listed in the future, this strategy outlines ODF's obligations as a non-federal landowner to comply with the Act.

   In 1988, Congress strengthened the protection of endangered plants. Section 9 of the Act prohibits "removal or destruction of endangered plants on non-federal land by anyone who in the process of destroying the plants knowingly violates any state law or regulation, including criminal trespass laws." (Rohlf 1989) Criminal trespass should not be an issue in state land management unless, for example, a person enters state land without permission and removes or destroys a plant. In the normal course of management activities, ODF intends to comply with all state laws and regulations such as the Forest Practices Act and the state Endangered Species Act. Even if a federally-listed endangered plant should be damaged during the course of lawful activities, ODF would not be in violation of the federal Endangered Species Act. However, if the Secretary of the Interior has issued specific regulations for either threatened or endangered plants under Section 4 of the ESA, then ODF must comply.

Timber

1. **Strategy: Continue to practice the silvicultural systems described in "Current Timber Management Practices", which is part of the subsection "Forest Products: Timber" in Section III.**

   a. Uneven-aged management in the ponderosa pine and white fir forest zones.

   b. Even-aged management in the lodgepole pine forest zone.

2. **Strategy:** Site-specific silvicultural prescriptions or marking guidelines will be prepared for all silvicultural treatments.

3. **Strategy: Adopt the additional stand density and large tree standards for the Forest Connectivity Areas articulated in the Wildlife and Fish Strategies (Section V).**

   Analysis: Strategy 1 describes a general direction for regulating stocking levels and species composition in the white fir, Douglas-fir, and ponderosa pine forest zones; and sets the basic silvicultural systems to be used in the lodgepole pine forest zone. Where there are particular insect or disease problems, these will be addressed by employing strategies contained in the Forest Health strategies and described in "Forest Health" in Section III.

   The site-specific prescriptions in strategy 2 will be based upon the particular set of stand density, species composition, structure, and forest health conditions existing at the time of a particular management treatment. In many areas, these prescriptions will dictate the removal of trees based on individual tree quality, species preference guidelines, stand structure, etc. In parts of stands with desirable species composition, stand structure, and forest health conditions, these prescriptions will dictate stand density reductions to the level that will allow the areas to grow back to the highest stocking level consistent with maintenance of adequate individual tree vigor and forest health by the next planned entry. Tools such as Stand Density Index as discussed by Long (1985) and Cochran (1992) and Growth Basal Area as discussed by Hall (1993) will be used in the development of these fine-tuned prescriptions. As new tools are developed they will be evaluated and used where appropriate.

   The standards in strategy 3 above were developed to assure that Sun Pass State Forest provides adequate connectivity between late successional habitat on surrounding federal lands. This timber management strategy was developed primarily to meet wildlife goals.

   The three strategies above, taken together, will contribute to meeting our goals of producing revenue, producing a sustained yield of timber, and promoting the growth of forest trees and stands by using appropriate silvicultural techniques

4. **Strategy: Regulate sustained yield harvest levels on an acreage, rather than volume, basis.**

   Analysis: The volume of timber harvested each year will vary, but the number of acres will be approximately equal. Because of wide variation in plant communities, site quality, current conditions, and other factors, volumes harvested from stand to stand will vary greatly. In addition, many of the most overstocked stands in need of immediate treatment

are also the stands that will yield the greatest volumes per acre. Acreage regulation enables the timely treatment of these stands by allowing more acres to be treated annually during the early years of the first decade than if we were regulating on a volume basis. This timely treatment of severely overstocked stands is crucial to the long-term productivity and health of these stands.

Implementation of strategies 1 through 4 will result in the estimated outputs shown in the following table.

Table V-1. Estimated Timber Harvest for the First Six Decades

	Harvest Acres			Harvest Volume (MMBF)		
Decade	**BOF**	**CSFL**	**Total Acres**	**BOF**	**CSFL**	**Total Volume**
1	9,813	2,074	**11,887**	74.04	16.03	**90.07**
2	10,228	1,737	**11,965**	74.57	12.34	**86.91**
3	9,011	1,353	**10,364**	56.76	6.84	**63.60**
4	10,703	1,301	**12,004**	76.95	10.51	**87.46**
5	11,393	1,999	**13,392**	81.33	11.43	**92.76**
6	10,907	2,134	**13,041**	90.07	11.16	**101.23**

Acronyms used in the table:

BOF	Board of Forestry Lands
CSFL	Common School Fund Lands
MMBF	Million board-feet

4

Because this plan is regulated on an acreage, rather than a volume basis, the number of acres receiving harvest treatment is less likely to change over time than the volume harvested. Through the process of adaptive management described in Section VIII, we will monitor how well our strategies are enabling us to achieve our goals. If necessary, we will adjust silvicultural prescriptions. Adjustments could either increase or decrease harvest volumes.

Strategy 5 clarifies how we intend to implement sustained yield harvesting.

5. **Strategy: Collect forest inventory data for the purpose of monitoring stand development and growth rates, modifying stand treatments, and calculating sustained yield harvest levels. See "Timber Inventory and Analysis for the New Plan" under "Forest Products: Timber" in Section III.**
   a. Update stand inventories and redo Stand Prognosis Model runs as a management cycle is completed for each stand.
   b. Maintain the existing permanent plot system in selected Sun Pass stands to obtain stand-level information on growth and development.

   Analysis: This strategy contributes to adaptive management by providing a feedback mechanism to answer many questions, including the following.
   - Have stand density, structure, and species composition objectives been met?
   - Are predicted growth rates being realized and do sustained yield estimates need to be adjusted?

   In addition, this strategy serves an important monitoring function for other resources. (See Section VIII, Monitoring, Research, and Adaptive Management).

6. **Strategy: Salvage harvest may be done following disease or insect epidemics, fire, and windthrow events. Structural elements for wildlife (e.g. snags and down woody debris) will be retained.**

   Analysis: Some benefits of salvage harvest are discussed in "Forest Health" in Section III. Some constraints on salvage harvest that provide for the retention of snags and woody debris for wildlife are discussed in the Wildlife and Fish strategies of this section. Catastrophic fire or massive insect and disease mortality could result in short-term harvest levels exceeding the sustained yield levels articulated above. If such a catastrophic event occurred, future sustained yield levels would need to be recalculated.

   This strategy contributes to meeting our revenue production goal by enabling us to capture the value of trees that would otherwise be lost. This strategy also contributes to meeting our Forest Health goal in cases where salvage will reduce further infestations.

7. **Strategy: During the first five years of the plan, a wood quality strategy will be developed to assist the Department of Forestry in making appropriate silvicultural decisions for improving revenue production.**

   Analysis: Market research will be conducted during the first three years to gather the information necessary to develop this wood quality strategy. The strategy would answer questions such as, what type of wood quality are we striving for? What are the desirable species and tree sizes? Should pruning be a part of our strategy to produce clear pine?

Water Resources

1. **Strategy: Continue to meet all Oregon Forest Practices requirements regulating the conduct of forest operations for protection of waters of the state.**

   Analysis: Forest Practices Act requirements must be met for all forest operations. The water protection rules (OAR 629, Divisions 635 through 660) are specifically designed to achieve Oregon's water quality standards. These standards are based on the federal Clean Water Act.

   This strategy will achieve the planning goals for water quality standards, beneficial uses of waters of the state, and water-related functions of riparian lands. Beneficial uses (i.e. fish and domestic use) are incorporated into the Forest Practices Act's stream classification system and protection guidelines. As stated in OAR 629-635-100(3), the purpose of the water protection rules is to "protect, maintain, and where appropriate, improve the functions and values of streams, lakes, wetlands, and riparian management areas. These functions and values include water quality, hydrologic functions, the growing and harvesting of trees, and fish and wildlife resources." Site-specific details are given in pre-sale plan reports and in written plans (as required) for riparian management areas. The timber sale operator must comply with the administrative rules during harvesting operations.

2. **Strategy: Cooperate with neighboring landowners, including federal and state agencies, to identify specific projects, practices, or monitoring needs that contribute toward solving a watershed problem or concern. Evaluate proposals with respect to the relative impact of state forests in the affected watersheds, as well as consistency with planning goals and strategies, primary land use, and laws and policies that guide the management of state forests.**

   Analysis: State forests are generally scattered across the landscape, and have a greater impact on local watersheds in comparison to the larger basin. ODF will consider projects or practices that make sense when measured according to the criteria given above.

   The overall set of water strategies will, in general, satisfy the goals for watershed health. This strategy describes how state forests can make an additional contribution toward solving special problems or concerns, without carrying a disproportionate share of the burden. At this time, no specific problems or concerns have been discussed with other landowners. Section III (in "Water Resources" and "Wildlife and Fish") describes how the Upper Klamath Basin's aquatic ecosystems have deteriorated, resulting in the listing of the Lost River and shortnose suckers as endangered. This strategy addresses the possibility that cooperative watershed-scale actions may be needed to improve aquatic conditions in the basin. Other landscape-scale strategies related to the broader forest ecosystem are addressed in the management strategies for "Forest Health" and "Wildlife and Fish."

3. **Strategy: Continue to use the Protective Conservancy — Critical Wildlife Habitat land use designation to protect stream, riparian, and wetland functions along Sun Creek, Annie Creek, and Tamarack Spring.**

   Analysis: This strategy gives additional protection to uncommon, water-related habitats. The strategy is consistent with the planning goals for water storage, water-related functions of riparian lands, beneficial uses of water, and wetlands. Protection given by the Protective Conservancy — Critical Wildlife Habitat land use designation exceeds Forest Practices Act requirements. The Board of Forestry or the State Land Board, as appropriate, must approve any significant reclassification. Timber harvesting is not precluded, but will be done only to improve fish or wildlife habitat at the request of ODFW biologists. Livestock grazing, which is managed by the Division of State Lands at Tamarack Spring, is not precluded. As stated in the grazing strategies, ODF and DSL are to coordinate the protection of forest resources such as Tamarack Spring.

4. **Strategy: Maintain water quality and aquatic habitat by complying with road construction and maintenance standards specified in the Forest Practices administrative rules (OAR 629-24-420 through 424).**

   Analysis: As stated in OAR 629-24-420, the purpose of these rules is to establish minimum standards for forest practices that will provide the maximum practical protection to maintain forest productivity, water quality, and fish and wildlife habitat during road construction and maintenance.

   Compliance with the rules will adequately protect streams from sediment that forest roads might generate. The few surface streams are not believed to be exposed to significant amounts of road sediment because of soil characteristics (permeability and infiltration rates) and road locations.

5. **Strategy: Ensure that a water right or permit is obtained from the Water Resources Department prior to any surface water use.**

   Analysis: ODF holds a number of water rights. For uses that are not covered by a water right, a temporary water permit will be obtained by ODF or the timber sale operator. The Klamath-Lake District feels this strategy will adequately provide for its long-term water needs. Water uses that require a water right or permit include prescribed burning, herbicide spraying, and road dust abatement. For these uses, there are alternatives in case temporary permits become unavailable.

6. **Additional strategies that may affect water resources are given in the soils section.**

Wildlife and Fish

The Eastern Region State Forests Planning Team has worked closely with biologists from ODFW and USFWS to determine the role of the Klamath-Lake District state forest lands in providing habitat. In addition, the planning team has worked closely with ODFW biologists to develop these strategies.

Coarse Filter Strategies for All State Forest Lands

Coarse filter strategies are those strategies designed to maintain or enhance overall biodiversity and provide for the needs of most species. The current management practices for timber and the current programs for wildlife and fish form a good basis for a coarse filter strategy, and are listed below. See Section III for discussion of these practices and programs (under "Forest Products: Timber" and "Wildlife and Fish"). More specifically, these standard practices and programs will provide the foundation for protecting biodiversity, and will meet the habitat needs of most wildlife species native to these state forest lands. The following strategies apply to all state forest lands in the Klamath-Lake District.

1. **Strategy: Continue to implement the current timber management practices.**

   Analysis: These practices are discussed in Section III under "Forest Products: Timber." The discussion in Section III provides detail about the uneven-aged and even-aged silvicultural systems used.

   A discussion of how these practices impact biodiversity is contained in Section III under "Biodiversity." These timber management practices provide diversity while minimizing fragmentation of habitat. These practices will provide much habitat for fish and wildlife species appropriate to the pine-dominated ecosystem.

2. **Strategy: Continue to maintain the current set of Conservancy — Critical Wildlife Habitat Areas.**

   Analysis: These areas are described in Section III under "Wildlife and Fish." This strategy gives protection to uncommon or unique special habitats. Protecting uncommon or unique habitats will contribute to the goal of providing habitat for wildlife species appropriate to the pine-dominated ecosystem. In addition, the conservancy areas along Sun Creek and Annie Creek will protect the quality of fish habitat.

3. **Strategy: Continue to implement the current timber management practices related to snags, large trees, cover areas, and annual sale planning.**

   Analysis: These practices are discussed in Section III under "Wildlife and Fish." The practices relating to snags and large trees provide additional habitat diversity. The practices related to cover areas provide hiding cover for big game as well as dense cover for a variety of other species. Annual sale planning enables ODFW to advise ODF if proposed sale areas have additional habitat needs not covered by the standard timber management practices, and to make habitat protection and enhancement recommendations.

4. **Strategy: Salvage harvests will be conducted only when the number of dead and dying trees exceeds at least twice the minimum targets for snags in the stands being considered for treatment, or where snags pose a hazard to property or public safety.**

   Analysis: Implementing the strategies for Forest Health and Timber will maintain a healthy forest and reduce the occurrence of catastrophic tree mortality from insect and disease epidemics. These Forest Health and Timber strategies will reduce the natural recruitment of snags. This strategy is designed to provide a means to capture snags when mortality does occur. Related strategies are found under Timber and Fire Management.

5. **Strategy: Minimum targets for snag levels on state forests will be set as follows:**

   a. At least 2.2 total snags per acre greater that 10 inches DBH.

   b. At least 0.2 of these snags per acre should be greater than 20 inches DBH.

   Analysis: Previous strategies provide several methods to ensure the continued recruitment of snags. This strategy enables the effectiveness of these snag recruitment strategies to be monitored. Snag levels will be monitored as part of periodic stand inventories. (See Section III, "Forest Products: Timber"; Section V, "Timber Strategies"; and Section VIII, "Monitoring.")

6. **Strategy: Artificial methods for creating snags will be used to bring snag levels up to the minimum targets.**

   Analysis: It is recognized that these targets will not be met on every acre or in every stand. Some stands will have more snags than the target and some will have less. This strategy will be employed only when significant blocks of forest are not meeting target snag levels. This determination will be made in conjunction with ODFW during annual timber sale planning.

   Strategies 3 through 6 further contribute to the goal of providing habitat for wildlife species appropriate to the pine-dominated ecosystem as well as contributing to the prevention of future listings of snag-dependent federal Category 2 and state critical sensitive species.

Fine Filter Strategies for Sun Pass State Forest

Individual species and habitats that are not adequately addressed using the coarse filter strategies are managed specifically under a fine filter strategy.

1. **Strategy: Continue to participate in the Sun Creek Cooperative Road Closure.**

   Analysis: The Sun Creek Cooperative Road Closure is discussed in Section III under "Wildlife and Fish." This strategy was designed to increase habitat effectiveness for calving and early winter staging elk. This strategy further contributes to the goal of providing habitat for wildlife species appropriate to the pine-dominated ecosystem.

Forest Connectivity Areas

One of the goals articulated in Section IV for the wildlife and fish resource was to manage habitat in a regional context. Glen Ardt, Central Region Habitat Biologist for the Oregon Department of Fish and Wildlife, was assigned to develop ODFW's answer to the following question: should Klamath-Lake District state forest land contribute to any additional regional habitat role that the coarse filter strategies do not provide?

In order to answer this question, Glen met with Crater Lake National Park and Winema National Forest staff to gather information on current habitat conditions and future trends on the federal lands adjacent to Sun Pass State Forest. Glen then worked with Chris Carey, ODFW's Central Region Wildlife Diversity Biologist and Dave McAllister, ODFW's Forest and Range Program Manager to develop ODFW's recommendation.

As a result of this work, ODFW recommended that Sun Pass State Forest provide connectivity for late successional dependent species between the four late successional reserves that surround Sun Pass on the Winema National Forest and the late successional habitat in Crater Lake National Park (see Section III, "Biodiversity"). In addition, ODFW recommended that the habitat needs of the pileated woodpecker and the goshawk be used to develop the habitat component standards and that these two species be monitored as indices of the standards' success.

Strategies 2 through 7 articulate how this connectivity role will be fulfilled.

2. **Strategy: Approximately 2,000 acres will be designated as Forest Connectivity Areas in the ponderosa pine and white fir forest zones, to provide additional assurance that Sun Pass State Forest fulfills its connectivity role. Once selected, these areas will remain relatively fixed for the duration of this plan. These stands will be managed for timber production, but will differ from the coarse filter silvicultural prescription in two key characteristics:**

   a. Higher density, with greater crown closure. Site-specific prescriptions must remain consistent with the need to maintain individual tree vigor and forest health. In most stands, this will be accomplished through lighter, more frequent timber harvests (for example, every 10 to 15 years instead of the usual 20 years). In high elevation stands, which receive higher annual precipitation, this may be accomplished by leaving higher densities in white fir and Shasta red fir.

   b. More large trees. The target will be to leave an average of at least 15 trees per acre over 18 inches DBH after each harvest entry. At least 4 of these trees will be over 25 inches DBH. Large trees create habitat that is favored by the indicator bird species, and provide recruitment for future large snags and woody debris.

3. **Strategy: During one of the first two years of the plan, Sun Pass State Forest will be surveyed for nesting pileated woodpeckers and goshawks.**

   Analysis: The pileated woodpecker, a state critical sensitive species, and the northern goshawk, a federal Category 2 and state critical sensitive species, were selected as indicator species to monitor the effectiveness of the Forest Connectivity Areas in achieving Sun Pass's connectivity role. This survey information will serve as baseline data and in the short-term will be used to help designate the location and distribution of the Forest Connectivity Areas. Selection of these areas will not occur until after this survey is complete.

4. **Strategy: Habitat information will be collected on nest areas and/or home ranges discovered for these two species.**

   Analysis: Habitat requirements for a species can vary significantly across its range. While much published information exists on the habitat requirements of these two species from around the country, it is important to determine what habitat conditions are being used in Sun Pass State Forest. The next strategy explains how this information will be used.

5. **Strategy: Additional standards for snags and woody debris for pileated woodpecker habitat will be developed for the Forest Connectivity Areas.**

   Analysis: These standards will be based on existing published information as well as habitat information collected on Sun Pass pair home ranges. Woody debris levels will also be monitored on these Forest Connectivity Areas as part of periodic stand inventories. Snag levels are monitored on all stands.

6. **Strategy: A subset of the Forest Connectivity Areas will include at least three areas approximately 80 acres in size managed to maintain goshawk nesting habitat. Existing published information plus habitat information collected on Sun Pass nest locations will be used to quantify additional standards for these areas. Once selected, these areas will remain relatively fixed for the duration of the plan.**

   Analysis: Goshawks generally require small blocks of relatively dense, mature forest for nesting habitat. The standard uneven-aged management prescription in the Forest Connectivity Areas may not automatically provide this nesting habitat. This strategy will assure that some goshawk nesting habitat is retained.

7. **Strategy: After the initial surveys, pileated woodpecker and goshawk surveys will be conducted every five years to monitor the effectiveness of the Forest Connectivity Areas.**

   Analysis: This strategy is part of an adaptive management approach to providing habitat for the indicator species. The target for these two species on the forest will be to maintain at least two pairs of pileated woodpeckers and one pair of goshawks over time. This strategy will ensure the eventual success of the Forest Connectivity Areas, and contribute to the prevention of future listing of these species.

Strategies 2 through 7 will contribute directly to the prevention of future listings of the goshawk and pileated woodpecker as well as other federal Category 2 and state critical sensitive species found in Sun Pass that are dependent on late successional habitat. These are also the strategies that put the forest's habitat contribution in a regional context. These strategies are expected to result in a 4% reduction in first decade harvest volume from the standard uneven-aged prescription. This reduction is well within ODF's policy of allowing modifications of forest management plans that result in volume or value reductions of up to 10% to achieve better wildlife habitat (Oregon Department of Forestry 1989). Harvest levels during later decades will not be affected.

Threatened and Endangered Species

Spotted Owls

1. **Strategy: Avoid any harvest activity that results in less than 70 acres of the best available suitable owl habitat encompassing the nest site and/or activity center of a pair of spotted owls.**
2. **Strategy: Avoid any harvest activity that results in less than 500 acres of suitable habitat within a 0.7 mile radius (1,000 acres) of a nest site and/or activity center. The 500 acres may include the 70 acres in strategy 1 above, and should be as contiguous as possible.**
3. **Strategy: Avoid any harvest activity that results in less than 40% coverage by suitable owl habitat within a circle with a radius of 1.2 miles centered on the nest site and/or activity center. The 40% may include the acreage required in strategies 1 and 2 above.**

   Analysis: The three strategies above are taken from the Procedures Leading to Endangered Species Act Compliance for the Northern Spotted Owl, commonly referred to as the rescinded federal Incidental Take Guidelines (USDI Fish and Wildlife Service, 1990). A discussion of this approach is contained in Northern Spotted Owl Interim Plan for ODF Managed Lands Outside the Elliott State Forest (Oregon Department of Forestry 1994). This plan was developed by ODF to meet the requirements of the state ESA and puts spotted owl management on state forests in a statewide perspective. The three strategies above represent one way to deal with owl activity centers. Other strategies may be developed in conjunction with ODFW and USFWS if owl activity centers are found on state forest land. Defining and designating suitable habitat will occur in conjunction with ODFW when activity centers are discovered.

   For the known owl activity centers adjacent to Sun Pass State Forest and any activity centers discovered in the future, "take" will be avoided by using the above three strategies unless incidental take is authorized by a 4(d) rule established by USFWS or a habitat conservation plan, or unless other strategies are negotiated with ODFW and USFWS. (See Appendix A, Glossary, for definitions of incidental take and 4(d) rule.)

4. **Strategy: Spotted owl surveys will be conducted every five years, instead of annually, in Sun Pass State Forest and the Southwest Block to determine if the spotted owl situation is changing over time. The next survey will be conducted during the 1999 survey season.**

   Analysis: Three years of protocol surveys failed to locate any activity centers on these lands. The rationale for this strategy is further discussed in the spotted owl subsection of Section III, "Wildlife and Fish." This strategy frees up resources to initiate monitoring of other species of concern such as the goshawk and pileated woodpecker and enables ODF to contribute to the prevention of future listings of these species.

Peregrine Falcons

Forest management activities will not result in take of this species.

Wolverines

Forest management activities will not result in take or appreciably reduce the likelihood of the survival or recovery of this species.

Bald Eagles

1. **Strategy: Prepare a Site Management Plan that will meet or exceed the Forest Practices Act requirements for any active bald eagle nest sites found on state forest land.**

   Analysis: A Site Management Plan would provide detail on how important elements of the site will be protected. This plan would be developed in conjunction with ODFW biologists. No State Conservation Plan exists for this species at this time. The above strategy would ensure that incidental take is avoided as well as ensuring that forest management practices do not appreciably reduce the likelihood of survival or recovery of the species.

Additional Monitoring

1. **Strategy: Explore opportunities to collect information on other wildlife species using volunteer programs with groups such as the Klamath Basin Audubon Society or Wingwatchers.**

   Analysis: This strategy would provide baseline information on which species are currently using the forest. If this information is collected over time it can tell us how communities are changing over time in response to management and can serve as an adaptive management tool. This strategy will contribute to the overall goal of providing habitat for wildlife species appropriate to the pine-dominated ecosystem by providing a tracking mechanism for species other than those for which formal surveys are being conducted.

Section VI

Asset Management

The Eastern Region State Forest Lands are a tangible asset of the people of the State of Oregon. In particular, they are an asset of the counties, local taxing districts (mostly schools), and the Common School Fund. By statutory mandates and constitutional requirement, these lands are, and will remain, a long-term revenue-generating asset. Prudent and careful management of this asset is a central theme to the overall planning for and management of the forest. Each major decision and implementing action must recognize this imperative.

Management of the asset includes investment of time, dollars, and resources to perpetuate the forest's ability to generate revenue long-term. These investments include direct expenses for the annual production of commodities such as timber, as well as indirect expenses for overall planning and long-term management, such as resource monitoring or studies.

Most revenue-generating resources on these forests are renewable, and therefore the forest's revenue-generating potential is very long-term.

Organization and Management

The Eastern Region State Forests are managed by the Klamath-Lake District of the Oregon Department of Forestry. The region's state forest lands are currently managed by a total of six permanent personnel.

The district provides direct management of the Klamath-Lake District state forest lands, including long range planning, operational planning, and the on-the-ground implementation of all plans. The district also carries out the Scattered Tracts Plan for the Common School Forest Lands in the other two districts in Eastern Oregon (see Appendix L, and also "The Land Base" in Section III).

Over the past seven years the district has accomplished an average of 564 acres of harvesting and associated intensive management per year. This plan calls for increasing this activity level to an average of 1,190 acres per year. This increase will phase in gradually over several years as first timber sale preparation, then timber sale administration, then post-sale intensive management activities reach this level. When this activity level is fully realized several years into the plan, an additional forester may be necessary to implement the strategies.

In addition to the management by Klamath-Lake District, the management of Eastern Region State Forests is supported by the state forests program central staff located in Salem at the State Forester's Office. Under the leadership of the Director of the State Forests Program, the Salem staff provides overall program policy direction, liaison with agencies and organizations, department-wide planning and program support, specialized expertise in biological, technical, and legal areas (silviculture, forest engineering, fish and wildlife, etc.), business management, and program accounting.

The program staff in Salem carries out the forest management and business management functions that benefit by economies of scale, landscape-level work, and a consistent department-wide approach across all state forests. Conversely, the Klamath-Lake District staff accomplishes those functions that benefit by local perspective, local knowledge, and on-the-ground management decisions. This logical division of program administration between district and program staff leads synergistically to effective, efficient, long-term asset management.

In addition to support provided by Department of Forestry staff, wildlife and fisheries technical support for management of the forest is provided by the Oregon Department of Fish and Wildlife biologists in Klamath Falls. The biologists provide expertise in habitat management in an important partnership role.

The state forest program is operated entirely on program-generated revenue, and therefore careful financial management is imperative. Approximately two-thirds or more of the gross revenues from the forest will be returned to the Common School Fund for Common School Forest Lands. Exactly 63.75% of gross revenues are returned to Klamath County from Board of Forestry Lands. Thus, the program is managed on approximately one-third of gross revenues. All planning, organizing, staffing levels, and budgeting are based upon this overall distribution.

Financial management of the program is accomplished in two main ways.

- Revenue and expenditure planning, accomplished through revenue forecasting and budgeting.
- Revenue accounting and expenditure monitoring.

The forest management plan serves as the basis for financial management planning, and in particular for the preparation of biennial program budgets and annual fiscal budgets at the district and program staff levels. Revenue forecasting is done at the district and program staff levels on a periodic basis. Expenditure and accomplishment monitoring is done at both the district and program staff levels on a monthly and quarterly basis. Regular revenue and expenditure reports are provided to the State Land Board, the counties, and other interested parties.

As a part of the current planning process, all resources have been assessed for their current revenue potential. For the foreseeable future, timber will remain the largest source of direct revenue generation. However, alternative revenue sources will continue to be examined and analyzed. Indirectly, the forest's clean water and productive wildlife habitat also produce important community-based revenues and income.

Resource Revenues and Expenses

As we look at each major resource of the forest, we find that not all resources are associated with direct revenues and/or expenses. Also, some immediate resource expenses are in fact investments in the health and sustainability of the forest, and therefore contribute to the forest's overall ability to generate future income. In addition, many expenses are not reported here because they are part of normal overhead costs.

Air Quality

No direct revenues are anticipated from implementation of the management strategies. Implementation of strategies to limit prescribed burning, such as chip sales, may result in lower management costs over time, as compared to broader application of prescribed burning.

Cultural Resources

No direct revenues are anticipated from implementation of the management strategies. Expenses associated with the strategies are anticipated to be approximately $60,000 over the next ten years, for direct consulting fees and operating program costs.

Fire Management

While no direct revenues are expected from implementing the fire management strategies, these strategies will help ensure that the assets of the various forest resources and their long-term revenue-generating potential are protected. Expenses for fire protection assessments are expected to be approximately $450,000 over the next ten years. Expenses for fuel management are included in the expenses listed for the timber resource.

Forest Health

Management strategies for forest health are closely linked to the strategies for the timber resource. Revenues and costs resulting from implementing forest health strategies are included in the numbers discussed in this section under the "Timber" heading.

Grazing

The Common School Forest Lands will continue to generate approximately $330 per year for a total of $3,300 over the next 10 years. Board of Forestry lands will continue to generate approximately $300 per year for a 10 year total of $3,000. No additional significant costs are anticipated as a result of implementing the grazing strategies.

Land Base

Implementation of the management strategies will increase efficiency and thus, indirectly, result in increased revenues. The cost of implementing these strategies will be approximately $120,000 for the next ten years. This includes the cost of contract cruises and timber and bare land appraisals. Any money needed to balance values on a land exchange or to purchase inholdings will be handled through special budget requests.

Recreation and Scenic Resources

Some revenues could occur as a result of the recreation strategies, but amounts are unknown at this time. Costs will be approximately $10,000 over the next ten years for the development and printing of brochures and to correct minor resource damage problems at the higher use areas.

Soils

The costs associated with the soil strategies are included in the costs shown in the timber part of this section. No direct revenues are anticipated.

Special Forest Products

Some revenues and costs may occur as a result of implementing the management strategies, but the amounts can not be determined at this time.

Subsurface Resources

Based on current knowledge of the resource, no significant revenues or costs are anticipated from implementation of the management strategies.

Threatened, Endangered, and State Candidate Plants

No direct revenues are anticipated from implementation of the management strategies. Expenses associated with the strategies are anticipated to be approximately $10,000 over the next ten years for direct consulting fees and operating program costs.

Timber

The following table shows what the total revenues, expenses, and net income would be (in 1994 dollars) for the timber resource over the next ten years.

Table VI-1. Revenues, Expenses, and Net Income for Eastern Region State Forests — Timber Only

Land Ownership	Revenue [1] Ten-Year Total 1995-2004	Expenses [2] Ten-Year Total 1995-2004	Net Income [3]
Board of Forestry Lands	$18,572,000 to $34,676,000	$8,122,000	$26,554,000
Common School Forest Lands	$3,798,692 to $6,697,000	$1,764,000	$ 4,933,000
Totals	$22,370,692 to $41,373,000	$9,886,000	$31,487,000

1. The high value in the revenue range assumes stumpage prices based on recent experience. The low value assumes stumpage prices experienced in the late 1980s. As stumpage prices change, actual revenue will change accordingly.
2. The district expenses for timber management include all associated management costs for the forest not included in other resource descriptions. These expenses include Eastern Oregon Area and Salem headquarters staff costs.
3. Net revenue was derived using the high end of the revenue range minus the anticipated expenses.

Timber Marketing

In 1993, the State Land Board requested the Department of Forestry to examine alternative marketing practices for forest products. This research was requested to ensure that constitutional and statutory responsibilities to maximize revenue over the long-term were met. The research took into account the following issues facing the state lands program: increased potential for litigation of sold timber sales affected by threatened and endangered species; significantly reduced west-side harvesting objectives and revenues; increasing uncertainty that makes it difficult to successfully plan and market timber sales; and increased costs to plan and market timber sales.

In mid-1993, the Department of Forestry interviewed representatives of 28 small to medium-sized companies, other agencies, and forestry consultants, in order to investigate different alternatives to marketing timber. The following seven marketing strategies were derived from these interviews.

1. Current practice — sell stumpage.
2. Modified current practices.
3. Sell delivered logs from standing timber.
4. Sell specialty products.
5. Sell logs in decks out of a log yard.
6. Enter into long-term license agreements for private management of state forest tracts.
7. Sell timber futures.

These alternatives were discussed in detail and analyzed for impacts in the following categories: policy, financial, operational, silvicultural/biological, organizational, and forest industry (Oregon Department of Forestry 1993).

In late 1993 the State Land Board and the Board of Forestry approved two alternative strategies for immediate implementation. These strategies were use of shorter, flexible contracts to sell timber (part of alternative 2), and sales of specialty products. In addition, the State Land Board requested further, more detailed financial analysis of the remaining alternatives. John Beuter (consultant and president of Duck Creek Associates) was hired to conduct this analysis and found that there was no advantage to adopting any additional marketing practices.

Additional market research will be conducted to gather information necessary to develop a wood quality strategy, including desirable log sizes, log quality, and tree species. This research is expected to cost approximately $15,000 in consultant fees during the first decade.

Water Resources

No direct revenues are anticipated from implementation of the management strategies. Expenses associated with the strategies are anticipated to be relatively minor over the next ten years and are incorporated into overall operating program costs.

Wildlife and Fish

No direct revenues are anticipated from implementation of the management strategies. Expenses associated with the strategies are anticipated to be approximately $60,000 over the next ten years for animal population surveys and habitat studies.

Summary of Asset Management

The total current value of the timber and land on the Klamath-Lake District state forest lands has been estimated for the two ownerships with the following results.

Board of Forestry Lands	$136,300,000
Common School Forest Land	$ 18,900,000

These numbers were calculated using timber volumes from the forest inventory (adjusted to 1994) and estimated bare land values from recent exchange appraisals. In addition to generating the annual revenues presented below, the base asset value of the land and timber continues to increase over time. This increase in base value results from increasing land and timber values, as well as from improvements such as precommercial thinning and pruning.

The following table summarizes the anticipated total revenues, expenses, and net income (in 1994 dollars) for all resources for the next ten years.

Table VI-2. Revenues, Expenses, and Net Income for Eastern Region State Forests — Total for All Resources

Land Ownership	Revenue [1] Ten-Year Total 1995-2004	Expenses [2] Ten-Year Total 1995-2004	Net Income
Board of Forestry Lands	$18,575,000 to 34,679,000	$8,294,000	$26,385,000
Common School Forest Lands	$3,802,000 to $6,700,000	$1,867,000	$4,833,000
Totals	$22,377,000 to $41,379,000	$10,161,000	$31,218,000

1. Includes estimated revenues from the timber and grazing resource sections of the asset management analysis. The timber revenues include a revenue range with high and low values. See Table VI-1 for the timber revenue range.
2. This is a total of the estimated costs discussed in the cultural, fire, land base, recreation, threatened and endangered plants, timber, and wildlife and fish resource sections of the asset management analysis.

Section VII

Implementation

This section describes who is responsible for implementing the plan, and how implementation will be carried out.

Responsibilities

The Klamath-Lake District Forester has the overall responsibility for implementing the Eastern Region Long-Range Forest Management Plan. Implementation of the plan consists of the four primary responsibilities listed below.

- Implement the management strategies listed in Section V, "Management Strategies."
- Monitor those activities as described in Section VIII, "Monitoring and Adaptive Management."
- Conduct periodic reviews of plan implementation as described in Section VIII, "Monitoring, Research, and Adaptive Management." Determine when changes are needed.
- Amend the plan as needed.

Plan Scope

For the Eastern Region State Forests, this Eastern Region Long-Range Forest Management Plan supersedes the Timber Resource Inventory, Analysis, and Plan for the Eastern Oregon Area State Forests (Oregon Department of Forestry, 1978).

Plan Duration and Amendments

Duration

This plan will be in effect until it is replaced by a new plan. It is intended that this plan be flexible enough to endure significant changes in legal requirements and knowledge base. It is expected that this plan will be used for 10 to 15 years.

In order for the plan to remain useful for more than a very short time, there must be a mechanism for identifying when changes in management strategy are needed and a process for making those changes. Monitoring will help identify when changes are needed in management strategy. An amendment process will be used to make the changes.

Amendments

Minor changes (amendments) to management strategies may be made at the discretion of the Klamath-Lake District Forester in consultation with the Salem staff. DSL will also be consulted when these changes affect Common School Forest Lands. Changes are minor when they do not significantly decrease revenues, increase management costs, or decrease the likelihood of achieving the management goals.

Major changes to management strategies must be approved by the State Forester for Board of Forestry land and by the State Land Board for Common School Forest Land. For major changes to the management strategies, the Klamath-Lake District Forester will prepare an amendment request package containing documentation on the proposed change, the need for action, and an analysis of the economic and environmental effects of the proposed change. The proposed change will be routed to the Area Director for review and approval. If approved, the Area Director will route the request to the Planning Coordinator for review and comment. The Planning Coordinator will coordinate the remainder of the review and approval process, obtain input from DSL, and ensure that all necessary approvals are received.

Implementation Levels

Many of the management strategies require investments of capital. Some examples of these strategies are: reforestation, stand improvements (precommercial thinning, pruning), habitat enhancement activities, and monitoring activities.

Since the State Lands program is financially self-supporting (no General Fund dollars), the degree to which these strategies are implemented will vary with the amount of funding available. Funding will depend on revenue from resource development activities such as timber sales; special forest product sales; and gas, oil, and mineral leases. The amount of funding available, therefore, will depend on current resource prices and the amount of resource development allowed under the selected set of management strategies.

Priorities for investment are generally as follows:

1. Legally required activities.
2. Activities with high economic return.
3. Activities with lower, but still acceptable, economic return.
4. Activities with little or no economic return that the state carries out as a good steward of the land.

This plan makes no attempt to categorize activities by priority. It is our belief that the categorical rankings will change from time to time as legal requirements change and resource prices fluctuate. Activities will be prioritized in the biennial and fiscal year budgeting processes initiated at the district level, and will be reviewed by the State Land Board, the Board of Forestry, and the Legislature as part of the approval process for the Department of Forestry's biennial budget.

Implementation through Other Plans

Implementation of the Eastern Region Long-Range Forest Management Plan will involve other levels of planning that are more specific than the forest management plan. Other planning levels include annual operations plans for timber sales and other silvicultural operations, biennial budgets, and fiscal year budgets. These more detailed levels of planning are described in Section I, under the heading "Forest Management Planning for State Forests." Monitoring, research, and adaptive management will also be valuable tools in implementation of the plan. These tools are discussed in Section VIII.

Section VIII

Monitoring, Research, and Adaptive Management

The guiding principles commit the Department of Forestry to an ongoing program of monitoring and research, with adaptive management to be used to incorporate new information as it becomes available.

Monitoring is a key to successfully implementing the forest management plan. The Department of Forestry is committed to carry out the monitoring activities described in this section.

In the context of the Eastern Region state forests, monitoring is a process of measuring key characteristics of forest resources, in order to determine the effects of carrying out management strategies. Monitoring helps us answer the question: "Are the management strategies we have implemented achieving our management goals for resource development and protection?"

Monitoring in a broader context keeps track of changes in legal requirements for forest land management, changes in scientific knowledge about forest resources, and expenditure levels on the state forests.

Together with ongoing research, monitoring provides the information needed to support an adaptive management approach to forest management.

The Oregon Strategy For Healthy Ecosystems (Oregon State Resource Agencies, 1993) states: "Adaptive management is the process of monitoring and analyzing management actions in order to understand their effects, and then adjusting plans accordingly. It acknowledges that we do not fully understand ecosystem processes, especially across landscapes, through time, and in response to natural and human-induced changes. This is accomplished through research and monitoring programs. Adaptive management is a necessary approach if ecosystem management is to succeed."

This forest management plan will be implemented in an adaptive management context. This means that as we learn more about the effects of our actions, management strategies may, and probably will, change over time. As management strategies change, expected levels of resource development and protection will also change.

Monitoring

Monitoring Legal Changes

The State Forester's State Lands Program Staff in Salem will monitor changes in state and federal laws and regulations for any needed changes in management direction. Some examples of possible legal changes that could significantly alter management strategies are new listings under the state or federal Endangered Species Acts and development of federal regulations for protection of northern spotted owls. Changes in legal requirements will be reviewed with legal counsel in the Department of Justice and communicated to the Klamath-Lake District Forester. The Klamath-Lake District Forester will recommend any needed changes to management strategies in accordance with the plan amendment procedure described in Section VII.

Monitoring Changes in Scientific Knowledge

This task is the responsibility of all State Lands Program personnel and of specialists in other state and federal natural resource agencies. Specialists on the State Forester's staff in Salem will monitor developments in the areas of silviculture, biology, planning, harvesting systems, inventory systems, and forest health. Department of Forestry personnel will maintain connections with specialists in other state and federal agencies that were developed in the Eastern Region State Forests planning process. Maintenance of these contacts will ensure that advances in knowledge are captured and incorporated into the future management of the Eastern Region State Forests.

Monitoring Expenditures

Expenditures will be monitored by the Klamath-Lake District Forester to ensure that expenditures do not exceed amounts approved by the State Land Board, Board of Forestry, and the State Legislature.

Monitoring of Resources

This subsection summarizes monitoring plans and the types of information that will be collected. Most of these plans are discussed in more detail in the resource assessments in Section III and the strategies in Section V. The following section on Adaptive Management will illustrate some ways in which monitoring information will be used.

Air Quality

The following records will be kept:

- Number of acres burned for prescribed burns and wildfires.
- Number of smoke intrusions into the Klamath Falls Special Protection Zone.
- Number of intrusions into Class I wilderness and national park areas.

Cultural Resources

- No formal monitoring is planned after the initial surveys. Informal monitoring will be done to ensure that resource sites receive adequate protection.

Forest Health

- Aerial surveys are conducted annually for insect and disease mortality by the ODF Insect and Disease Section.
- Trap surveys are conducted annually for tussock moth populations.
- Periodic timber inventories and permanent plot inventories collect data on the occurrence, severity, and types of insect and disease pests.

Grazing

- The Division of State Lands is responsible for monitoring grazing on Common School Lands.
- ODF will informally monitor Board of Forestry lands to ensure that all resource values are being protected.

Land Base

- No formal monitoring is planned.

Recreation and Scenic Resources

- There will be informal monitoring of recreational use and impacts during routine visits to the forest. Additional user surveys will probably not be necessary unless a change is detected in recreation use, demand, or impacts.

Soils

- Protection of soils is monitored through contract administration.
- There will be informal monitoring of all operations that could potentially impact soils.

Special Forest Products

- Numbers and types of permits issued will be monitored.
- There will be informal monitoring to ensure that these activities are compatible with other forest uses and that other resources are protected.

Subsurface Resources

- DSL is responsible for monitoring subsurface resources on all state-owned land. These responsibilities include administering leases and reviewing exploration reports that are filed with the Department of Geology and Mineral Industries.

Threatened, Endangered, and State Candidate Plants

- No populations of listed plants are known to occur at this time on state forests. If a population is located, then ODF will consult with ODA on how to comply with monitoring and reporting requirements.

Timber

The following records will be kept:

- Acres, volume, and value of timber sold, by harvesting type (uneven-aged or even-aged management).
- Acres, volume, and value of timber harvested, by harvesting type (uneven-aged or even-aged management).
- Acres of trees planted, by species.
- Acres of site preparation, by type.
- Acres of vegetation management, by type.
- Acres of precommercial thinning.
- Acres of chip thinning.
- Acres of pruning.
- Data from periodic stand inventories, permanent plot inventories, and stocking surveys of recently planted areas.

Water Resources

- Streams and lakes downstream from Sun Pass State Forest will be monitored through research coordinated by the Bureau of Reclamation and Oregon State University Extension Service. OSU currently has seven sample points on Sun Creek and Annie Creek. Additional monitoring may be done as discussed in Section V, water resources, strategy 2.
- Forest management activities that may impact water resources will be informally monitored (mostly through contract administration) to ensure compliance with the Forest Practices Act.
- The Water Resources Department will be contacted periodically for new information on water users and water use locations.

Wildlife and Fish

- Habitat monitoring:
  a. There will be an inventory of each stand at the end of its management cycle to provide feedback on the results of timber harvesting and associated activities. The timber data will be used to describe stand structure and species composition, and to predict the future development of the stand. Data on vegetative cover, snags, and woody debris will be collected at the same time.
  b. A system of permanent plots has been established in a subset of the stands at Sun Pass State Forest. The same type of data will be collected as in the periodic inventory described above. This data will provide a better look at changes over time.
- Population monitoring:
  a. Pileated woodpecker and goshawk populations will be surveyed within two years, and every five years thereafter.
  b. Spotted owl surveys will be conducted every five years in Sun Pass State Forest and the Southwest Block. The next survey will be in 1999.
  c. General wildlife surveys:

     ODFW will monitor deer populations indirectly, by observing the usage of winter and spring range that is located away from the state forests. In addition, ODFW will monitor elk populations in the Sun Pass road closure area.

     Additional data on wildlife populations may be gathered by using volunteer help. ODF will consult with ODFW about data collection methodology and on how to organize a volunteer program.

Research

The Oregon Department of Forestry will sponsor research to better understand managed forest conditions that support healthy pileated woodpecker and goshawk populations. (See Wildlife and Fish Strategies in Section V for details.) The research objective is to develop and implement habitat standards (for example, snags and woody debris) and refine silvicultural prescriptions for the Forest Connectivity Areas. These standards should ensure the maintenance over time of at least two nesting pairs of pileated woodpeckers and one nesting pair of goshawks. The study plan will be developed.

ODF has identified two additional topics where site-specific research may be useful. One topic involves the relationship of site productivity with woody debris management, underburning, and fertilization on pumice soils. These relationships are poorly understood, but potentially very important. Current recommendations from various sources frequently conflict. The other topic involves site-specific density management research. Current guidelines have been inferred from off-district research, and may not apply to the soil-site situation on these lands. Study plans will be developed when the decision is made to proceed with these projects.

Adaptive Management

A commitment to adaptive management is one of the guiding principles driving the Eastern Region planning process. Adaptive management involves collecting new data, analyzing it, and adjusting management if necessary. Specifically, it involves taking input from monitoring activities and research, and incorporating this information into ongoing planning and implementation. It may also involve partnerships with other landowners to share information, collaborate on research, and implement joint or complementary management activities.

Adaptive management is based on sound, verifiable science that is peer-reviewed. It involves a regular assessment of current management practices. This occurs through ongoing implementation and also through the yearly sale planning and budget cycles. For the Eastern Region State Forests, it will involve a partnership approach between district personnel and staff specialists at the Salem headquarters.

The Klamath-Lake District plans to hold an annual review of plan implementation. The review may include a field tour, and will be an opportunity to collect input from resource specialists and the general public.

Information Sources for Adaptive Management

Adaptive management will be supported by information from a variety of sources. These sources include (but are not limited to) the following items.

- The research described above on pileated woodpeckers and goshawks.
- The monitoring information described earlier in this section.
- Published research such as the habitat requirements of wildlife and fish, studies of east side forest ecosystems, and silvicultural research.

Future Directions for Adaptive Management

As an illustration of how adaptive management will work, here are some examples of how we intend to implement it on the Eastern Region State Forests.

- It is important to make sure that the Forest Connectivity Areas fulfill the connectivity role described in the wildlife and fish strategies. Populations of goshawks and pileated woodpeckers will be the key indicator of the success of this role. An adaptive management process is described in the strategies. The planned research will improve our understanding of the habitat structure needed to support these species in Sun Pass, and silvicultural prescriptions will be modified as needed to ensure the desired population levels.

- Surveys have shown that spotted owls do not currently use state forest land in eastern Oregon. The strategy of periodically surveying owls will enable management strategies to be changed if there is a change in owl usage. Management strategies will also be modified to remain consistent with the current legal framework and department policies.

Appendix A

Glossary

Definitions followed by "RMAR" are from the Division of State Land's Rangeland Management Administrative Rules. The following references were used in developing the glossary.

Oregon Department of Forestry. 1993. Elliott State Forest Draft Management Plan. Oregon Department of Forestry, Salem, OR. December 1993.

USDA Forest Service, et al. 1994. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl. Also known as the Clinton Forest Plan or the Final SEIS. USDA Forest Service, Pacific Northwest Region, Portland, OR. February 1994.

4(d) rule	Section 4(d) of the Endangered Species Act provides the U.S. Fish and Wildlife Service with broad authority to issue regulations that provide threatened species with various kinds of protection. In the past, rules written under the authority of 4(d) have been used to tailor regulatory protection to the unique needs of a threatened species, or to relax unnecessary restrictions.
Allotment	Block of land granted to a permittee for exclusive grazing use.
Allotment management plan	A plan covering a specific federal grazing allotment developed by the federal agency managing the allotment; the AMP outlines various aspects of range management.
Alluvial plain	A broad, level to gently sloping land surface built by extensive deposition of alluvium. It is currently above overflow level. (Duncan and Steinbrenner, 1975)
Alluvium	Unconsolidated soil and similar materials that were transported and deposited by a stream.
Ambient	Surrounding.
AMP	See "allotment management plan."

Andesite	A common volcanic rock; andesite is gray, brown, or green and commonly occurs as lava flows, ash deposits, and accumulations of angular debris. (Alt and Hyndman, 1981)
Animal Unit	An animal unit typically consists of one cow; or one cow and a calf less than six months old; or 1.4 yearlings; or one horse; or five sheep. (RMAR)
Animal Unit Month (AUM)	The amount of forage (approximately 800 pounds of air-dried forage) necessary to feed one animal unit for one month. (RMAR)
Archaeological and historical resources	Those districts, sites, buildings, structures, and artifacts which possess material evidence of human life and culture of the prehistoric and historic past.
Archaeological object	An object that is at least 75 years old; is part of the physical record of an indigenous or other culture found in the state or waters of the state; and is material remains of past human life or activity that are of archaeological significance, including, but not limited to, monuments, symbols, tools, facilities, technological by-products and dietary by-products. (ORS 358.905)
Archaeological site	A geographic locality in Oregon, including but not limited to submerged and submersible lands and the bed of the sea within the state's jurisdiction, that contains archaeological objects and the contextual associations of the archaeological objects with: each other; or biotic or geological remains or deposits. (ORS 358.905)
AUM	See "animal unit month."
Basal area	The area of the cross-section of a tree stem near the base, generally at breast height (4.5 feet above the ground) and including the bark. The basal area per acre is the total basal area of all trees on that acre.
Basalt	A fine-grained, smooth, volcanic rock; basalt is frequently black, and sometimes greenish black or rusty shades of brown. The commonest volcanic rock. (Alt and Hyndman, 1981)
Bear Valley Tract	The largest piece of state forest within the Southwest Block; it is located in the Bear Valley area.
Best Management Practices (BMPs)	Forest practice rules adopted by the Board of Forestry that ensure, as much as possible, that nonpoint source discharges of pollutants resulting from forest operations regulated by the Board meet the water quality standards established by the Environmental Quality Commission.

Burial	Any natural or prepared physical location whether originally below, on or above the surface of the earth, into which, as a part of a death rite or death ceremony of a culture, human remains were deposited. (ORS 358.905)
Cairn	Stones piled up as a memorial or as a landmark. (This term is not defined in Oregon law.)
Caldera	A large, basin-shaped crater formed when a volcano collapses during an eruption. (Alt and Hyndman, 1981)
Cinder cone	A small basalt volcano that erupts a conical pile of bubbly fragments and then produces one or two lava flows that emerge from the base of the cone. (Alt and Hyndman, 1981)
Cinnabar	A heavy, bright red mineral; it is the principal ore of mercury.
Class I areas	National park lands and some wilderness areas are designated as federal mandatory Class I areas under the Clean Air Act.
Class I-III	The Clean Air Act divides clean air into three classes; Class I allows for minimal degradation of air quality, while Class III allows a relatively greater degree of degradation.
Clean Air Act	Federal law passed in 1970, and amended several times since. The authority to implement the act is delegated to the states. The act is implemented, in part, through a permit system.
Climax plant species	Species that are self-perpetuating in their environment in the absence of perturbing, degenerating, or disturbing influences.
Climax stage	A highly stable stage of ecological succession. An ecosystem will stay at the climax stage until disturbance affects the ecosystem and the stages of ecological succession begin again.
Cohort	Within a stand, a group or a layer of trees that regenerated after a single disturbance, such as a fire or timber harvest; the group or layer of trees is an even-aged component of the stand.
Common School trust lands	State lands owned by the State Land Board, the primary goal in managing these lands is the generation of the greatest amount of income for the Common School Fund over the long-term, consistent with sound techniques of land management. Common School trust lands that have been listed by the State Land Board for the primary use of timber production are called Common School Forest Lands. Other Common School trust lands are designated as rangelands or for other uses.
Composition	The different species of plants and animals that live in an ecosystem.

CSFL	Common School Forest Lands. See "Common School trust lands."
Dacite	A volcanic rock; it is a mixture of quartz and other minerals.
DEQ	Oregon Department of Environmental Quality.
Diatomite	Diatomaceous earth; when dry, it forms a fine powder used as an abrasive, pottery glaze, etc. Diatoms are microscopic algae that are rich in silica; their fossils form diatomaceous earth.
Dispersion	The spreading or scattering of smoke.
Disturbance	A force that causes significant change in an ecosystem's structure and/or composition; can be caused by natural events or human activities.
East Block	Includes the Yainax Butte tract northeast of Klamath Falls, plus twenty satellite pieces in eastern Klamath County and Lake County.
Eastern Region State Forests	Includes all state forests in eastern Oregon. For this plan, eastern Oregon consists of Klamath County, Lake County, and all other counties east of the Cascade crest.
Ejecta	Material erupted from a volcano or volcanic vent.
EPA	Environmental Protection Agency. This federal agency administers the Clean Air Act, among other responsibilities.
Ephemeral stream	Streams that carry surface run-off only during or immediately after a rainstorm or snow melt. Channels are not well-defined, and are often covered with leaf litter.
Escarpment	A long, more or less continuous, cliff or steep slope trending in one general direction. An escarpment separates two level or gently sloping surfaces, and is formed by faulting or erosion. (Duncan and Steinbrenner, 1975)
Exceedance	Documented instance of a NAAQS standard being exceeded in a particular area.
Exchange of use	An agreement between a rancher and the BLM or Forest Service that gives the rancher permission to graze livestock on federal land in exchange for allowing the federal agency to regulate and control grazing on the rancher's owned or leased lands that are adjacent or intermingled with the federal lands.
Forest operation	Any commercial activity relating to the growing and harvesting of trees.
Forest zone	The land base on which a particular series is found.

Forested wetland	A wetland that supports wetland vegetation as well as a tree canopy that is adapted to periodic inundation or soil saturation.
Formazin turbidity unit (FTU)	A measure of turbidity (see "turbidity" below). FTUs measure the amount of light scattered or absorbed by the water; this indicates how many particles are in suspension in the water.
Fragmentation	The spatial arrangement of successional stages across the landscape as the result of disturbance; often used to refer specifically to the process of reducing the size and connectivity of late successional or old growth forests.
Function	Activity or process that goes on in an ecosystem; some typical functions are plant growth, animal reproduction, decay of dead plants.
Funerary objects	Any artifacts or objects that, as part of a death rite or ceremony of a culture, are reasonably believed to have been placed with individual human remains either at the time of death or later.
Gallinaceous species	A bird species belonging to *Galliformes*, an order of birds that includes pheasants, turkeys, quail, and partridges, as well as common domestic fowl such as chickens. They are mostly ground birds, with heavy bodies, short wings, and legs adapted to running and scratching for food; they nest on the ground and produce large broods.
Geographic information system	Geographic information system; a computer system that stores and manipulates spatial data, and can produce a variety of maps and analyses.
Geomorphology	Branch of geology that includes the study of surface features of the earth (landforms). (Duncan and Steinbrenner, 1975)
GIS	See "geographic information system."
Goal	In Oregon Department of Forestry long-range plans, goals are general, non-quantifiable statements of direction.
Grave	See "Burial."
Historic artifacts	Three-dimensional objects including furnishings, art objects and items of personal property which have historic significance. "Historic artifacts" does not include paper, electronic media or other media that are classified as public records. (ORS 358.635)
Historic property	Real property that is currently listed in the National Register of Historic Places, established and maintained under the National Historic Preservation Act of 1966, or approved for listing on an Oregon register of historic places.

Host	An organism on or in which another organism (called a parasite) lives for nourishment or protection.
Human remains	The physical remains of a human body, including, but not limited to, bones, teeth, hair, ashes or mummified or otherwise preserved soft tissues of an individual. (ORS 358.905)
Igneous	Formed by volcanic action or great heat.
Incidental take	The taking of a federally listed wildlife species, if the taking is incidental to, and not the purpose of, carrying out otherwise lawful activities. Under the federal Endangered Species Act, "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect a federally listed threatened or endangered species, or to attempt to do so.
Indian tribe	Any tribe of Indians recognized by the Secretary of the Interior or listed in the Klamath Termination Act, 25 U.S.C. 3564 et seq., or listed in the Western Oregon Indian Termination Act, 25 U.S.C. 3691 et seq., if the traditional cultural area of the tribe includes Oregon lands (ORS 97.740).
Induced landscape diversity	Aspects of the landscape that change as a result of disturbances such as fire, windstorms, human activities, and animals; for example, the successional stages of vegetation that occur after a wildfire.
Informal dispersed recreation	Recreational use that occurs with little or no regulation or development. The users are reasonably free to choose what activity they will participate in and the location for this activity to take place.
Inherent landscape diversity	Aspects of the landscape that are relatively permanent (changing only slowly over long periods of time) in any particular landscape, but that vary among landscapes. Examples are climate, soils, topography, and aspect.
Inoculum	Material such as bacteria, viruses, or spores that implant themselves in another organism, infecting that organism and causing disease.
Intermittent stream	Any nonpermanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two physical criteria. (USDA Forest Service et al., 1994a)
Isolated parcel	A parcel that is either largely surrounded by land not owned by the state, isolated from larger state-owned tracts and/or difficult or uneconomical to manage.

Klamath-Lake District lands	Includes all state forest lands in the North Block, East Block, and Southwest Block. Except for one 40 acre satellite piece in Lake County, all Klamath-Lake District lands are in Klamath County.
Lagomorph	An animal species belonging to *Lagomorpha*, an order of rodent mammals that is characterized by two pairs of upper incisors, one behind the other. Examples are hares, rabbits, pikas, etc.
Landform	A configuration of the landscape resulting from the physical and chemical actions of water, wind, ice, and gravity acting on various geologic materials and structures over along period of time. (Duncan and Steinbrenner, 1975)
Landscape	A unit of land with separate plant communities or ecosystems forming ecological units with distinguishable structure, function, geomorphology, and disturbance regimes.
Late successional habitat	A forest stand whose typical characteristics are a multi-layered, multi-species canopy dominated by large overstory trees; numerous large snags; and abundant large woody debris (such as fallen trees) on the ground. Other characteristics such as canopy closure may vary by the forest zone (lodgepole, ponderosa, mixed conifer, etc.).
LCDC	Land Conservation and Development Commission of the State of Oregon, made up of seven lay citizens appointed by the Governor and confirmed by the Oregon Senate.
Lithic reduction site (lithic scatter)	A location where prehistoric stone tools were made, usually from obsidian. The tools and weapons were used locally or traded.
Livestock	Livestock are domestic animals such as beef and dairy cattle, horses, sheep, and goats kept or produced primarily for farm, ranch, or market purposes. Livestock also may include bison, llamas, emus, ostriches, and other species approved for use on a leasehold by the Division of State Lands. (RMAR)
Million board-feet	A board foot is the amount of wood equivalent to a piece of wood one foot by one foot by one inch thick.
Miocene Epoch	A geological epoch that spans the time interval between 25 and 11 million years ago.
MMBF	See “million board-feet.”
Moderate slope	In this discussion, slopes of 20-40%. Gentle slopes are less than 20%, and steep slopes are more than 40%.
NAAQS	See “National Ambient Air Quality Standards.”

National Ambient Air Quality Standards	Under the federal Clean Air Act, the Environmental Protection Agency was responsible for setting air quality standards. They developed NAAQS, which establish the maximum concentration for various pollutants that may be present in the ambient (surrounding) air. Standards are measured on short-term (3, 8, or 24 hours) or annual basis.
Non-attainment area	An area in which national air quality standards have not been met. Special provisions apply to these areas.
North Block	Includes the Sun Pass State Forest north of Klamath Falls, and various satellite pieces in northern Klamath County.
Object of cultural patrimony	An object having ongoing historical, traditional or cultural importance central to the native Indian group or culture itself, rather than property owned by an individual native Indian, and which, therefore, cannot be alienated appropriated or conveyed by an individual regardless of whether or not the individual is a member of the Indian tribe. The object shall have been considered inalienable by the native Indian group at the time the object was separated from such group. (ORS 358.905)
Olivine	A silicate of magnesium and iron; found as green crystals in many rocks, and used as a semiprecious stone.
Olivine	A pale green mineral that occurs in small crystals scattered through black igneous rocks. (Alt and Hyndman, 1981)
Open range	An area wherein livestock may lawfully be permitted to run at large. (ORS 607.005(6))
Particulate	Small particles that are in smoke produced by burning wood and other forest debris. Two kinds of particulate are regulated by the Clean Air Act: TSP and PM-10.
Passerine	A bird species belonging to a group of small or medium-sized, perching songbirds that have grasping feet with the first toe directed backward. More than half of all bird species belong to this group.
Pathogen	Any agent that can cause disease.
Perlite	A glassy volcanic rock with a pearly luster; it is a form of obsidian.
Petroglyph	Prehistoric rock carving.
Pictograph	Prehistoric rock painting.
Plant association	A classification system for grouping plant species that reoccur on the landscape within particular environmental tolerances. They are stable groupings of plant species capable of self-perpetuation and can be thought of as climax plant communities.

Plant communities	A general term for an assemblage of plants living together and interacting among themselves in a specific location and at a specific point in time.
Pliocene Epoch	A geological epoch that spans the time interval between 11 and 3 million years ago.
PM-10	Particles smaller than 10 microns in diameter, present in wood smoke.
Prescribed burning	Controlled fire burning under specified conditions in order to accomplish planned objectives; also called slash burning, as a frequent objective is to reduce the amount of slash left after logging.
PSD	Prevention of Significant Deterioration standards. These standards determine the maximum amount that pollutants may exceed 1977/1978 baseline levels.
Pumice, pumicite	A spongy, porous volcanic rock that is very light weight. Some pumice is light enough to float on water. Pumice is used in solid or powdered form for removing stains, smoothing, and polishing.
Rangeland	Rangeland is state land designated and managed by the Division of State Lands for livestock grazing and/or conservation use, determined by the Division to be appropriate to the subject leasehold(s) and consistent with applicable local, state, and federal laws.
Rangeland management plan	A written document prepared and approved by the Division of State Lands, in consultation with the lessee and other affected agencies and interests, indicating how a particular leasehold shall be managed during a specified term of a rangeland lease. (RMAR)
Reach	A short length of stream channel; typically a section between two bends.
Recognized Indian tribe	A tribe of Indians with federally acknowledged treaty or statutory rights. The federally recognized tribes in the Eastern Oregon planning region are the Burns Paiute, the Confederated Tribes of the Umatilla Indian Reservation, and the Klamath Tribe. The Klamath Tribe includes the Klamath, Modoc, and Yahooskin Band of Snake Indians.
RMP	See “rangeland management plan.”
Sacred object	An archaeological object that is demonstrably revered by any ethnic group, religious group or Indian tribe as holy; is used in connection with the religious or spiritual service or worship of a deity or spirit power; or was or is needed by traditional native Indian religious leaders for the practice of traditional native Indian religion. (ORS 358.905)

Saprophyte Any organism that lives on decaying organic matter, such as some fungi and bacteria.

Satellite pieces Small pieces of state forest in Klamath and Lake Counties, other than Sun Pass State Forest, Bear Valley Tract, and Yainax Butte Tract.

Scattered tracts Small pieces of state forest scattered in other eastern Oregon counties besides Klamath and Lake Counties.

Seral plant species Species that do not self-perpetuate in their environments in the absence of disturbing influences, but are replaced by climax plant species.

Seral stages Developmental stages that succeed each other as an ecosystem changes over time; specifically, the stages of ecological succession as a forest develops.

Seral stages Developmental stages that succeed each other as an ecosystem changes over time; specifically, the stages of ecological succession as a forest develops.

Series Collection of plant associations having the same climax species in the dominant layer. As an example, the lodgepole pine series includes all the lodgepole pine plant associations.

Significant wetland As defined in OAR 629-56-310, significant wetlands are "wetlands that are larger than eight acres; estuaries; bogs; and important springs in eastern Oregon." Includes forested and non-forested wetlands larger than eight acres (OAR 629-24-1300 and 1350).

SIP State Implementation Plans. These plans are developed by Oregon state agencies in order to implement the Clean Air Act.

Site class Site class is a measure of an area's relative capacity for producing timber or other vegetation. It is measured through the site index. The site index is expressed as the height of the tallest trees in a stand at an index age (King 1966). In this document, an age of 50 years is used. The 5 site classes are defined below.

Site class I — 135 feet and up
Site class II — 115-134 feet
Site class III — 95-114 feet
Site class IV — 75-94 feet
Site class V — Below 75 feet

Site index A measure of forest productivity. It is expressed as the height of the tallest trees in a stand at an index age. In this document, an age of 50 years is used. See also "site class."

Site of archaeological significance	Any archaeological site on, or eligible for inclusion on, the National Register of Historic Places as determined in writing by the State Historic Preservation Officer, or any archaeological site that has been determined significant in writing by an Indian tribe. (ORS 358.905)
Southwest Block	Includes the Bear Valley tract southwest of Klamath Falls, plus satellite pieces in western Klamath County.
SPZ	Special Protection Zone. An area established around cities that are non-attainment areas; Klamath Falls has an SPZ established around it.
Stand	A term used in this plan to designate a contiguous area of land in the same vegetative series and having the same management history.
State Historic Preservation Office (SHPO)	Oregon's SHPO was created in 1966 by federal statute. It administers the Statewide Plan for Historic Preservation and submits Oregon's nominations for the National Register of Historic Places.
Strategy	In Oregon Department of Forestry long-range plans, strategies are specific actions that will be taken to achieve the management goals. (See also "goal.")
Structure	The physical parts of an ecosystem that we can see and touch; typical structures in a forest are trees, standing dead trees (snags), fallen dead trees.
Succession	A series of changes by which one group of organisms succeeds another group; a series of developmental stages in a plant community.
Sun Pass State Forest	The state forest located 40 miles north of Klamath Falls, and near the southeastern corner of Crater Lake National Park. Sun Pass comprises 20,031 acres of the 42,020 acres of state forest land in eastern Oregon.
Sustained yield	A timber harvest level for the next decade that can be maintained or increased through future planning decades without significant declines. Sustained yield has been calculated on an acreage basis for this plan.
Threatened and endangered species	Formal classifications of species. Federal designations are made by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service. State of Oregon designations include all federal species listed as of May 15, 1987; and those species determined by the Oregon Department of Fish and Wildlife since then to qualify for listing.

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Federal Classifications

Threatened and endangered species

Candidate species, category 1 — Species for which there is substantial information to support listing the species as threatened or endangered; listing proposals are either being prepared or are delayed by work on higher priority species.

Candidate species, category 2 — Species for which information indicates that listing is possibly appropriate, but conclusive data are not available; additional information is being collected.

Endangered species — A species determined to be in danger of extinction throughout all or a significant portion of its range.

Proposed threatened or endangered species — Species proposed by the USFWS or NMFS for listing as threatened or endangered; not a final designation.

Threatened species — Species likely to become endangered species throughout all or a significant portion of their range within the foreseeable future.

State Classifications

Candidate species (plants) — State of Oregon list, developed by the Oregon Department of Agriculture, of plant species under review for listing as threatened or endangered.

Endangered species — Any native wildlife species determined by the State Fish and Wildlife Commission to be in danger of extinction throughout any significant portion of its range within Oregon; or any native wildlife species listed as endangered by the federal ESA.

Sensitive species (wildlife) — A watchlist, developed by the Oregon Department of Fish and Wildlife, of wildlife species that are likely to become threatened or endangered throughout all or a significant portion of their range in Oregon. Subdivided into four categories: critical, vulnerable, peripheral, and undetermined status.

Threatened species — Any native wildlife species that the State Fish and Wildlife Commission determines is likely to become endangered within the foreseeable future throughout any significant portion of its range within Oregon.

TMDL

Total Maximum Daily Load. A TMDL is the total amount of a pollutant that can enter a body of water without triggering a violation of the water quality standard for that pollutant.

Trophic status In hydrology, refers to levels of nutrients in a body of water; trophic status is categorized into the five levels listed below.

Ultra-oligotrophic — Cleanest, clearest water, with very low levels of phosphorus and chlorophyll; supports little or no photosynthetic plant life (such as algae).

Oligotrophic — Somewhat higher levels of phosphorus and chlorophyll, but still supports a limited amount of photosynthetic plant life.

Trophic status

Mesotrophic — Mid-range levels.

Eutrophic — High levels of phosphorus and chlorophyll, and high levels of photosynthetic plant life; water is turbid; the water also has limited amounts of dissolved oxygen.

Hypereutrophic — Very high levels of phosphorus, chlorophyll, and photosynthetic plant life; water is turbid and has very little dissolved oxygen.

TSP Total suspended particulate in smoke.

Turbidity The relative clarity of the water, which may be affected by material in suspension in the water.

Ungulate Hoofed mammals, such as deer and elk.

Unrecognized Indian tribe A tribe of Indians that has never been recognized by the federal government, or whose federal relations were terminated by the Klamath Termination Act or the Western Oregon Indian Termination Act.

Vision quest site In the Klamath region, these are sites used for seeking spiritual power, often on mountain tops, rimrocks, and other outcrops. They often contain constructed rock features ranging in age from prehistoric to contemporary.

Watershed The drainage basin contributing water, organic matter, dissolved nutrients, and sediments to a stream or lake. (USDA Forest Service et al., 1993b)

Wetland As defined in Oregon's Forest Practice Rules OAR 629-24-101 (77), wetlands are "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

Yainax Butte tract The largest piece of state forest within the East Block; it is located near Yainax Butte.

Appendix B

References

This appendix lists the books, reports, and other publications referred to in the plan. Listings are alphabetical. The following format is used.

Author's name in bold. Year published. Title of publication. Publisher, publisher's location.

The following abbreviations are used in this appendix. Standard two-letter postal abbreviations are used for the names of states.

BLM	Bureau of Land Management
DEQ	Oregon Department of Environmental Quality
GTR	General Technical Report
ODF	Oregon Department of Forestry
ODFW	Oregon Department of Fish and Wildlife
ONHP	Oregon Natural Heritage Program
PNW	Pacific Northwest Research Station (part of USDA Forest Service)
USDA	U.S. Department of Agriculture
USDI	U.S. Department of the Interior

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Appendix C

Legal and Policy Mandates

This appendix describes in detail the main legal and policy mandates that affect state forests. It is divided into five sections, listed below.

- **Common School Forest Land —** This section discusses the history, legal mandates, and funding mechanisms for these lands.
- **Board of Forestry Land —** This section discusses the history, legal mandates, and funding mechanisms for these lands.
- **Policies and administrative rules —** This section discusses the key policies and rules that affect the Department of Forestry's management of Board of Forestry and Common School Forest Lands.
- **Comparison of state and federal legal mandates —** The legal mandates for state forests are very different from the legal mandates for national forests. This section discusses the key differences.
- **Other legal mandates —** This section discusses other legal mandates that affect the state forests, including federal and state Endangered Species Act requirements; Oregon statewide planning goals; and Oregon Forest Practices Act requirements.

Common School Forest Land

History

The history of Common School Forest Lands (CSFL) can be traced to the Land Ordinance of 1785, the creation of the Territory of Oregon in 1848, and the Admission Act of 1859. The federal government's policy at the time Oregon gained statehood was to grant sections 16 and 36 of every township to the new state for the use of schools. Oregon's grant included 3.5 million acres of grazing and forest lands. Eventually, all but 130,000 acres of the forest lands was either sold for the benefit of schools or lost through fraudulent land deals.

By the time Oregon gained statehood, Congress had taken steps to define the trust nature of the CSFL grants. This was in response to early abuses of the land grant system as states disposed of their school lands without restraint. As a result, Congress stipulated that the grant lands be managed for the use of schools and not for other public needs. Permanent investment trusts were established to protect the financial principal derived when grant lands were disposed. Lands that were retained were to be managed by the states in accordance with the beneficiary trust interest. These obligations are spelled out in the Oregon Constitution and the Admission Act of 1859.

Legal Mandates

The Oregon Constitution

The Oregon Constitution (Article VIII, Section 5) authorizes the State Land Board to manage CSFL lands. The Land Board is directed to "manage lands under its jurisdiction with the object of obtaining the greatest benefit for the people of this state, consistent with the conservation of this resource under sound techniques of land management." This responsibility has been clarified through the 1992 opinion of state Attorney General Charles S. Crookham, which is discussed below.

The Oregon Constitution provides for revenues derived from CSFL lands and other specified sources to be deposited into the Common School Fund. It also authorizes the State Land Board to withdraw money from the Common School Fund to carry out its powers and duties to manage the lands. The State Land Board has implemented its authority through a contract with the Department of Forestry and the Division of State Lands to manage CSFL lands.

Oregon Revised Statutes

Statutes concerning CSFL lands are found in ORS 530.450 through 530.520. Some of the lands under the jurisdiction of the Division of State Lands are suitable for use as state forests. ORS 530.460 and 530.470 describe the process by which the Division of State Lands and the State Board of Forestry may "designate" these lands for the primary purpose of "growing timber and other forest products." Lands so designated are named "Common School Forest Lands." Through a similar process, CSFL lands may be reverted to their original status.

Under ORS 530.490, the State Forester is directed to manage Common School Forest Lands so as to "secure the greatest permanent value of the lands to the whole people of the State of Oregon." Although the statutes again refer to timber production as the dedicated use of the land, much of the statutory language has been found to be inconsistent with constitutional mandates. Oregon's Attorney General has opined that the land's various other natural resources must also be considered as long-term sources of revenue. The Attorney General's opinion is discussed below.

The statutes refer to forest management planning in ORS 526.255, which calls for "long-range management plans based on current resource descriptions and technical assumptions, including sustained yield calculations for the purpose of maintaining economic stability in each management region."

Attorney General's Opinion

Currently, the fullest description of the Oregon Constitution's mandates for managing Common School Forest Lands is found in a July 24, 1992 opinion of Oregon Attorney General Charles S. Crookham. (46 Op. Atty. Gen. 468 (1992), Opinion No. 8223, July 24, 1992) This opinion addresses the lawful uses of Admission Act lands and the effect of

federal or state regulations on such uses. The issue at hand was the State Land Board's compliance with the federal and state Endangered Species Acts.

Admission Act lands are those lands offered by the federal government to the State of Oregon for the use of schools upon Oregon's admission to the United States in 1859. The Attorney General's opinion discussed the restrictions that Congress intended to impose on Oregon's use of these lands.

According to Crookham, a binding obligation was imposed on Oregon when it accepted the Admission Act lands "for the use of the schools." The Oregon Constitution dedicates the proceeds of Admission Act lands to the Common School Fund and gives the Land Board responsibility to manage these lands in trust for the benefit of the schools. The Land Board has a further constitutional obligation to manage lands under its jurisdiction "with the object of obtaining the greatest benefit for the people of this state, consistent with the conservation of this resource under sound techniques of land management." Crookham noted that the "greatest benefit for the people" standard requires the Land Board to use the lands for schools and the production of income for the Common School Fund.

It was Crookham's opinion that the resources of Admission Act lands are not limited to those, such as timber, that are currently recognized as revenue generators for the Common School Fund, but include all of the features of the land that may be of use to schools. Other resources, such as minerals, water, and plant materials that may offer revenue for the fund should be considered.

The Land Board may incur present expenses or take management actions that reduce present income if these actions are intended to maximize income over the long run. Lands may be temporarily set aside for the purpose of "banking" an asset while its economic value appreciates if the Land Board has a rational, non-speculative basis for concluding that such action will maximize economic return to the Common School Fund over the long term.

Neither the Oregon Admission Act nor the Oregon Constitution exempts the Land Board from complying with the federal and state Endangered Species Acts (ESA), in the opinion of the Attorney General.

Crookham felt it is unlikely that the courts would exempt the Land Board from complying with the federal ESA. Even if the grant of Admission Act lands were viewed as a contract or trust arrangement between the state and the federal government, Congress retains the authority to alter the terms of the arrangement by virtue of its sovereign power to legislate.

Because the state ESA does not explicitly require or prohibit any particular action with respect to the management of Admission Act lands, Crookham felt that the state ESA does not restrict the Land Board's exercise of its constitutional powers over the disposition and management of Admission Act lands. The Land Board must comply with the state ESA unless it unduly burdens the Land Board's constitutional responsibility to manage the Admission Act lands. Only if the state ESA fundamentally impaired the Board's ability to

maximize revenue over the long term from the Admission Act lands would there be an undue burden on the Land Board's management and powers.

Finally, the Attorney General said it is not possible to predict whether the application of the federal ESA to Admission Act lands could result in a claim against the federal government for a taking of property. However, the state ESA definitely could not result in a taking because the Land Board would not be required to comply with a law that prevented it from its constitutional responsibility to maximize revenue from Admission Act lands over the long term.

Funding

Receipts from the CSFL lands enter the Common School Fund. The Department of Forestry is reimbursed on a quarterly basis for management expenses incurred on these lands. The Department's budget is subject to authorization by the state legislature. The Common School Forest Lands and Board of Forestry Lands budgets are considered as a whole, and are categorized as "other funds" that are separate from the state's general fund. The Common School Forest Lands and Board of Forestry Lands budgets are accounted for separately within the Department of Forestry.

Board of Forestry Land

History

Board of Forestry Lands (BOFL) were acquired by the Board of Forestry in two ways: (1) through direct purchase; and (2) through transfer of ownership from counties in exchange for a portion of the future revenue produced by these lands. Under the Board of Forestry's supervision, the Department of Forestry manages BOFL lands to produce income for the counties.

Legal Mandates

Forest Management Planning

The statutes refer to forest management planning in ORS 526.255, which calls for "long-range management plans based on current resource descriptions and technical assumptions, including sustained yield calculations for the purpose of maintaining economic stability in each management region."

Other Key Statutes

Oregon Revised Statutes 530.010 through 530.170 guide the acquisition, management, and development of state forests which are under the jurisdiction of the Board of Forestry. The statutes are discussed below.

1. ORS 530.010 authorizes the Board of Forestry, in the name of the State of Oregon, to acquire lands which are chiefly valuable for forest crop production, watershed protection and development, erosion control, grazing, recreation, or forest administrative purposes.

   The lands may be acquired by purchase, donation, devise, or exchange from any public, quasi-public, or private landowner. All land acquisitions are subject to the prior approval of the county commissioners of the county in which the lands are located. The lands so acquired are designated as "state forests."
2. ORS 530.030 deals with the conveyance of county forest lands to the state. This statute recognizes that BOFL lands are managed to produce income for the counties.

   Most of these lands were originally acquired by the counties through foreclosure of tax liens. Under county ownership, the lands provided revenue to the counties. The statute maintains this revenue source by allowing ownership to be conveyed to the state "in consideration of the payment to such county of the percentage of revenue derived from such lands." The percentage distribution of revenue between counties and the state is addressed in ORS 530.110.
3. ORS 530.050 directs that BOFL lands shall be managed so as "to secure the greatest permanent value of such lands to the state." To this end, the State Forester, under the authority and direction of the State Board of Forestry, is given the latitude to:

- Sell forest products.
- Reforest and protect from fire.
- Execute mining leases and contracts.
- Sell rock, sand, gravel, pumice, etc.
- Produce minor forest products.
- Grant easements, and charge fees for road use.
- Permit the lands to be used for other purposes (e.g. fish and wildlife environment, landscape effect, flood and erosion protection, recreation, domestic livestock, and water supplies), provided such uses are "not detrimental to the best interest of the state" in the opinion of the Board of Forestry.
- Do all things necessary for the "management, protection, utilization, and conservation of the lands."

Analysis of Legal Mandates

The Board of Forestry's legal mandates for managing BOFL lands include the dual obligations of sharing income with the counties (ORS 530.030) and conserving, protecting, and using a variety of natural resources (ORS 530.050). The statutes do not specify how to balance these needs. Answers to this question are found in rulings of the Oregon Supreme Court and appellate courts, as well as in opinions of the Attorney General's office.

The various rulings and opinions are summarized by Assistant Attorney General Melinda L. Bruce in an analysis prepared for Martha O. Pagel, Governor's Assistant for Natural Resources and Environment. ("Management Options for Board of Forestry Lands Obtained from Counties Under ORS 530.030," July 17, 1991) The highlights of the analysis are:

1. The Oregon Supreme Court found it unnecessary to describe the arrangement between counties and the state in contract or trust terms. Rather, the arrangement is adequately described in the statutes.
2. The Board of Forestry has a statutory obligation to share revenues produced from BOFL lands with the counties, but the statutes do not guarantee that any particular level of harvest or revenue will be maintained. Also, the counties may not expect that BOFL lands will be exclusively managed for timber harvest because ORS 530.050 authorizes the Board of Forestry to use the lands for a variety of other needs.

   Throughout the history of legislation allowing the counties to convey forest lands to the Board of Forestry, "the counties' statutory expectations have only been that <u>one</u> of the purposes of managing the lands would be timber production and that when timber revenues flowed from such production, the counties would be entitled to a certain percentage of the revenues."

   The Attorney General's office has characterized the counties' expectations as "analogous to 'output' or 'production' contracts under which the state must pay the counties a percentage of revenues from the forest lands <u>only if revenues are realized</u>. In such production contracts, there is no implied promise to maintain output absent an expression to that effect in the contract."
3. The Board of Forestry may not manage BOFL lands under ORS 530.050 in such a manner as to deny all output from the lands. The court has so ruled with regard to exchanging revenue-producing lands for non-revenue-producing lands. Similarly, in the opinion of the Attorney General's office, this could apply to permanently setting aside lands from production in order to conserve or preserve wildlife habitat.
4. In managing the lands, the Board of Forestry retains discretion to balance a variety of needs against timber production so that the state may secure the "greatest permanent value" of the lands. However, it is not known exactly how far the Board may deviate from producing maximum harvest returns before breaching its statutory obligation to the counties.
5. The term "greatest permanent value" has not been defined through appellate court decisions or opinions of the Attorney General's office. Nevertheless, it is not likely that an interpretation of the term would be limited to economic values.

Funding

36¼% of the revenues derived from BOFL lands is used by the Department of Forestry to pay for the management and protection of the land. The Department's budget is subject to the authorization of the state legislature. The BOFL and CSFL budgets are considered as a whole, and are categorized as "other funds" that are separate from the state's general fund.

Policies and Administrative Rules

Legal mandates for the management of state forests are set by legislative statute and the Oregon Constitution. Additional guidance may be given in the form of policies and administrative rules.

The Forestry Program for Oregon

The Board of Forestry provides overall policy guidance for the Department of Forestry. The Forestry Program for Oregon (FPFO) is the Board's umbrella policy. The FPFO describes the Board's guidance to the State Forester, legislature, governor, and to the citizens of Oregon on matters of forest policy that the board considers important. It guides the actions of both the Board of Forestry and the Department of Forestry as they work with the forestry community and the public in implementing sound forest policy (Oregon Board of Forestry 1995a).

To meet its timber growth and harvest objective, the FPFO directs the Department of Forestry to "provide exemplary stewardship on state forests that balances economic, environmental and social values and provides abundant and sustainable timber supplies." (Oregon Board of Forestry 1995a)

The FPFO continues, "The Department will intensively manage State forest lands (Board of Forestry and Common School Lands) in an exemplary fashion for the sustained production of timber in a cost-effective and environmentally sound manner. Such intensive management is designed to generate revenue for the beneficiaries of the land, including county government, local taxing districts and the Common School Fund. In carrying out this program, the Department will employ the "Board of Forestry Policy for Practicing Silviculture on State Lands," and will emphasize the long-term compatibility of growing and harvesting timber with other forest uses." (Oregon Board of Forestry 1995a)

Board of Forestry Policy for Practicing Silviculture on State Lands

This policy, adopted on March 8, 1995, provides overall policy direction for the management of State Forest land. It states that "production of timber on a sustained basis is the primary goal, but due consideration is given to all other appropriate forest uses and values." The Department carries out the policy and fulfills its trust responsibilities "by practicing forest management that considers the ecological and biological long-term productivity of the land, along with the silvicultural and economic gains of that management." (Oregon Board of Forestry 1995b)

The Department of Forestry uses this policy to accomplish Forestry Program for Oregon objectives on state forest lands. In particular, the objectives promote the growth and harvest of timber on publicly-owned commercial forest land consistent with statutory direction, encourage opportunities for other forest uses, and promote the maintenance of long-term forest health (Oregon Board of Forestry 1995b).

The policy has twelve Guiding Principles. It calls for landscape-level planning, but with management strategies designed to fit individual sites. The primary role of the state forests is to provide intermediate stand ages and structures. There is an emphasis on structural complexity and age diversity, as well as managing habitats to meet species needs. The policy recognizes long-term soil productivity, genetic and biological diversity, non-commodity forest values, and intensive timber management techniques. The Department is committed to an ongoing monitoring and research program, with adaptive management used to incorporate new information as it becomes available.

Other Current Policies

The State Forester may establish policies that are consistent with direction given by the Board of Forestry. The following policies are currently in place for managing state forests.

- **Policies for Fish and Wildlife Management on State Forest Land —** This policy has been in effect since June 21, 1989. It defines how much emphasis may be given to fish and wildlife habitat, given that timber production is the primary goal for management of Board of Forestry and Common School Forest Lands. It directs forest managers to (a) consider fish and wildlife habitat in making forest management plans; and (b) modify forest management plans to achieve better fish and wildlife habitat where, but only where, such modification does not significantly conflict with the primary goal. As a guideline, "significant" means 5% to 10% of the timber growth and harvest at stake. The policy also addresses the role of biologists in planning, the designation of conservancy lands, and the funding of fish and wildlife enhancements.
- **State Lands Riparian Protection Policy —** As directed by the Board of Forestry, this policy was established on August 5, 1994 to clarify the level of protection that riparian areas should receive on state forest lands. The policy states that riparian protection shall be based on the new Forest Practices Act water protection rules. All state forest lands outside the Elliott State Forest are covered by the policy.
- **Threatened and Endangered Species —** Department of Forestry policies and guidance that pertain to the federal and state Endangered Species Acts are summarized in an internal document, the "T&E Handbook, State Lands Program" (Mannix 1994).

Policies and Rules under Development

The following policies and rules were under development as of spring 1995.

- **Land Acquisition and Exchange Policy —** To provide guidance for the acquisition and exchange of state forest lands. The Board of Forestry's policy is to actively pursue acquisitions and exchanges that meet statutory requirements and which serve the public interest.
- **Marketing Policy —** To identify and implement marketing activities that will lead to enhancing revenue from state lands.
- **Special Forest Products Policy —** To address the marketing of special forest products and the biological capacity of state forests. Will be used as an umbrella policy, allowing districts to develop their own pricing and operational guidelines.
- **Research Policy —** To enable staff to assess new and ongoing projects and to ensure that money spent on research fits with the program mission.
- **Recreation Administrative Rules —** To regulate public use of state forest lands. Will provide for a safe, enjoyable experience for all users, minimize conflicts between various types of uses, and minimize impacts on other resources.

Comparison of State and Federal Management Mandates

Many people are already familiar with the laws that guide the planning and management of the national forests. State forests operate under a completely different set of mandates. This section outlines the fundamental differences between the state and federal requirements.

National Forests (U.S. Forest Service)

National forests must be managed in accordance with multiple use and sustained yield principles. The Multiple-Use Sustained-Yield Act of 1960 calls for renewable surface resources (e.g. outdoor recreation, range, timber, watershed, wildlife, and fish) to be managed in the combination that will best meet the needs of the American people. These resources are to be managed to achieve a perpetually high level of output.

The requirement to develop management plans for national forests comes from the Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA). This was later amended through the National Forest Management Act of 1976 (NFMA) and pursuant regulations.

National forest management plans are considered to be major federal actions which significantly affect the quality of the human environment. Therefore, each plan must be accompanied by an environmental impact statement (EIS) in accordance with the National Environmental Policy Act of 1969 (NEPA) and Council on Environmental Quality (CEQ) regulations which implement NEPA.

The Resources Planning Act and National Forest Management Act provide for public participation in national forest planning processes. CEQ regulations provide for public involvement in the NEPA processes. Federal actions which require an EIS have a greater level of public involvement than those which require an environmental assessment (EA).

State Forests

State law (ORS 526.255) calls for "long range management plans based on current resource descriptions and technical assumptions, including sustained yield calculations for the purpose of maintaining economic stability in each management region."

Unlike the Forest Service, "multiple use" management is not a legal mandate for either Board of Forestry Lands or Common School Forest Lands. However, the conservation and use of renewable and non-renewable resources must necessarily be factored into state forest management plans. Board of Forestry Lands are managed under statutory direction to produce income for the counties as well as to conserve, protect, and use a variety of natural resources. Common School Forest Lands are managed under the Oregon Constitution with the object of "obtaining the greatest benefit for the people of this state, consistent with the conservation of this resource under sound techniques of land management."

Environmental impact statements and environmental assessments are not required for state forest planning unless there is a federal action involved.

There is no legal mandate for public participation in state forest planning. Public involvement in the Eastern Oregon Region management plan reflects the Department of Forestry's desire to use public comments as a planning resource. Public involvement also furthers understanding, acceptance, and support of the plan.

Other Legal Mandates

Federal Endangered Species Act

The federal Endangered Species Act (ESA) was enacted in 1973 to preserve species which are at risk of becoming extinct. The ESA has been modified several times since 1973. Administration of the ESA falls under the authority of the U.S. Fish and Wildlife Service and the National Marine Fisheries Service.

The ESA protects species which have been designated as "threatened" or "endangered" (T&E) through a listing process. The federal ESA defines an "endangered" species as one which is in danger of extinction throughout all or a portion of its range. A "threatened" species is likely to become an endangered species within the foreseeable future.

The USFWS maintains two categories of "candidate" species which are not protected under the law. These remain in candidate status because there is not sufficient information to list them or because the listing process has not been completed.

As explained below, various provisions of the ESA may distinguish between federal and non-federal lands, plant and animal species, and species listed as threatened or endangered.

Agencies of the federal government are prohibited from jeopardizing the existence of any T&E species and from destroying or adversely modifying "critical habitat." The designation of critical habitat occurs at the time a species is listed. Only federal lands are subject to the restrictions pertaining to critical habitat. Another provision of the ESA directs federal agencies to carry out programs for the conservation of T&E species. None of these provisions distinguish between plant and animal species.

The ESA's prohibition against "take" applies equally to non-federal and federal lands, and specifically to fish and wildlife species. The term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

A significant revision of the ESA occurred in 1982, when provisions allowing for "incidental take" were added. Such taking must be incidental to, and not the main purpose of, the carrying out of an otherwise lawful activity. In order to obtain an incidental take permit, an applicant must submit a conservation plan, sometimes known as a "habitat conservation plan" or HCP. An incidental take permit may be granted if the following conditions are satisfied: (1) the taking will be incidental; (2) the applicant will minimize and mitigate the impacts of taking; (3) there will be adequate funding to implement the conservation plan; and (4) the likelihood of the survival and recovery of the species will not be reduced.

The ESA does not merely protect surviving populations; it directs the Secretary of Interior to develop a "recovery plan" for each T&E species. The objective is to enable each species to recover to the point that protection under the ESA is no longer necessary and it can be taken off the list.

The term "take" does not apply to plant species. The ESA prohibits the removal, damage, or destruction of endangered plants on federal lands. For endangered plants on non-federal land, the ESA prohibits removal or destruction by anyone who in the process of destroying the plants knowingly violates any state law or regulations including criminal trespass laws. The activities prohibited for endangered plants are not automatically prohibited for threatened plants. However, such prohibitions may be established for threatened plants through regulation, if they are found to be "necessary and advisable for the conservation of such species." (Federal ESA)

State Endangered Species Act

The Oregon laws covering threatened and endangered species of plants and animals are found in Oregon Revised Statutes 496.172 through 496.192 (for wildlife) and ORS 564.010 through 564.994 (for plants). Further legal requirements are given in the Oregon Administrative Rules.

Wildlife Species

Threatened and endangered wildlife species in Oregon are managed under the authority of the State Fish & Wildlife Commission. The 1995 Oregon Legislature made substantial changes to the state Endangered Species Act for wildlife. A summary was not available for publishing in this plan. The law as summarized below will remain in effect until September 9, 1995.

Through administrative rule, the Commission maintains a list of species which are determined to be threatened or endangered in accordance with the statutory definitions of these terms. The Oregon Revised Statutes define an "endangered" species as any native wildlife species (a) in danger of extinction throughout any significant portion of its range within this state; or (b) listed as endangered as of May 15, 1987 pursuant to the federal Endangered Species Act. A "threatened" species is one which is likely to become endangered or has been listed as threatened pursuant to the federal ESA as of May 15, 1987.

The decision to add or remove a species from either list must be based upon documented and verifiable scientific information and other pertinent data.

Protection and conservation programs for T&E species are established by the Commission through administrative rule. The objective of a conservation program is to enable the recovery of a species so that it may be taken off the state T&E list. Priorities for conservation programs may be set according to available funding and the seriousness of the threat to a species.

State agencies such as the Department of Forestry are directed to cooperate with the Department of Fish and Wildlife in furthering conservation programs for T&E species. A consultation with ODFW is required prior to any action on state lands. It must be shown that such actions are consistent with existing state T&E species programs. If no program exists for an affected species, the state agency must follow this procedure: (1) Determine whether such action has the potential to appreciably reduce the likelihood of the survival or recovery of the species. (2) If so, then ODFW must be notified, and within 90 days ODFW must recommend any reasonable alternatives to the proposed action which are consistent with conserving and protecting the affected species. (3) If the state agency chooses not to adopt such recommendations, then it must demonstrate that (a) the potential public benefits of the proposed action outweigh the potential harm from failure to adopt the recommendations; and (b) measures will be taken to minimize the adverse impact on the affected species.

Plant Species

Oregon's threatened and endangered plant species are managed under the authority of the Director of Agriculture, with administrative responsibilities delegated to the Oregon Department of Agriculture (ODA).

The statutes pertaining to listing and conserving T&E plant species are very similar to those described above for wildlife. One difference is that, with respect to plant conservation programs, state agencies must consult not only with the Department of Agriculture, but with any other state agency that has established programs to conserve or protect threatened or endangered species.

State agencies are directed to ascertain the occurrence, or likely occurrence, of any listed species before taking any action on state-owned land. The term "action" has been defined to include activities that disturb the ground or vegetation or suppress plant growth. A sale or exchange of state-owned land, such that a listed species would be removed from state jurisdiction, would also be considered an action.

If it is determined that there is a conflict between a proposed activity and a listed plant, the following procedure is used. A state agency, in consultation with ODA, must determine whether the activity is consistent with ODA's conservation program for the species. If no conservation program is in place, the state agency must determine whether the activity has the potential to "appreciably reduce the likelihood of survival or recovery of any population of any plant species that is listed as threatened or endangered." If so, the state agency must recommend reasonable measures to minimize any potential adverse impacts of the activity. ODA's role is to review the proposal and recommend alternatives if necessary. In deciding whether or not to implement ODA's alternatives, the state agency may weigh the benefits of the proposed activity against the harm from failing to implement the alternatives.

Oregon's Statewide Planning Goals

Since 1973, with the passing of The Oregon Land Use Act, Oregon's land use has been guided by local comprehensive planning under a number of Statewide Planning Goals (ORS 195, 196 and 197; OAR Chapter 660). State forest land management complies with this law by following the Department of Forestry's current State Agency Coordination Program, described in OAR Chapter 629, Division 20, adopted in 1990.

To date, 19 Statewide Planning Goals have been adopted by the Land Conservation and Development Commission (LCDC). These include goals on citizen involvement, the planning process, farm lands, forest lands, natural resources, development and coastal resources (Oregon Department of Land Conservation and Development 1994). These goals are quite detailed and have the force of law. As part of the 1973 law, the Department of Land Conservation and Development (DLCD) was established to implement the policies and goals of the Commission. Later, in 1979, the Legislature created the Land Use Board of Appeals (LUBA) to rule on matters involving land use.

State law requires each city, county, and special district to have a comprehensive plan, as well as the zoning and ordinances needed to put the plan into effect (ORS 197.175). Locally adopted land use plans are reviewed by LCDC to make sure they are consistent with the statewide goals. After LCDC has officially approved a local government's plan, the plan is said to be "acknowledged." An acknowledged local comprehensive plan is the controlling document for land use in the area covered by the plan. Thus, management of state lands must be compatible with local comprehensive plans and land use regulations (ORS 197.180).

In 1978, LCDC approved the Oregon Department of Forestry's State Agency Coordinating Agreement. This agreement, required of all state agencies, describes ODF's rules and programs that affect land use, and spells out how the agency will coordinate its functions with local governments, other state agencies, and federal agencies. In 1987, the Oregon Legislature passed House Bill 3396, which resolved issues between the Forest Practices Act and the land use programs. Specifically, the Statewide Planning Goals do not apply to programs, rules, procedures, decisions, determinations, or activities carried out under the Forest Practices Act (ORS 197.180 and 197.277). The FPA prohibits local governments from regulating, prohibiting, or limiting forest practices in any way on forest lands outside an urban growth boundary unless an acknowledged exception has been taken to a forest land goal (ORS 527.722). In 1991 LCDC certified that the Department of Forestry's new State Agency Coordination Program (OAR 629-20) was compatible with the Statewide Planning Goals.

Goal 4 of the Statewide Planning Goals, "Forest Lands", is "To conserve forest lands by maintaining the forest land base and to protect the state's forest economy by making possible economically efficient forest practices that assure the continuous growing and harvesting of forest tree species as the leading use on forest land consistent with sound

Key Terms

Acknowledgment — Approval by the Land Conservation and Development Commission (LCDC) of a city or county's comprehensive plan; acknowledgment of compliance with the Statewide Planning Goals.

Certification — Approval by LCDC of a state agency program found to be consistent with the Statewide Planning Goals.

Department of Land Conservation and Development (DLCD) — State agency that administers Oregon's statewide planning program and provides professional support to the LCDC.

Land Conservation and Development Commission (LCDC) — A seven-person commission that sets the standards for Oregon's statewide planning program. Members are volunteers appointed by the Governor and confirmed by the State Senate.

Land Use Board of Appeals (LUBA) — Established in 1979 essentially as a state court that rules on matters involving land use. Appeals from LUBA go to the State Court of Appeals and finally to the Supreme Court.

State Agency Coordination Program — Required under law for each state agency, to establish procedures to assure compliance with statewide land use goals and acknowledged city and county comprehensive plans and land use regulations.

Statewide Planning Goals — Statewide Planning Goals are adopted by the Land Conservation and Development Commission to set standards for local land use planning. They have the force of law.

management of soil, air, water, and fish and wildlife resources and to provide for recreational opportunities and agriculture." (Oregon Department of Land Conservation and Development 1994)

Goal 4 allows the following land uses on forest land: "(1) uses related to and in support of forest operations; (2) uses to conserve soil, water and air quality, and to provide for fish and wildlife resources, agriculture and recreational opportunities appropriate in a forest environment; (3) locationally dependent uses; (4) dwellings authorized by law." In addition, "Forest operations, practices and auxiliary uses shall be allowed on forest lands subject only to such regulation of uses as are found in ORS 527.722 [the Forest Practices Act]." (Oregon Department of Land Conservation and Development 1994)

Two other Statewide Planning Goals are of particular interest. Goal 5 (Open Spaces, Scenic and Historic Areas, and Natural Resources) is "To conserve open space and protect natural

and scenic resources." Goal 6 (Air, Water and Land Resources Quality) is "To maintain and improve the quality of the air, water and land resources of the state."

The Department of Forestry has established procedures under OAR 629-20, its State Agency Coordination Program, to assure that land use programs comply with Statewide Land Use Planning Goals and are compatible with acknowledged city and county comprehensive plans and land use regulations. In the case of a state forest plan, the District Forester will notify local government when a forest plan is being developed, and will request their review and comment on the compatibility of the draft forest plan with the local government's comprehensive plan. If a conflict is found between the Department's statutory obligations and land use compatibility, OAR 629-20-050 describes the dispute resolution process to be followed. OAR 629-20 also describes procedures to be followed if land use designations are updated; land is acquired, sold or exchanged; non-forest uses or forest uses not regulated by the Forest Practices Act must be approved; or when block plans, annual operations plans and transportation plans are developed. OAR 629-20-000 states that "it is not the intent of these rules to prevent either the Board of Forestry or the Department of Forestry from carrying out their statutory responsibilities."

Oregon Forest Practices Act

Activities on lands managed by the Department of Forestry are subject to the Forest Practices Act (FPA), which is found in Chapter 527 of the Oregon Revised Statutes, and the Oregon Administrative Rules pursuant to these statutes.

The FPA declares it public policy to encourage economically efficient forest practices that assure the continuous growing and harvesting of forest tree species consistent with sound management of soil, air, water, fish, and wildlife resources as well as scenic resources within visually sensitive corridors. The Board of Forestry is granted the exclusive authority to develop and enforce rules protecting forest resources and to coordinate with other agencies concerned with the forest environment.

The Forest Practices Act has developed in an evolutionary manner since the original act was passed in 1971. The 1971 law established minimum standards for reforestation, road construction and maintenance, timber harvesting, application of chemicals, and disposal of slash. Subsequently, administrative rules were written to define the "waters of the state" and to protect streams and riparian areas. Rules were adopted to prevent soil damage resulting from logging and to prevent mass soil movement.

The Forest Practices Act was strengthened in 1987 with the passage of House Bill 3396. The concept of sensitive resource sites was introduced, along with the requirement that written plans be approved prior to operating near those sites. Provisions were added which allow interested citizens to review and comment on notifications of operations and written plans.

The 1991 enactment of Senate Bill 1125 added new standards for reforestation, wildlife habitat, and scenic considerations. The new requirements included timeframes and trees per acre standards for reforestation, limits on the size and proximity of clearcuts, visual standards for logging in visually sensitive highway corridors, and specifications for wildlife trees and downed woody debris retained after logging. In addition, the Board of Forestry was directed to reclassify and develop appropriate protection levels for the waters of the state. Subsequently, new water protection rules were adopted in 1994.

The entire set of Forest Practice Administrative Rules (Chapter 629) has been reorganized for ease of use. The new publication contains the general forest practice rules (Division 24), reforestation rules (Division 610), water protection rules (Divisions 635-660), and other rules that were changed during the 1994 rule-making process. The publication also footnotes places where the rules will be further reorganized in the future (Oregon Department of Forestry 1995).

Appendix D

Plant Associations

Plant associations are groups of plant species that reoccur on the landscape within particular environmental tolerances. They are stable groupings of plant species capable of self-perpetuation, and can be thought of as climax plant communities. There are several main uses for plant associations (Topik et al. 1988).

1. Plant associations can be used to describe key environmental features of sites.
2. Plant associations provide site-specific information that can help managers to understand the results of natural events and management activities on a site, and also to understand research results.
3. Managers can then prescribe appropriate management activities for sites, based on their improved ability to predict site response to treatment.
4. Plant associations can form the basis for a natural inventory system of land resources.

In the 1989 to 1991 forest inventory that was conducted on the Klamath-Lake District state forest lands, plant associations were identified for all stands classified as “production lands” in the land use classification system. The tables on the following pages present these plant associations, grouped by North Block, Southwest Block, and East Block.

Each plant association has a name and a code number. The code numbers are not included in these tables. Each name is composed of the dominant species of tree, shrub, and herbaceous plant found in that association. The species that has the greatest presence across all stands representing the association is used in the name. In some associations, two or three species are used within the tree, shrub, or plant groups. In each plant association name, a forward slash (/) separates the tree, shrub, and herbaceous plant species, while a dash (-) separates the species names when there is more than one species within the tree, shrub, or plant group. An example is given below. Common names of species are used in these tables.

Ponderosa/bitterbrush-sagebrush/fescue

Tree name/brush species names/herbaceous plant name

The name of an association does not necessarily describe all vegetation present in that association, but merely designates important species. These species help characterize the plant community that would occur at a stable vegetative condition.

Table D-1. North Block Plant Associations

Plant Association	Acres
Lodgepole needlegrass basins	245
Lodgepole/needlegrass-lupine	125
Lodgepole/sedge-lupine	1272
Lodgepole/blueberry/forb wetland	205
Lodgepole/bitterbrush/needlegrass	1789
Lodgepole/bitterbrush/sedge	235
Lodgepole/manzanita	27
Lodgepole/grouse huckleberry	129
Lodgepole/snowbrush-manzanita	122
Ponderosa/bitterbrush/needlegrass	138
Ponderosa/bitterbrush-manzanita/needlegrass	115
Ponderosa/bitterbrush/sedge	2065
Ponderosa/bitterbrush-snowbrush/needlegrass	519
Ponderosa/bitterbrush-snowbrush/sedge	251
Shasta red fir-white fir/chinquapin-prince's pine/long-stolon sedge	295
Mixed conifer/snowbrush-chinquapin	2596
Mixed conifer/snowbrush-manzanita	2013
Mixed conifer/snowbrush/sedge	9329
Mixed conifer/snowbrush-squawcarpet/strawberry	919
Total Acres for Production Lands in the North Block	**22,389**

Table D-2. Southwest Block Plant Associations

Plant Association	Acres
Ponderosa pine-Douglas-fir	933
Ponderosa/bitterbrush/fescue	83
Ponderosa/bitterbrush/needlegrass	168
Ponderosa	160
Shasta red fir/long-stolon sedge	80
Mixed conifer/snowbrush-pinemat	742
White fir/chinquapin-boxwood-prince's pine	705
Mixed conifer/snowbrush-squawcarpet/strawberry	1382
White fir/snowberry/strawberry	209
Total Acres for Production Lands in the Southwest Block	**4,462**

Table D-3. East Block Plant Associations

Plant Association	Acres
Ponderosa pine-juniper/mountain mahogany-bitterbrush-big sagebrush/fescue	210
Ponderosa/wooly wyethia	555
Ponderosa/bitterbrush/fescue	552
White fir-ponderosa pine-incense cedar/serviceberry	888
White fir-ponderosa pine-western white pine/sticky currant	40
White fir-ponderosa pine/manzanita-Oregon grape	1698
White fir-ponderosa pine/snowberry/starwort	797
Total Acres for Production Lands in the East Block	**4,740**

Appendix E

Rare, Threatened, or Endangered Plants: Species List, Status, and Habitat

This appendix lists the rare, threatened, or endangered plant species that have a strong possibility of occurring somewhere within the planning area. The list encompasses all state forest lands in Klamath-Lake District. The following steps were used to create the list.

Carol Tyson, botanist for the Winema National Forest, developed the initial list of plant species of concern. This list included species on the Oregon Department of Agriculture's threatened, endangered, and candidate lists; all four of the Oregon Natural Heritage Program's (ONHP) lists; and the U.S. Fish and Wildlife Service's federal lists. Carol initially reviewed the Oregon Natural Heritage Program's species lists for Klamath County. Both the Forest Service (Winema and Fremont National Forests) and the Bureau of Land Management have done extensive plant surveys on federal lands in Klamath County. Carol used the results of these surveys in combination with the ONHP lists to create a comprehensive list of suspect and documented species for state forest lands in Klamath-Lake District. The resulting list is on the following pages.

None of the plant species on this list are currently listed as threatened or endangered under the State of Oregon or federal ESAs. Twelve of the species are currently listed as candidate species under the Oregon ESA. Two of the candidate species, *Astragalus peckii* (Peck's milkvetch) and *Botrychium pumicola* (pumice grape-fern), are currently being proposed for addition to the State threatened and endangered list. Peck's milkvetch is found on dry, sandy soils in lodgepole/bitterbrush forest openings and sagebrush scrub. Pumice grape-fern is found in fine pumice gravel without humus above 7800 feet and in lodgepole pine basins down to 5000 feet. Habitat for both species could exist in the North Block.

On the next page, there is an explanation of the format used in the list. The list itself begins on page E-3. References for the plant list are in Appendix B.

Acronyms Used in Plant List

BLM	Bureau of Land Management
ONHP	Oregon Natural Heritage Program
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service

The plant listings are given in the following format.

Scientific name of plant species

Habitat/Range	Typical habitats for the species, and the known range for the plant.
Identification Period	Time of year when plant is most easily identified, such as the flowering season.
PNW Documentation	Areas where plant is known to have been found in Oregon and Washington.
Status	Status of plant as threatened, endangered, candidate, or sensitive species. See the explanations below for the status categories.
Reference	Reference publications; complete information for references is in Appendix B.

Explanation of Status Categories

Federal category 1 candidate	USFWS has substantial information to support listing the species, but it is not listed yet.
Federal category 2 candidate	USFWS needs additional information to support listing the species, but it is not listed yet.
Federal category 3 candidate	The species has proven to be more abundant or widespread than previously believed and/or there are no identifiable threats to the species.
Proposed federal endangered status	USFWS has proposed to list the species as endangered; the proposal has not been finalized yet.
State of Oregon candidate	State of Oregon list, developed by the Oregon Department of Agriculture, of candidate plant species under review for listing as threatened or endangered.
ONHP List 1	Taxa that are endangered or threatened throughout their range or which are presumed extinct.
ONHP List 2	Taxa that are endangered, threatened, or possibly extirpated from Oregon, but which are more common or stable elsewhere.
ONHP List 3	Species for which information is needed before status can be determined, but which may be threatened or endangered in Oregon or throughout their range.
ONHP List 4	Taxa of concern that are not currently threatened or endangered. Includes taxa that are very rare but are currently secure, as well as taxa that are declining in numbers or habitat but are still too common to be proposed as threatened or endangered.
Sensitive list	Species recognized as needing special management in order to prevent their being placed on federal or state threatened or endangered lists.
Threatened or endangered	See Appendix A, Glossary, for a complete set of definitions for state and federal threatened and endangered species categories.

Allium bolanderi

Habitat/Range	Dry rocky areas, heavy clay soils, openings in brush and woods below 4,000 feet; chaparral, foothill woodlands, ponderosa pine forests, inner coast ranges. Douglas and Curry Counties to California.
Identification Period	Flowers from May-July. After flowering, can be identified by the dry flower segments, which appear long-tapered and pointed (Stansell 1992).
PNW Documentation	Siskiyou National Forest.
Status	ONHP List 3, USFS sensitive list.
Reference	Abrams 1940 (Vol. I, p. 395); Hickman 1993 (p. 1176); Munz 1973 (p. 1373).

Allium campanulatum

Habitat/Range	Ponderosa pine and mixed conifer forests at 4,800-6,400 feet. Often dryish places, montane to alpine, open coniferous forests, north central Oregon to California and Nevada.
Identification Period	Flowers from June to August. Look for linear leaf, often withered at anthesis; purple/white petals with a dark spot at the base and rolled tips; and crested ovary (Croft 1992).
PNW Documentation	Chiloquin and Klamath Ranger Districts (Winema National Forest); Deschutes, Malheur, Mt. Hood, Ochoco, Rogue River, Umatilla, Umpqua, Wallowa-Whitman, Willamette National Forests.
Status	ONHP List 4, USFS sensitive list.
Reference	Hickman 1993(p. 1176); Abrams 1940 (Vol. I, p. 395); Hitchcock and Cronquist 1973 (p. 682); Munz 1973 (p. 1371).

Arabis suffrutescens var. horizontalis

Habitat/Range	High altitudes in the Cascades Mountains; above 8,000 feet, gravelly or stony alpine slopes, dry pumice slopes; sparse pine, Shasta red fir, or hemlock forests.
Identification Period	Flowers from July-August (Hopkins & Garrett 1990). Fruits are spreading to more-or-less recurved.
PNW Documentation	Klamath Ranger District sighting; not relocated (Winema National Forest). Also Crater Lake National Park.
Status	Federal category 2 candidate; State of Oregon candidate; ONHP List 1; USFS sensitive list.
Reference	Hickman 1993 (p. 403); Abrams 1944 (Vol. II, p. 311); Hitchcock and Cronquist 1973 (p. 153).

Arnica viscosa

Habitat/Range	Rocky places at or above timberline; 5,500-9,000 feet. Mt. Shasta to southern Oregon. Deschutes, Douglas, Klamath Counties.
Identification Period	August.
PNW Documentation	Deschutes and Umpqua National forests, Chemult Ranger District (Winema National Forest), and Crater Lake National Park.
Status	Federal category 3 candidate; State of Oregon candidate; ONHP List 2; USFS sensitive list.
Reference	Abrams and Ferris 1960 (Vol. IV, p. 426-7; Munz 1973 (p. 1243).

Asarum wagneri

Habitat/Range	Early-mid seral mixed conifer and lodgepole pine forests; openings in mature stands; skid trails, roadsides; boulder fields and other rocky sites; 4,500-8,500 feet. Douglas, Jackson, Klamath Counties.
Identification Period	Flowers from April-July. Heart-shaped leaves identifiable from April-September.
PNW Documentation	Klamath Ranger District (Winema National Forest); Rogue River and Umpqua National Forests; Klamath Falls Area BLM.
Status	State of Oregon candidate; ONHP List 1; USFS sensitive list.
Reference	Lu and Mesler 1983.

Astragalus peckii

Habitat/Range	Dry sandy pumice soils; lodgepole/bitterbrush forest openings and/or sagebrush scrub; 3,000-3,600 feet. Endemic to eastern Oregon Cascades. Deschutes and Klamath Counties.
Identification Period	July-August.
PNW Documentation	Chemult Ranger District (Winema National Forest); Deschutes National Forest.
Status	Federal category 2 candidate; State of Oregon candidate; ONHP List 1.
Reference	Hitchcock et al. 1961 (part 3, p. 253).

Botrychium pumicola

Habitat/Range	Fine pumice gravel without humus, grassy slopes, above 7,800 feet; lodgepole pine basins; 5,000 feet. Mt. Shasta to southern Oregon. Paulina Mountains, Crater Lake area. Deschutes, Klamath Counties.
Identification Period	Sporulates in August.
PNW Documentation	Chemult Ranger District (Winema National Forest); Deschutes and Willamette National Forests; Crater Lake National Park.
Status	Federal category 2 candidate, State of Oregon candidate; ONHP List 1.
Reference	Abrams 1940 (Vol. I, p. 3); Munz 1973 (Supplement p. 3).

Calliergon trifarium

Habitat/Range	Calcareous fens, standing water, often completely submerged.
Identification Period	Sporulates in August-September. Vegetatively identifiable throughout summer.
PNW Documentation	Klamath Ranger District (Winema National Forest).
Status	ONHP List 2; USFS sensitive list.
Reference	Vitt et al. 1988 (p. 88).

Calochortus longebarbatus var. longebarbatus

Habitat/Range	Dry/moist meadows or edges adjacent to ponderosa pine or lodgepole forested woodlands; 4,500-5,500 feet; discrete northern and southern group of Lake and Klamath Counties, Oregon; and Shasta, Modoc, and Siskiyou Counties, California.
Identification Period	June-July (August).
PNW Documentation	Chiloquin Ranger District (Winema National Forest), and Fremont National Forest.
Status	Federal category 1 candidate; ONHP List 1.
Reference	Hitchcock et al. 1969 (Part 1, p. 771).

Carex buxbaumii

Habitat/Range	Bogs, marshes, wet meadows, and other wet places. Wide range, but uncommon. California to Alaska. Curry, Deschutes, Jackson, Klamath, and Lane Counties.
Identification Period	Flowers from June-August.
PNW Documentation	Klamath and Chemult Ranger Districts (Winema National Forest); Colville, Mt. Baker-Snoqualmie, Okanogan, and Wenatchee National Forests.
Status	Washington sensitive list; ONHP List 3.
Reference	Hitchcock et al. 1969 (Part 1, p. 251); Hickman 1993 (p. 1122).

Castilleja chlorotica

Habitat/Range	Dry gravelly slopes, summits and shrub/graminoid forest openings of ponderosa pine/lodgepole pine openings; 5,000-8,200 feet. Volcanic sandy loams. Deschutes, Klamath, and Lake Counties, Oregon.
Identification Period	June-August.
PNW Documentation	Fremont and Deschutes National Forests.
Status	Federal category 2 candidate; State of Oregon candidate; ONHP List 1.
Reference	Abrams 1951 (Vol. III, pp. 830-832); Piper 1920.

Cicuta bulbifera

Habitat/Range	Wet places with standing water, swamps, marsh edges.
Identification Period	August-September.
PNW Documentation	Wenatchee and Colville National Forests.
Status	State of Washington sensitive list; ONHP List 2. Extirpated from Oregon.
Reference	Abrams 1951 (Vol. III, p. 237); Hitchcock and Cronquist 1973 (p. 322).

Collomia mazama

Habitat/Range	Alpine meadows and slopes; mixed conifer, true fir, and lodgepole pine forests; often disturbed or somewhat open sites. Mid to high elevations. Douglas, Jackson, and Klamath Counties.
Identification Period	Flowers from July-August. Can identify by toothed leaves before and after flowering.
PNW Documentation	Klamath Ranger District (Winema National Forest); Rogue River and Umpqua National Forests; Crater Lake National Park.
Status	Federal category 2 candidate; State of Oregon candidate; ONHP List 1.
Reference	Abrams 1951 (Vol. III, p. 406); Peck 1961 (p. 634).

Draba aureola

Habitat/Range	Alpine summits, fell-fields; volcanic peaks above timberline. Mt. Lassen, California to Washington.
Identification Period	June-August.
PNW Documentation	Willamette, Mt. Hood, and Deschutes National Forests.
Status	USFS sensitive list.
Reference	Abrams 1944 (Vol. II, p. 298); Hitchcock et al. 1964 (Vol. II, p. 490-491); Munz 1973 (p. 251).

Eriogonum diclinum

Habitat/Range	Dry rocky ridge tops in Siskiyou County, California; serpentine, sandy to gravelly flats and slopes in southwest Oregon; 5,500-8,000 feet.
Identification Period	May-August.
PNW Documentation	Siskiyou and Rogue River National Forests.
Status	ONHP List 2; USFS sensitive list.
Reference	

Eriogonum prociduum

Habitat/Range	Barren, light volcanic slopes; basalt flows on slopes and hills, typically in pine woodlands; 4,200-8,200 feet; Modoc plateau, California; to south central Oregon and northwest Nevada.
Identification Period	May-early August.
PNW Documentation	Fremont National Forest.
Status	Federal category 3 candidate; State of Oregon candidate; ONHP List 1; USFS sensitive list.
Reference	

Gentiana newberryi

Habitat/Range	Subalpine and alpine meadows, vernally wet to moderately dry; stream sides; fell-fields; 5,000-12,000 feet. Northern California to southern Oregon to western Nevada.
Identification Period	Flowers from July-September. Rosettes (similar to Mimulus primuloides on Klamath Ranger District) can be identified before and after flowering.
PNW Documentation	Klamath Ranger District (Winema National Forest); Willamette and Deschutes National Forests.
Status	ONHP List 2; USFS sensitive list.
Reference	Hickman 1993 (p. 668); Abrams 1951 (Vol. III, p. 356); Hitchcock et al. 1969 (Vol. I, p. 860); Munz 1973 (p. 4411).

Haplopappus whitneyi ssp. discoideus

Habitat/Range	Rocky, open forest slopes, red fir forests; 3,000-7,000 feet; inner coast ranges. Lake County to Siskiyou Mountains, California, southern Oregon.
Identification Period	July-September.
PNW Documentation	Chemult Ranger District (Winema National Forest); Rogue River, Siskiyou, and Umpqua National Forests.
Status	ONHP List 2; USFS sensitive list.
Reference	Abrams and Ferris 1960 (Vol. IV, p. 277); Munz 1973 (p. 1178).

Hieracium bolanderi

Habitat/Range	Mixed conifer, ponderosa pine, red fir woods, and dry woods; 1,000-9,000 feet, in northern California and southwest Oregon; high elevation slopes in the Cascades (Mt. McLoughlin).
Identification Period	Flowers from June-August.
PNW Documentation	Chemult Ranger District (Winema National Forest); Rogue River, Siskiyou, and Willamette National Forests.
Status	ONHP List 2; USFS sensitive list.
Reference	Abrams and Ferris 1960 (Vol. IV, p. 598); Munz 1959 (p. 1306); Peck 1961 (p. 864); Hickman 1993 (p. 288).

Melica stricta

Habitat/Range	Open sites, coniferous forest, rock outcrops, and rocky areas in alpine; 3,900-11,000 feet; in California: Klamath, Sierra Nevada, North Coastal, Trinity, White, and Inyo Mountains; into Oregon and Utah.
Identification Period	
PNW Documentation	Chemult and Chiloquin Ranger Districts (Winema National Forest); Harney, Lake, Klamath, and Malheur Counties.
Status	ONHP List 4; USFS sensitive list.
Reference	

Mimulus jepsonii

Habitat/Range	Forest gaps, primarily with lodgepole pine but occasionally with ponderosa pine; residual soils; Deschutes and Umpqua National Forests and distributed along the east slope of the Cascades from central Deschutes County south to Diamond Lake (and to Lassen County, California?).
Identification Period	(June) July-August (September); scattered pubescence/hairs on the lower and upper lips of the corolla denote M. Jepsonii (vs. M. nanus).
PNW Documentation	Deschutes and Umpqua National Forests.
Status	ONHP List 2; USFS sensitive list.
Reference	Munz 1959 (p. 618).

Mimulus pygmaeus

Habitat/Range	Vernally wet depressions, flats, or intermittent stream beds in sagebrush grasslands, open woods, or meadows; 3,800-5,500 feet. Northern California; Jackson, Klamath, and Lake Counties, Oregon.
Identification Period	Flowers from May-August (Thompson 1991).
PNW Documentation	Klamath and Chiloquin Ranger Districts (Winema National Forest); BLM lands adjacent to the Rogue River and Fremont National Forests.
Status	Federal category 2 candidate; State of Oregon candidate; USFS sensitive list.
Reference	Abrams and Ferris 1960 (Vol. IV, p. 726); Munz 1959 (p. 1306); Peck 1961 (p. 710); Hickman 1993 (p. 1044).

Mimulus tricolor

Habitat/Range	Moist flats; wet clay soils; vernal pools. Willamette Valley, Oregon, south to San Joaquin Valley, California.
Identification Period	May-July
PNW Documentation	Chiloquin Ranger District (Winema National Forest), Fremont National Forest.
Status	ONHP List 2; USFS sensitive list.
Reference	Abrams 1951 (Vol. III, p. 727); Hitchcock and Cronquist 1973 (p. 428); Munz 1973 (p. 621).

Penstemon glaucinus

Habitat/Range	High elevation lodgepole pine and white fir forests; Gearhart Mountain Wilderness and near Campbell Lake, Fremont National Forest; Chemult and Chiloquin Ranger Districts (Winema National Forest).
Identification Period	June-August.
PNW Documentation	Chemult and Chiloquin Ranger Districts (Winema National Forest); Fremont National Forest; Klamath Agency CRD.
Status	Federal category 2 candidate; State of Oregon candidate; ONHP List 1.
Reference	Abrams 1951 (Vol. III, p. 742).

Perideridia erythrorhiza

Habitat/Range	Meadows, pasturelands; poorly drained sites; oak and pine woodland openings; to 5,000 feet. Douglas, Klamath, and Josephine Counties.
Identification Period	Flowers from July-August, petals narrow and 5-veined. Fruits from August-September, ellipsoid. Identifiable by linear leaf segments before flowering and fruiting.
PNW Documentation	Klamath Ranger District (Winema National Forest); Roseburg District BLM; and Klamath Agency CRD.
Status	Federal category 2 candidate; State of Oregon candidate; ONHP List 1; USFS sensitive list.
Reference	Chuang and Constance 1969.

Perideridia howellii

Habitat/Range	Moist slopes, meadows, stream sides; 2,000-5,000 feet; ponderosa pine, mixed conifer forests, scab areas. Douglas County south to northern California.
Identification Period	July-August.
PNW Documentation	Rogue River National Forest.
Status	ONHP List 2; USFS sensitive list.
Reference	Abrams 1951 (Vol. III, p. 233); Munz 1959 (p. 1012); Peck 1961 (p. 562).

Rorippa columbiae

Habitat/Range	Damp ground along streams and lakes; meadows; moist areas with gravelly soil; 4,000-6,000 feet. Columbia River east of Cascades to Klamath County; east to Montana and Nebraska; south to New Mexico.
Identification Period	Flowers from May-September.
PNW Documentation	Klamath Ranger District sighting in 1916, Chemult and Chiloquin Ranger Districts (Winema National Forest); Klamath Resource Area BLM.
Status	Federal category 2 candidate; State of Oregon candidate; State of Washington endangered; ONHP List 1.
Reference	Abrams 1944 (Vol. II, p. 233); Munz 1959 (Rorippa calycina (Englem.) Rydb. var columbiae (Suksdorf) Rollins p. 239); Hitchcock and Cronquist 1973 (Rorippa calycina (Englem.) Rydb. var columbiae (Suksdorf) Rollins p. 175); Peck 1961 (p. 369).

Silene nuda spp. insectivora

Habitat/Range	Dry shrub meadows and vernally wet meadows in ponderosa/ lodgepole woodland openings; 4,000-6,000 feet. East slope of Sierra Nevadas to Klamath County (numerous sightings in the Gerber Reservoir area).
Identification Period	July-August (September).
PNW Documentation	Chiloquin, Klamath, and Chemult Ranger Districts (Winema National Forest); and Fremont National Forest.
Status	ONHP List 2; USFS sensitive.
Reference	Munz 1959 (p. 291).

Thelypodium brachycarpum

Habitat/Range	Sagebrush shrub and/or pond margins, damp ground near streams, and meadows adjacent to ponderosa pine forests; alkali soils; 3,000-6,500 feet.
Identification Period	April-August.
PNW Documentation	Chiloquin and Klamath Ranger Districts (Winema National Forest).
Status	ONHP List 2; USFS sensitive.
Reference	Munz 1959 (p. 214).

Appendix F

Mammals: Species List, Status, and Habitat

This appendix lists species of mammals that are known to be present or are likely to occur on state forest lands in Klamath-Lake District. The information was compiled by the Oregon Natural Heritage Program (ONHP), for the Oregon Department of Forestry. Biologists from the Oregon Department of Fish and Wildlife reviewed the information.

The species list was generated from a combination of recognized sources, including ONHP's data information systems, the Oregon Department of Fish and Wildlife's OSIS database, the Oregon Department of Forestry's forest stands database for the Klamath-Lake District, and a literature search. A complete list of sources is included in ONHP's report to the Department of Forestry (Oregon Natural Heritage Program 1994). ONHP developed an initial, working list of species in Klamath County from their data information systems, including their EMAP database, which has statewide distribution information about vertebrate species; and their Vertebrate Characterization Abstracts (VCA) database. Next, ONHP identified habitat categories on state forest lands in Klamath-Lake District, using the district's forest stands database. They then revised the working list to include only those species found in habitat types that occurred on state forest lands in the district.

The common names of the mammals are given first, followed by the scientific name in italics. Three categories of information are provided for each species: protection status, breeding status and relative abundance in Klamath County, and habitat information. These categories are discussed briefly below.

Protection Status

The "Status" column provides information about whether a species is listed as threatened, endangered, candidate, sensitive, or other special status. The column includes both federal and state status information. This column also notes if a species is classified as a game species in Oregon, and if it is an introduced species (not native to Oregon). The protection status information was taken from three sources: ONHP's publication "Rare, Threatened, and Endangered Plants and Animals of Oregon"; ONHP's species tracking database; and the Oregon Department of Fish and Wildlife's "Wildlife Diversity Plan."

The following protection status codes are used.

FE Federally endangered, under the federal Endangered Species Act

FT Federally threatened, under the federal Endangered Species Act

FC Federal candidate, under the federal Endangered Species Act

SE State endangered, under the Oregon Endangered Species Act

ST State threatened, under the Oregon Endangered Species Act

SC State critical — species for which listing as threatened or endangered is pending, or may be appropriate if immediate conservation actions are not taken.

SV State vulnerable — species for which listing as threatened or endangered is not believed to be imminent, and can be avoided through continued or expanded protective measures and monitoring.

SP State peripheral or naturally rare — species whose Oregon populations are on the edge of the range, or those species that have had historically low populations because of naturally occurring limiting factors.

SU State unknown — state status is unclear. These species may be susceptible to population declines of sufficient magnitude that they could qualify for one of the state status categories above, but scientific study will be required before a judgment can be made.

→ Species is known to occur on state forest lands in Klamath-Lake District, based on sightings or documentation by the Oregon Department of Fish and Wildlife, or information in ONHP's databases, or letters from Craig Bienz of the Klamath Tribe (letters provided by the Oregon Department of Forestry).

G State game animal

I Introduced species (not native to Oregon)

Breeding Status and Abundance in Klamath County

The "Breeding Status / Abundance" column provides information about the breeding status of the species in Klamath County, and also about the relative abundance of the species in Klamath County. The information for this column was generated from data contained in ONHP's EMAP and VCA databases, and the Oregon Department of Fish and Wildlife's OSIS database.

Breeding status is described with the following three terms.

Confirmed breeder	Breeding documented in Klamath County.
Probable breeder	Based on available habitat, the species probably breeds in Klamath County, though ONHP does not have documentation of it.
Possible breeder	Species may breed in Klamath County, but there is little available habitat, or the species is particularly rare in the county.

The description of abundance in Klamath County is based on a relative scale. Species were rated as abundant, common, uncommon, rare, or irregular. The "irregular" designation is used for species that are occasionally seen in the county, but are not considered part of the usual fauna. Specific documentation concerning the presence and/or abundance of a species on a specific tract of state forest land is not available, due to a lack of field surveys on those lands. However, a reader can make predictions by looking at the abundance of a species in Klamath County, and the presence on state forest lands of habitat types used by that species. For example, the long-toed salamander is abundant in Klamath County. It uses several forest types that are common on state forest lands in Klamath County. Based on this information, a person could predict that the long-toed salamander is abundant on state forest lands. The Cascade frog, on the other hand, is common in Klamath County, but uses wetland habitats. Since there are few wetlands on state forest lands in Klamath County, one would not expect the Cascade frog to be common on state forest lands. Similar predictions can be made for the mammal species in this appendix.

Habitat Information

ONHP developed 9 habitat categories through an assessment and synthesis of various sources. First, they reviewed the forest associations in the Klamath-Lake District's forest stands database. They then added additional habitat types that they expected to be present on the state forest lands, including wetland, riparian, talus/scree/outcrop. ONHP also reviewed the 140 vegetation types found statewide, listed in the Oregon Department of Fish and Wildlife's OSIS database. These vegetation types are described in Kagan and Caicco (1992). After assessing these sources, plus using their own knowledge of state forest lands, ONHP then identified 27 habitat types that occur on state forest lands in Klamath County. Finally, they distilled these 27 types into 8 habitat categories, and added a ninth category for talus, cliffs, and rocky areas. Each category is described briefly below.

Snags, Litter, Duff	Recent timber harvest areas, snags, downed wood.
Talus, Cliffs, Rocky Areas	Caves, quarry operations, talus, scree, outcrops.
Wetland, Riparian Areas	Riparian zones, open water, rivers.
Sagebrush	Low shrub communities dominated by big sagebrush, low sagebrush, or mountain big sagebrush.
Chaparral	Tall shrub community with closed canopy dominated by serviceberry, bitterbrush, bittercherry, snowbrush, or mountain brush.
Pine Forest	Forests dominated by ponderosa or lodgepole pine.
Fir Forest	Fir-dominated forests.
Grasses, Forbs, Meadows	Areas of open grass or forbs.

Mixed forest	Montane forests with canopies ranging from open to closed, with numerous co-dominant conifers.

The habitat listings for each species are based on information from ONHP's VCA database, and the Oregon Department of Fish and Wildlife's OSIS database and Wildlife Diversity Plan. The codes used in the habitat listings are defined below.

X Species breeds and feeds in this habitat.

R Species reproduces in this habitat.

F Species feeds in this habitat.

C Species uses this habitat for cover.

S This category is secondary habitat for this species.

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Vagrant shrew *Sorex vagrans*		Probable Breeder Present Year Round County Abundance: Common	X		X					X	
Dusky shrew *Sorex monticolus*		Probable Breeder Present Year Round County Abund: Uncommon			X				X	X	
Water shrew *Sorex palustris*		Probable Breeder Present Year Round County Abundance: Common			X			X	X		X
Pacific water shrew *Sorex bendirii*		Probable Breeder Present Year Round County Abundance: Common	X		X			X	X		X
Trowbridge's shrew *Sorex trowbridgii*		Probable Breeder Present Year Round County Abundance: Common							X		S
Merriam's shrew *Sorex merriami*		Probable Breeder Present Year Round County Abund: Uncommon	X		X			X			
Broad-footed mole *Scapanus latimanus*		Probable Breeder Present Year Round			X					X	

		County Abundance: Common									

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Little brown myotis *Myotis lucifugus*	→	Confirmed Breeder Present Year Round County Abundance: Common	X	R	F	X	X	X	F	S	X
Yuma myotis *Myotis yumanensis*		Probable Breeder Present Year Round County Abund: Uncommon	X	R	X	X		F	X	F	X
Long-eared myotis *Myotis evotis*		Probable Breeder Present Year Round County Abundance: Common	X	C	X	X		F	X		X
Fringed myotis *Myotis thysanodes*	SV	Probable Breeder Seasonally Present County Abundance: Common	X	X				X	X		X
Long-legged myotis *Myotis volans*		Probable Breeder Present Year Round County Abundance: Common	X	C	X	X		X	X	F	X
California myotis *Myotis californicus*		Probable Breeder Present Year Round County Abundance: Common	C	X	X			X	F		F
Silver-haired bat *Lasionycteris*		Probable Breeder Present Year Round	X					X	F		R

noctivagans		County Abundance: Common									

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Big brown bat *Eptesicus fuscus*		Probable Breeder Present Year Round County Abundance: Common	X	X	F			F	F	F	F
Hoary bat *Lasiurus cinereus*		Probable Breeder Seasonally Present County Abundance: Common			X			X	X		X
Pacific W. big-eared bat *Plecotus townsendii*	FC, SC	Confirmed Breeder Present Year Round County Abundance: Rare		X		X		X	X		X
Pacific pallid bat *Antrozous pallidus pacificus*	SV	Confirmed Breeder Present Year Round County Abund: Uncommon	C	X	X	X					
Brazilian free-tailed bat *Tadarida brasiliensis*		Possible Breeder Present Year Round County Abund: Uncommon		F		X		X	X		
Pika *Ochotona princeps*		Probable Breeder Present Year Round County Abund.: Uncommon		X				X	X		
Nuttall's cottontail *Sylvilagus nuttalli*	→	Probable Breeder Present Year Round		R	F	X	X	X		F	

		County Abundance: Common									

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Snowshoe hare *Lepus americanus*		Probable Breeder Present Year Round County Abundance: Common					X	X	X		X
White-tailed jackrabbit *Lepus townsendii*	SV	Possible Breeder Present Year Round County Abund: Rare				X	F			F	
Black-tailed jackrabbit *Lepus californicus*	→	Confirmed Breeder Present Year Round County Abund: Common				X	X	F		F	
Mountain beaver *Aplodontia rufa*		Confirmed Breeder Present Year Round County Abund: Uncommon		R					X		X
Least chipmunk *Tamias minimus*	→	Confirmed Breeder Present Year Round County Abund: Common		C		X		S		F	
Yellow-pine chipmunk *Tamias amoenus*	→	Confirmed Breeder Present Year Round County Abundance: Common		X			X	X		F	S
Allen's chipmunk *Tamias senex*		Possible Breeder Present Year Round						X			

		County Abund: Uncommon									

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Yellow-bellied marmot *Marmota flaviventris*	→	Confirmed Breeder Present Year Round County Abundance: Common		X				X	X	F	
Belding's ground squirrel *Spermophilus beldingi*		Confirmed Breeder Present Year Round County Abund: Common	X		X					X	
California ground squirrel *Spermophilus beecheyi*	→	Confirmed Breeder Present Year Round County Abund: Common				X				X	
Golden-mantled ground squirrel *Spermophilus lateralis*	→	Confirmed Breeder Present Year Round County Abundance: Common	C	X	X	X	X	X	X		X
Western gray squirrel *Sciurus griseus*	→ G	Confirmed Breeder Present Year Round County Abundance: Common						X			
Douglas' squirrel *Tamiasciurus douglasii*	→	Confirmed Breeder Present Year Round County Abundance: Abundant	X					X	X	F	X
Northern flying squirrel *Glaucomys sabrinus*	→	Confirmed Breeder Present Year Round	X		X			X	X	F	X

		County Abund.: Uncommon									

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Botta's pocket gopher *Thomomys bottae*		Probable Breeder Present Year Round County Abund: Uncommon			X					F	
Northern pocket gopher *Thomomys talpoides*	→	Confirmed Breeder Present Year Round County Abundance: Abundant	X		X	X	X	X	X	X	X
Western pocket gopher *Thomomys mazama*		Probable Breeder Present Year Round County Abundance: Common	X		X					X	
Great Basin pocket mouse *Perognathus parvus*		Probable Breeder Present Year Round County Abund: Uncommon		X		X	X			X	
Heermann's kangaroo rat *Dipodomys heermanni*		Possible Breeder Present Year Round County Abund: Rare				X	X				
Beaver *Castor canadensis*	→ G	Confirmed Breeder Present Year Round County Abundance: Abundant	S		X			X	X	X	X
Western harvest mouse *Reithrodontomys*		Probable Breeder Present Year Round			X					X	

megalotis		County Abundance: Common									

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Deer mouse *Peromyscus maniculatus*	→	Confirmed Breeder Present Year Round County Abundance: Abundant	X	X	X	X	X	X	X	X	X
Pinon mouse *Peromyscus truei*		Probable Breeder Present Year Round County Abundance: Common	X	X		X	X	X			X
Northern grasshopper mouse *Onychomys leucogaster*		Probable Breeder Present Year Round County Abundance: Common				X	X			X	
Dusky-footed woodrat *Neotoma fuscipes*	→	Confirmed Breeder Present Year Round County Abund: Common		X	X		X	X	X	X	X
Bushy-tailed woodrat *Neotoma cinerea*		Confirmed Breeder Present Year Round County Abundance: Common		X	X	X	S	X	X		X
Western red-backed vole *Clethrionomys californicus*		Probable Breeder Present Year Round County Abund: Common						X	X		X
Heather vole *Phenacomys*		Probable Breeder Present Year Round	C					X	X	X	

intermedius		County Abund: Uncommon									

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Montane vole *Microtus montanus*		Probable Breeder Present Year Round County Abundance: Abundant		R	X					X	
Long-tailed vole *Microtus longicaudus*		Probable Breeder Present Year Round County Abundance: Common	X		X		X	X	S	X	S
Creeping vole *Microtus oregoni*		Probable Breeder Present Year Round County Abundance: Common	X		X				X		X
Water vole *Microtus richardsoni*		Probable Breeder Present Year Round County Abundance: Abundant			X					X	
Muskrat *Ondatra zibethicus*	G	Confirmed Breeder Present Year Round County Abundance: Abundant			X					X	
Western jumping mouse *Zapus princeps*		Probable Breeder Present Year Round County Abundance: Abundant	X		X					X	
Pacific jumping mouse *Zapus trinotatus*		Probable Breeder Present Year Round	X		X			X	X	X	X

		County Abundance: Common									

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Porcupine *Erethizon dorsatum*	→	Confirmed Breeder Present Year Round County Abundance: Abundant	X		X	X	X	X	X	F	X
Coyote *Canis latrans*	→	Confirmed Breeder Present Year Round County Abundance: Abundant	X	X	F	X	X	X	X	X	X
Red fox *Vulpes vulpes*	→ G	Confirmed Breeder Present Year Round County Abund: Uncommon	X	X	X			X	S	X	X
Gray fox *Urocyon cinereoargenteus*	→ G	Confirmed Breeder Present Year Round County Abund: Uncommon	X	X	X		X	X			
Black bear *Ursus americanus*	→ G	Confirmed Breeder Present Year Round County Abundance: Common	X	X	X		X	X	X	X	X
Ringtail *Bassariscus astutus*	SU	Confirmed Breeder Present Year Round County Abund: Uncommon		X	X		X	X	X		X
Raccoon *Procyon lotor*	→ G	Confirmed Breeder Present Year Round	X	R	X					F	

		County Abundance: Common									

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Marten *Martes americana*	→ SC, G	Confirmed Breeder Present Year Round County Abund: Common	X	X				X	X		X
Pacific fisher *Martes pennanti pacifica*	FC, SC, G	Probable Breeder Present Year Round County Abund: Rare	X	X				X	X		X
Ermine *Mustela erminea*	→	Confirmed Breeder Present Year Round County Abundance: Common		X	X			X	X	X	X
Long-tailed weasel *Mustela frenata*	→	Confirmed Breeder Present Year Round County Abundance: Common	F	X	X	X	X	X	X	X	X
Mink *Mustela vison*	→ G	Confirmed Breeder Present Year Round County Abundance: Common	X	X	X			X	S	F	S
California wolverine *Gulo gulo luteus*	FC, ST	Confirmed Breeder Present Year Round County Abundance: Rare		X				X	X		X
Badger *Taxidea taxus*	→	Confirmed Breeder Present Year Round	X	X	X	X	S	X		X	

		County Abundance: Common									

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Western spotted skunk *Spilogale gracilis*		Confirmed Breeder Present Year Round County Abund: Uncommon	X	X	X			X	X	X	X
Striped skunk *Mephitis mephitis*	→	Confirmed Breeder Present Year Round County Abundance: Common	X	R	X		X			X	
River otter *Lutra canadensis*	G	Confirmed Breeder Present Year Round County Abundance: Common			X			X	S		S
Bobcat *Felis rufus*	→ G	Confirmed Breeder Present Year Round County Abundance: Common	X	X	X	X	X	X	X	X	X
Mountain lion *Felis concolor*	→ G	Confirmed Breeder Present Year Round County Abund.: Uncommon		X	X			X	X		X

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Elk *Cervus elaphus*	→ G	Confirmed Breeder Present Year Round County Abundance: Common	X		X			X	F	X	X
Black-tailed deer *Odocoileus hemionus hemionus*	→ G	Confirmed Breeder Present Year Round County Abundance: Abundant	X		X	X	X	X	X	X	X
Mule deer *Odocoileus hemionus*	→ G	Confirmed Breeder Present Year Round County Abundance: Abundant	X		X	X	X	X	X	X	X
Pronghorn *Antilocapra americana*	→ G	Confirmed Breeder Present Year Round County Abundance: Common				X					

Appendix G

Fish: Species List, Status, and Habitat

This appendix lists species of fish that are known to be present or are likely to occur on state forest lands in Klamath-Lake District. The information was compiled by the Oregon Natural Heritage Program (ONHP), for the Oregon Department of Forestry. Biologists from the Oregon Department of Fish and Wildlife reviewed the information.

The species list was generated from a combination of recognized sources, including ONHP's data information systems, the Oregon Department of Fish and Wildlife's OSIS database, the Oregon Department of Forestry's forest stands database for the Klamath-Lake District, and a literature search. A complete list of sources is included in ONHP's report to the Department of Forestry (Oregon Natural Heritage Program 1994). ONHP developed an initial, working list of species in Klamath County from their data information systems, including their EMAP database, which has statewide distribution information about vertebrate species; and their Vertebrate Characterization Abstracts (VCA) database. Next, ONHP identified habitat categories on state forest lands in Klamath-Lake District, using the district's forest stands database. They then revised the working list to include only those species found in habitat types that occurred on state forest lands in the district.

The common names of the fish are given first, followed by the scientific name in italics. Three categories of information are provided for each species: protection status, breeding status and relative abundance in Klamath County, and habitat information. These categories are discussed briefly below.

Protection Status

The "Status" column provides information about whether a species is listed as threatened, endangered, candidate, sensitive, or other special status. The column includes both federal and state status information. This column also notes if a species is classified as a game species in Oregon, and if it is an introduced species (not native to Oregon). The protection status information was taken from three sources: ONHP's publication "Rare, Threatened, and Endangered Plants and Animals of Oregon"; ONHP's species tracking database; and the Oregon Department of Fish and Wildlife's "Wildlife Diversity Plan."

The following protection status codes are used.

FE Federally endangered, under the federal Endangered Species Act

FT Federally threatened, under the federal Endangered Species Act

FC Federal candidate, under the federal Endangered Species Act

SE State endangered, under the Oregon Endangered Species Act

ST State threatened, under the Oregon Endangered Species Act

SC State critical — species for which listing as threatened or endangered is pending, or may be appropriate if immediate conservation actions are not taken.

SV State vulnerable — species for which listing as threatened or endangered is not believed to be imminent, and can be avoided through continued or expanded protective measures and monitoring.

SP State peripheral or naturally rare — species whose Oregon populations are on the edge of the range, or those species that have had historically low populations because of naturally occurring limiting factors.

SU State unknown — state status is unclear. These species may be susceptible to population declines of sufficient magnitude that they could qualify for one of the state status categories above, but scientific study will be required before a judgment can be made.

→ Species is known to occur on state forest lands in Klamath-Lake District, based on sightings or documentation by the Oregon Department of Fish and Wildlife, or information in ONHP's databases, or letters from Craig Bienz of the Klamath Tribe (letters provided by the Oregon Department of Forestry).

G State game animal

I Introduced species (not native to Oregon)

Breeding Status and Abundance in Klamath County

The "Breeding Status / Abundance" column provides information about the breeding status of the species in Klamath County, and also about the relative abundance of the species in Klamath County. The information for this column was generated from data contained in ONHP's EMAP and VCA databases, and the Oregon Department of Fish and Wildlife's OSIS database.

Breeding status is described with the following three terms.

Confirmed breeder	Breeding documented in Klamath County.
Probable breeder	Based on available habitat, the species probably breeds in Klamath County, though ONHP does not have documentation of it.
Possible breeder	Species may breed in Klamath County, but there is little available habitat, or the species is particularly rare in the county.

The description of abundance in Klamath County is based on a relative scale. Species were rated as abundant, common, uncommon, rare, or irregular. The “irregular” designation is used for species that are occasionally seen in the county, but are not considered part of the usual fauna. Specific documentation concerning the presence and/or abundance of a species on a specific tract of state forest land is not available, due to a lack of field surveys on those lands.

Habitat Information

ONHP developed 9 habitat categories for terrestrial species, through an assessment and synthesis of various sources. These categories are described in Appendices F, H, and I. For fish, only one habitat category is available on state forest lands. That category is resident stream habitat. The Klamath-Lake District state forest lands do not have any lakes or provide any habitat for anadromous fish species.

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Category Resident Stream Habitat
Rainbow trout *Oncorhyncus mykiss*	→ G	Confirmed Breeder Present Year Round County Abundance: Common	X
Brown trout *Salmo trutta*	→ G, I	Confirmed Breeder Present Year Round County Abundance: Common	X
Bull trout *Salvelinus confluentus*	FC, SC G	Confirmed Breeder Present Year Round County Abundance: Common	X
Brook trout *Salvelinus fontinalis*	→ G, I	Confirmed Breeder Present Year Round County Abundance: Common	X
Speckled dace *Rhinichthys osculus*		Confirmed Breeder Present Year Round County Abundance: Common	X

Appendix H

Birds: Species List, Status, and Habitat

This appendix lists species of birds that are known to be present or are likely to occur on state forest lands in Klamath-Lake District. The information was compiled by the Oregon Natural Heritage Program (ONHP), for the Oregon Department of Forestry. Biologists from the Oregon Department of Fish and Wildlife reviewed the information.

The species list was generated from a combination of recognized sources, including ONHP's data information systems, the Oregon Department of Fish and Wildlife's OSIS database, the Oregon Department of Forestry's forest stands database for the Klamath-Lake District, and a literature search. A complete list of sources is included in ONHP's report to the Department of Forestry (Oregon Natural Heritage Program 1994). ONHP developed an initial, working list of species in Klamath County from their data information systems, including their EMAP database, which has statewide distribution information about vertebrate species; and their Vertebrate Characterization Abstracts (VCA) database. Next, ONHP identified habitat categories on state forest lands in Klamath-Lake District, using the district's forest stands database. They then revised the working list to include only those species found in habitat types that occurred on state forest lands in the district.

The common names of the birds are given first, followed by the scientific name in italics. Three categories of information are provided for each species: protection status, breeding status and relative abundance in Klamath County, and habitat information. These categories are discussed briefly below.

Protection Status

The "Status" column provides information about whether a species is listed as threatened, endangered, candidate, sensitive, or other special status. The column includes both federal and state status information. This column also notes if a species is classified as a game species in Oregon, and if it is an introduced species (not native to Oregon). The protection status information was taken from three sources: ONHP's publication "Rare, Threatened, and Endangered Plants and Animals of Oregon"; ONHP's species tracking database; and the Oregon Department of Fish and Wildlife's "Wildlife Diversity Plan."

The following protection status codes are used.

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FC Federal candidate, under the federal Endangered Species Act

SE State endangered, under the Oregon Endangered Species Act

ST State threatened, under the Oregon Endangered Species Act

SC State critical — species for which listing as threatened or endangered is pending, or may be appropriate if immediate conservation actions are not taken.

SV State vulnerable — species for which listing as threatened or endangered is not believed to be imminent, and can be avoided through continued or expanded protective measures and monitoring.

SP State peripheral or naturally rare — species whose Oregon populations are on the edge of the range, or those species that have had historically low populations because of naturally occurring limiting factors.

SU State unknown — state status is unclear. These species may be susceptible to population declines of sufficient magnitude that they could qualify for one of the state status categories above, but scientific study will be required before a judgment can be made.

→ Species is known to occur on state forest lands in Klamath-Lake District, based on sightings or documentation by the Oregon Department of Fish and Wildlife, or information in ONHP's databases, or letters from Craig Bienz of the Klamath Tribe (letters provided by the Oregon Department of Forestry).

G State game animal

I Introduced species (not native to Oregon)

Breeding Status and Abundance in Klamath County

The "Breeding Status / Abundance" column provides information about the breeding status of the species in Klamath County, and also about the relative abundance of the species in Klamath County. The information for this column was generated from data contained in ONHP's EMAP and VCA databases, and the Oregon Department of Fish and Wildlife's OSIS database.

Breeding status is described with the following three terms.

Confirmed breeder	Breeding documented in Klamath County.
Probable breeder	Based on available habitat, the species probably breeds in Klamath County, though ONHP does not have documentation of it.
Possible breeder	Species may breed in Klamath County, but there is little available habitat, or the species is particularly rare in the county.

The description of abundance in Klamath County is based on a relative scale. Species were rated as abundant, common, uncommon, rare, or irregular. The "irregular" designation is used for species that are occasionally seen in the county, but are not considered part of the usual fauna. Specific documentation concerning the presence and/or abundance of a species on a specific tract of state forest land is not available, due to a lack of field surveys on those lands. However, a reader can make predictions by looking at the abundance of a species in Klamath County, and the presence on state forest lands of habitat types used by that species. For example, the long-toed salamander is abundant in Klamath County. It uses several forest types that are common on state forest lands in Klamath County. Based on this information, a person could predict that the long-toed salamander is abundant on state forest lands. The Cascade frog, on the other hand, is common in Klamath County, but uses wetland habitats. Since there are few wetlands on state forest lands in Klamath County, one would not expect the Cascade frog to be common on state forest lands. Similar predictions can be made for the bird species in this appendix.

Habitat Information

ONHP developed 9 habitat categories through an assessment and synthesis of various sources. First, they reviewed the forest associations in the Klamath-Lake District's forest stands database. They then added additional habitat types that they expected to be present on the state forest lands, including wetland, riparian, talus/scree/outcrop. ONHP also reviewed the 140 vegetation types found statewide, listed in the Oregon Department of Fish and Wildlife's OSIS database. These vegetation types are described in Kagan and Caicco (1992). After assessing these sources, plus using their own knowledge of state forest lands, ONHP then identified 27 habitat types that occur on state forest lands in Klamath County. Finally, they distilled these 27 types into 8 habitat categories, and added a ninth category for talus, cliffs, and rocky areas. Each category is described briefly below.

Snags, Litter, Duff	Recent timber harvest areas, snags, downed wood.
Talus, Cliffs, Rocky Areas	Caves, quarry operations, talus, scree, outcrops.
Wetland, Riparian Areas	Riparian zones, open water, rivers.
Sagebrush	Low shrub communities dominated by big sagebrush, low sagebrush, or mountain big sagebrush.
Chaparral	Tall shrub community with closed canopy dominated by serviceberry, bitterbrush, bittercherry, snowbrush, or mountain brush.
Pine Forest	Forests dominated by ponderosa or lodgepole pine.
Fir Forest	Fir-dominated forests.
Grasses, Forbs, Meadows	Areas of open grass or forbs.
Mixed forest	Montane forests with canopies ranging from open to closed, with numerous co-dominant conifers.

The habitat listings for each species are based on information from ONHP's VCA database, and the Oregon Department of Fish and Wildlife's OSIS database and Wildlife Diversity Plan. The codes used in the habitat listings are defined below.

X Species breeds and feeds in this habitat.

R Species reproduces in this habitat.

F Species feeds in this habitat.

C Species uses this habitat for cover.

P Species uses this habitat for perching.

S This category is secondary habitat for this species.

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Pied-billed grebe *Podilymbus podiceps*		Confirmed Breeder Present Year Round County Abundance: Common			X						
Great blue heron *Ardea herodias*		Confirmed Breeder Present Year Round County Abundance: Common			X					X	
Canada goose *Branta canadensis*	→ G	Confirmed Breeder Present Year Round County Abundance: Abundant	R		X					X	
Wood duck *Aix sponsa*	→ G	Confirmed Breeder Present Year Round County Abundance: Common	R		X				X		X
Mallard *Anas platyrhynchos*	→ G	Confirmed Breeder Present Year Round County Abundance: Abundant			X		F			X	
Cinnamon teal *Anas cyanoptera*	G	Confirmed Breeder Present Year Round County Abundance: Abundant			X		F			X	
Common merganser *Mergus merganser*	G	Confirmed Breeder Present Year Round County Abund: Uncommon	R		X			R	R		

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Turkey vulture *Cathartes aura*	→	Confirmed Breeder Seasonally Present County Abundance: Common	F	R	F	X	F	X	X	F	X
Osprey *Pandion haliaetus*		Confirmed Breeder Seasonal County Abund: Uncommon	R		F				X		X
Bald eagle *Haliaeetus leucocephalus*	→ FT, ST	Confirmed Breeder Present Year Round County Abundance: Abundant	X		F			X	X		X
Northern harrier *Circus cyaneus*		Confirmed Breeder Present Year Round County Abundance: Common	F		X	S	S			X	
Sharp-shinned hawk *Accipiter striatus*	→	Confirmed Breeder Present Year Round County Abund: Common	F			F	F,S	X	X		X
Cooper's hawk *Accipiter cooperii*	→	Confirmed Breeder Present Year Round County Abund: Common	F			F	F	X	X		X
Northern goshawk *Accipiter gentilis*	→ FC, SC	Confirmed Breeder Present Year Round County Abund.: Uncommon	F		F		F	X	X		S

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Red-tailed hawk *Buteo jamaicensis*	→	Confirmed Breeder Present Year Round County Abundance: Common	F	X		X	F	X	X	F	X
Golden eagle *Aquila chrysaetos*	→	Confirmed Breeder Present Year Round County Abund: Common	F	R	F	X	F	X	X	F	X
American kestrel *Falco sparverius*	→	Confirmed Breeder Present Year Round County Abundance: Common	X	X	F	F	F	X	X	F	S
Merlin *Falco columbarius*		Non Breeder Seasonally Present County Abundance: Rare	F		F		S		F	F	
American peregrine falcon *Falco peregrinus anatum*	→ FE, SE	Confirmed Breeder Present Year Round County Abundance: Rare	F	X			F	F	F		F
Prairie falcon *Falco mexicanus*		Confirmed Breeder Seasonally Present County Abund: Uncommon	F	X	F	X	F,S			F	
Blue grouse *Dendragapus obscurus*	→ G	Confirmed Breeder Present Year Round County Abund: Common	F		F	X	X	X	X	F	X

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			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Ruffed grouse *Bonansa umbellus*	→ G	Confirmed Breeder Present Year Round County Abund: Uncommon	F		F	X	X	X	X	F	S
California quail *Callipepla californica*	→ G	Confirmed Breeder Present Year Round County Abundance: Common	X		X	X				X	
Mountain quail *Oreortyx pictus*	→ FC, G	Confirmed Breeder Present Year Round County Abund.: Uncommon	X			X	X	X	X	X	X
American coot *Fulica americana*	G	Confirmed Breeder Present Year Round County Abundance: Abundant			X					F	
Greater sandhill crane *Grus canadensis*	SV	Confirmed Breeder Seasonally Present County Abundance: Common			X					X	
Killdeer *Charadrius vociferus*		Confirmed Breeder Seasonally Present County Abundance: Common		S	X					X	
Willet *Catoptrophorus semipalmatus*		Confirmed Breeder Seasonally Present County Abundance: Common			X					X	

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			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Spotted sandpiper *Actitis macularia*		Confirmed Breeder Seasonally Present County Abund: Common			X					X	
Common snipe *Gallinago gallinago*	G	Confirmed Breeder Seasonally Present County Abundance: Common			X					X	
Rock dove *Columba livia*	I	Confirmed Breeder Present Year Round County Abundance: Abundant		R						F	
Mourning dove *Zenaida macroura*	→ G	Confirmed Breeder Seasonally Present County Abundance: Common	F		F	X	X	X	X	F	X
Barn owl *Tyto alba*		Confirmed Breeder Present Year Round County Abundance: Common	F	R	F					F	
Flammulated owl *Otus flammeolus*	→ SC	Confirmed Breeder Present Year Round County Abund: Uncommon	R					X	X	F	
Western screech-owl *Otus kennicottii*		Confirmed Breeder Present Year Round County Abund: Uncommon	F		X			X	X	F	X

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Great horned owl *Bubo virginianus*	→	Confirmed Breeder Present Year Round County Abundance: Common	F	R	X	F	F	X	X	F	X
Northern pygmy-owl *Glaucidium gnoma*	→ SU	Confirmed Breeder Present Year Round County Abund: Common	F		X			X	X		X
Northern spotted owl *Strix occidentalis caurina*	→ FT, ST	Confirmed Breeder Present Year Round County Abund: Uncommon						X	X		X
Great gray owl *Strix nebulosa*	→ SV	Confirmed Breeder Present Year Round County Abund: Uncommon	F					X	X	F	X
Long-eared owl *Asio otus*	→	Confirmed Breeder Present Year Round County Abund: Uncommon			X		S			F	X
Northern saw-whet owl *Aegolius acadius*		Probable Breeder Present Year Round County Abund: Uncommon	F		F			X	X		X
Common nighthawk *Chordeiles minor*	→	Confirmed Breeder Seasonally Present County Abundance: Common	X	R	F	X	X	X	X	F	X

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Common poorwill *Phalaenoptilus nuttallii*		Confirmed Breeder Seasonally Present County Abund: Uncommon		X	F	X	X	X	X	F	X
Vaux's swift *Chaetura vauxi*	→	Confirmed Breeder Seasonally Present County Abund: Uncommon	F	F	X			X	X		X
Anna's hummingbird *Calypte anna*	→	Confirmed Breeder Seasonally Present County Abundance: Common	X		F	F	X	X	X	F	X
Calliope hummingbird *Stellula calliope*	→	Confirmed Breeder Seasonally Present County Abund: Uncommon	F		X			X	X	F	X
Rufous hummingbird *Selasphorus rufus*	→	Confirmed Breeder Seasonally Present County Abund: Uncommon	X		F	F	X	X	X	F	X
Belted kingfisher *Ceryle alcyon*	→	Confirmed Breeder Present Year Round County Abund: Common	S		X					F	
Lewis' woodpecker *Melanerpes lewis*	SC	Confirmed Breeder Present Year Round County Abund: Uncommon	X		X	S	S	S		S	S

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Yellow-bellied sapsucker *Sphyrapicus varius*		Possible Breeder Present Year Round County Abund: Irregular	X		X						
Red-breasted sapsucker *Sphyrapicus ruber*	→	Confirmed Breeder Present Year Round County Abundance: Common	X		X			X	X		X
Williamson's sapsucker *Sphyrapicus thyroideus*	→ SU	Confirmed Breeder Present Year Round County Abund: Uncommon	X		X			X	X		S
Downy woodpecker *Picoides pubescens*		Confirmed Breeder Present Year Round County Abund: Common	F		X						S
Hairy woodpecker *Picoides villosus*	→	Confirmed Breeder Present Year Round County Abund: Common	X		X			X	X		X
White-headed woodpecker *Picoides albolarvatus*	→ SC	Confirmed Breeder Present Year Round County Abund: Uncommon	F					X	X		X
Three-toed woodpecker *Picoides tridactylis*	SC	Confirmed Breeder Present Year Round County Abundance: Rare	X					X	X		X

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Black-backed woodpecker *Picoides arcticus*	→ SC	Confirmed Breeder Present Year Round County Abund: Uncommon	X					X	X		S
Northern flicker *Colaptes auratus*	→	Confirmed Breeder Present Year Round County Abundance: Common	X		X	F	F	X	X	F	X
Pileated woodpecker *Dryocopus pileatus*	→ SC	Confirmed Breeder Present Year Round County Abund: Uncommon	X					X	X		X
Olive-sided flycatcher *Contopus borealis*		Confirmed Breeder Seasonally Present County Abund: Uncommon	F					X	X		X
Western wood-pewee *Contopus sordidulus*	→	Confirmed Breeder Seasonally Present County Abundance: Common	F		X	X	F	X	X	F	X
Willow flycatcher *Empidonax traillii*	→	Confirmed Breeder Seasonally Present County Abundance: Common	X		X	F	X				
Hammond's flycatcher *Empidonax hammondii*		Confirmed Breeder Seasonally Present County Abundance: Common						X	X		X

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Dusky flycatcher *Empidonax oberholseri*	→	Confirmed Breeder Seasonally Present County Abundance: Common	F		X	X	X	X	X		X
Pacific Slope flycatcher *Empidonax difficilis*		Probable Breeder Seasonally Present County Abund: Uncommon	F		F		X	X	X		X
Say's phoebe *Sayornis saya*		Probable Breeder Seasonally Present County Abund: Uncommon	S	X				F	F		
Ash-throated flycatcher *Myiarchus cinerascens*		Confirmed Breeder Seasonally Present County Abund: Uncommon	R		X	X	X	F	F		
Western kingbird *Tyrannus verticalis*	→	Confirmed Breeder Seasonally Present County Abundance: Common	S		X	F		F		S	
Horned lark *Eremophila alpestris*	SU	Confirmed Breeder Present Year Round County Abundance: Common			F	X	X	F,S		F	
Purple martin *Progne subis*	SC	Probable Breeder Seasonally Present County Abundance: Rare	F		X		F	X	X		X

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Tree swallow *Tachycineta bicolor*	→	Confirmed Breeder Seasonally Present County Abundance: Common	X		X	F	F	X	X		X
Violet-green swallow *Tachycineta thalassina*		Confirmed Breeder Seasonally Present County Abundance: Common	F	X	X	F	F	F	F	F	F
N. rough-winged swallow *Stelgidopterix serripennis*		Confirmed Breeder Seasonally Present County Abundance: Common		R	X	F	F	S		F	
Bank swallow *Riparia riparia*	SU	Confirmed Breeder Seasonally Present County Abund.: Uncommon		R	X	F	F	S		F	
Cliff swallow *Hirundo pyrrhonota*		Confirmed Breeder Seasonally Present County Abundance: Abundant		R	X	F	F			F	
Barn swallow *Hirundo rustica*		Confirmed Breeder Seasonally Present County Abundance: Abundant	X		F	F	F				
Gray jay *Perisoreus canadensis*	→	Confirmed Breeder Present Year Round County Abundance: Common						X	X		X

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Steller's jay *Cyanocitta stelleri*	→	Confirmed Breeder Present Year Round County Abundance: Common	F			F	F	X	X		X
Scrub jay *Aphelocoma coerulescens*		Confirmed Breeder Present Year Round County Abund: Common	X		X		X	X	S		S
Pinyon jay *Gymnorhinus cyanocephalus*		Possible Breeder Present Year Round County Abundance: Rare					F	X			
Clark's nutcracker *Nucifraga columbiana*	→	Known Breeder Present Year Round County Abundance: Common	F				F	X	F		X
Black-billed magpie *Pica pica*		Confirmed Breeder Present Year Round County Abundance: Common		F	X	X				F	
American crow *Corvus brachyrhynchos*		Confirmed Breeder Present Year Round County Abundance: Common	F		X	X	F			F	
Common raven *Corvus corax*	→	Confirmed Breeder Present Year Round County Abund: Common	F	X	X	X	F	X	X	F	X

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Black-capped chickadee *Parus atricapillus*		Confirmed Breeder Present Year Round County Abund.: Uncommon	X		X		F				S
Mountain chickadee *Parus gambeli*	→	Confirmed Breeder Present Year Round County Abundance: Common	X		X	F	F	X	X		X
Chestnut-backed chickadee *Parus rufescens*		Probable Breeder Present Year Round County Abund: Uncommon	X		X			X	X		X
Plain titmouse *Parus inornatus*		Probable Breeder Present Year Round County Abund: Uncommon	X				F				
Bushtit *Psaltriparus minimus*	→	Confirmed Breeder Present Year Round County Abund: Common	F		X	X	X				
Red-breasted nuthatch *Sitta canadensis*	→	Confirmed Breeder Present Year Round County Abundance: Abundant	X					X	X		X
White-breasted nuthatch *Sitta carolinensis*	→	Confirmed Breeder Present Year Round County Abundance: Common	X					X	X		X

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			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Pygmy nuthatch *Sitta pygmaea*	SV	Confirmed Breeder Present Year Round County Abundance: Abundant	X					X	X		X
Brown creeper *Certhia americana*	→	Confirmed Breeder Present Year Round County Abund: Uncommon	X		F			X	X		X
Rock wren *Salpinctes obsoletus*		Confirmed Breeder Present Year Round County Abundance: Common	X	X		X	X				
Canyon wren *Catherpes mexicanus*		Confirmed Breeder Present Year Round County Abund: Uncommon	S	X		X	X				
Bewick's wren *Thryomanes bewickii*		Probable Breeder Present Year Round County Abundance: Rare	R		X		X				
House wren *Troglodytes aedon*		Confirmed Breeder Seasonally Present County Abundance: Common	X		X		X				
Winter wren *Troglodytes troglodytes*		Confirmed Breeder Present Year Round County Abund: Uncommon	X		X		X		X		X

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			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Marsh wren *Cistothorus palustris*		Confirmed Breeder Present Year Round County Abundance: Abundant			X						
American dipper *Cinclus mexicanus*	→	Confirmed Breeder Present Year Round County Abund: Uncommon			X						
Golden-crowned kinglet *Regulus satrapa*	→	Confirmed Breeder Present Year Round County Abund: Uncommon			F			S	X		X
Ruby-crowned kinglet *Regulus calendula*	→	Confirmed Breeder Present Year Round County Abundance: Common	F		F		F	S	X	F	X
Western bluebird *Sialia mexicana*	→	Confirmed Breeder Present Year Round County Abund: Uncommon	X							X	
Mountain bluebird *Sialia currucoides*	→ SV	Confirmed Breeder Present Year Round County Abundance: Common	X		F		F	X	X	X	X
Townsend's solitaire *Myadestes townsendi*	→	Confirmed Breeder Present Year Round County Abund: Common	X		F		X	X	X	F	X

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			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Swainson's thrush *Catharus ustulatus*		Confirmed Breeder Seasonally Present County Abundance: Common	F		X		X	X	X		X
Hermit thrush *Catharus guttatus*		Probable Breeder Seasonally Present County Abundance: Common	F		F	S	X	S	X		X
American robin *Turdus migratorus*	→	Confirmed Breeder Present Year Round County Abundance: Abundant	X		X			F	X	F	X
Varied thrush *Ixoreus naevius*		Confirmed Breeder Seasonally Present County Abund: Uncommon			F		F		X	F	X
Wrentit *Chamaea fasciata*		Probable Breeder Present Year Round County Abundance: Rare					X		X	F	X
Sage thrasher *Oreoscoptes montanus*		Confirmed Breeder Seasonally Present County Abundance: Common				X	X				
American pipit (water pipit) *Anthus rubescens*		Probably Breeder Seasonally Present County Abund: Uncommon			F					F	

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Cedar waxwing *Bombycilla cedrorum*	→	Probable Breeder Present Year Round County Abund: Uncommon	F		X			F	X		X
Northern shrike *Lanius excubitor*		Probable Breeder Seasonally Present County Abund: Uncommon	F		F	F	F				
Loggerhead shrike *Lanius ludovicianus*	FC	Confirmed Breeder Seasonally Present County Abund: Uncommon				X	X				
Solitary vireo *Vireo solitarius*	→	Confirmed Breeder Seasonally Present County Abund: Uncommon	F		X		F		X		X
Warbling vireo *Vireo gilvus*		Confirmed Breeder Seasonally Present County Abundance: Common	F		X						X
Orange-crowned warbler *Vermivora celata*		Probable Breeder Seasonally Present County Abund: Uncommon	X		X	S	X				S
Nashville warbler *Vermivora ruficapilla*		Probable Breeder Seasonally Present County Abund: Uncommon	F		F		X		X	R	X

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			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Yellow warbler *Dendroica petechia*		Confirmed Breeder Seasonally Present County Abundance: Common	F		X	F	F	F	S		S
Yellow-rumped warbler *Dendroica coronata*	→	Confirmed Breeder Present Year Round County Abundance: Common	F		X		X	X	X		X
Black-throated gray warbler *Dendroica nigrescens*		Probable Breeder Seasonally Present County Abundance: Common	F		F		X	F	X		X
Townsend's warbler *Dendroica townsendii*		Probable Breeder Seasonally Present County Abund: Uncommon			X			X	X		X
MacGillivray's warbler *Oporonis tolmiei*		Probable Breeder Seasonally Present County Abund: Uncommon	X		X		X				
Common yellowthroat *Geothlypis trichas*		Confirmed Breeder Seasonally Present County Abundance: Common			X					F,S	
Wilson's warbler *Wilsonia pusilla*		Confirmed Breeder Seasonally Present County Abund: Uncommon	X		X		X		X		S

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Yellow-breasted chat *Icteria virens*		Probable Breeder Seasonally Present County Abund: Uncommon			X	X	X				
Western tanager *Piranga ludoviciana*	→	Confirmed Breeder Seasonally Present County Abundance: Common	F		F	F	F	F	X		X
Black-headed grosbeak *Pheucticus melanocephalus*	→	Confirmed Breeder Seasonally Present County Abund: Common	F		X	F	X		S		
Lazuli bunting *Passerina amoena*		Probable Breeder Seasonally Present County Abund: Uncommon	F		X	X	X	S	S	F	
Green-tailed towhee *Pipilo chlorurus*		Confirmed Breeder Seasonally Present County Abundance: Common				X	X			F	
Rufous-sided towhee *Pipilo erythrophtalmus*	→	Confirmed Breeder Present Year Round County Abund: Common	F		X	X	X				
American tree sparrow *Spizella arborea*		Non Breeder Seasonally Present County Abund: Irregular			F	F	F			F	

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Chipping sparrow *Spizella passerina*	→	Confirmed Breeder Seasonally Present County Abundance: Common				X	X	X	X	F	X
Brewer's sparrow *Spizella breweri*		Probable Breeder Seasonally Present County Abundance: Common				X	S			F	
Vesper sparrow *Pooecetes gramineus*		Probable Breeder Seasonally Present County Abund: Uncommon				X	F			X	
Lark sparrow *Chondestes grammacus*		Probable Breeder Seasonally Present County Abund: Uncommon			F	X	F,S			X	
Sage sparrow *Amphispiza belli*		Confirmed Breeder Seasonally Present County Abundance: Common				X	S			X	
Savannah sparrow *Passerculus sandwichensis*		Confirmed Breeder Seasonally Present County Abund: Uncommon			X		F			X	
Fox sparrow *Passerella iliaca*		Confirmed Breeder Present Year Round County Abundance: Common	F		F	X	X	X	X	F	X

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			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Song sparrow *Melospiza melodia*		Confirmed Breeder Present Year Round County Abundance: Common	X		X		X			F	
Lincoln's sparrow *Melospiza lincolnii*		Probable Breeder Seasonally Present County Abundance: Common			F	F	F			X	
White-crowned sparrow *Zonotrichia leucophrys*		Confirmed Breeder Present Year Round County Abundance: Common	X		X		X			X	
Dark-eyed junco *Junco hyemalis*	→	Confirmed Breeder Present Year Round County Abundance: Abundant	S		F			X	X	X	X
Red-winged blackbird *Agelaius phoeniceus*		Confirmed Breeder Present Year Round County Abundance: Common			X					X	
Western meadowlark *Sturnella neglecta*		Confirmed Breeder Present Year Round County Abundance: Common			S	X	X			X	
Yellow-headed blackbird *Xanthocephalus xanthocephalus*		Confirmed Breeder Seasonally Present County Abund.: Uncommon			X					X	

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Brewer's blackbird *Euphagus cyanocephalus*		Confirmed Breeder Present Year Round County Abundance: Abundant			X	X	X			X	
Brown-headed cowbird *Molothrus ater*		Confirmed Breeder Present Year Round County Abund: Uncommon	X		X		X			F	
Northern oriole *Icterus galbula*	→	Confirmed Breeder Seasonally Present County Abund: Uncommon			X			F	S		
Purple finch *Carpodacus purpureus*		Confirmed Breeder Present Year Round County Abund: Uncommon	F		F	F	F	X	X	F	X
Cassin's finch *Carpodacus cassinii*		Confirmed Breeder Present Year Round County Abundance: Common	F		F		F		X	F	S
House finch *Carpodacus mexicanus*	→	Confirmed Breeder Present Year Round County Abundance: Common		X	S		X			S	
Red crossbill *Loxia curvirostra*	→	Confirmed Breeder Present Year Round County Abundance: Common	F		F				X	F	S

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Pine siskin *Carduelis pinus*	→	Confirmed Breeder Present Year Round County Abundance: Common	F		F			X	X	F	X
American goldfinch *Carduelis tristis*	→	Probable Breeder Present Year Round County Abund: Common	X		X					F	
Evening grosbeak *Coccothraustes vespertinus*	→	Confirmed Breeder Present Year Round County Abundance: Common	F		F				X	F	X

Appendix I

Amphibians and Reptiles: Species List, Status, and Habitat

This appendix lists species of amphibians and reptiles that are known to be present or are likely to occur on state forest lands in Klamath-Lake District. The information was compiled by the Oregon Natural Heritage Program (ONHP), for the Oregon Department of Forestry. Biologists from the Oregon Department of Fish and Wildlife reviewed the information.

The species list was generated from a combination of recognized sources, including ONHP's data information systems, the Oregon Department of Fish and Wildlife's OSIS database, the Oregon Department of Forestry's forest stands database for the Klamath-Lake District, and a literature search. A complete list of sources is included in ONHP's report to the Department of Forestry (Oregon Natural Heritage Program 1994). ONHP developed an initial, working list of species in Klamath County from their data information systems, including their EMAP database, which has statewide distribution information about vertebrate species; and their Vertebrate Characterization Abstracts (VCA) database. Next, ONHP identified habitat categories on state forest lands in Klamath-Lake District, using the district's forest stands database. They then revised the working list to include only those species found in habitat types that occurred on state forest lands in the district.

The common names of the amphibians and reptiles are given first, followed by the scientific name in italics. Three categories of information are provided for each species: protection status, breeding status and relative abundance in Klamath County, and habitat information. These categories are discussed briefly below.

Protection Status

The "Status" column provides information about whether a species is listed as threatened, endangered, candidate, sensitive, or other special status. The column includes both federal and state status information. This column also notes if a species is classified as a game species in Oregon, and if it is an introduced species (not native to Oregon). The protection status information was taken from three sources: ONHP's publication "Rare, Threatened, and Endangered Plants and Animals of Oregon"; ONHP's species tracking database; and the Oregon Department of Fish and Wildlife's "Wildlife Diversity Plan."

The following protection status codes are used.

FE Federally endangered, under the federal Endangered Species Act

FT Federally threatened, under the federal Endangered Species Act

FC Federal candidate, under the federal Endangered Species Act

SE State endangered, under the Oregon Endangered Species Act

ST State threatened, under the Oregon Endangered Species Act

SC State critical — species for which listing as threatened or endangered is pending, or may be appropriate if immediate conservation actions are not taken.

SV State vulnerable — species for which listing as threatened or endangered is not believed to be imminent, and can be avoided through continued or expanded protective measures and monitoring.

SP State peripheral or naturally rare — species whose Oregon populations are on the edge of the range, or those species that have had historically low populations because of naturally occurring limiting factors.

SU State unknown — state status is unclear. These species may be susceptible to population declines of sufficient magnitude that they could qualify for one of the state status categories above, but scientific study will be required before a judgment can be made.

→ Species is known to occur on state forest lands in Klamath-Lake District, based on sightings or documentation by the Oregon Department of Fish and Wildlife, or information in ONHP's databases, or letters from Craig Bienz of the Klamath Tribe (letters provided by the Oregon Department of Forestry).

G State game animal

I Introduced species (not native to Oregon)

Breeding Status and Abundance in Klamath County

The "Breeding Status / Abundance" column provides information about the breeding status of the species in Klamath County, and also about the relative abundance of the species in Klamath County. The information for this column was generated from data contained in ONHP's EMAP and VCA databases, and the Oregon Department of Fish and Wildlife's OSIS database.

Breeding status is described with the following three terms.

Confirmed breeder	Breeding documented in Klamath County.
Probable breeder	Based on available habitat, the species probably breeds in Klamath County, though ONHP does not have documentation of it.
Possible breeder	Species may breed in Klamath County, but there is little available habitat, or the species is particularly rare in the county.

The description of abundance in Klamath County is based on a relative scale. Species were rated as abundant, common, uncommon, rare, or irregular. The "irregular" designation is used for species that are occasionally seen in the county, but are not considered part of the usual fauna. Specific documentation concerning the presence and/or abundance of a species on a specific tract of state forest land is not available, due to a lack of field surveys on those lands. However, a reader can make predictions by looking at the abundance of a species in Klamath County, and the presence on state forest lands of habitat types used by that species. For example, the long-toed salamander is abundant in Klamath County. It uses several forest types that are common on state forest lands in Klamath County. Based on this information, a person could predict that the long-toed salamander is abundant on state forest lands. The Cascade frog, on the other hand, is common in Klamath County, but uses wetland habitats. Since there are few wetlands on state forest lands in Klamath County, one would not expect the Cascade frog to be common on state forest lands. Similar predictions can be made for the other species in this appendix.

Habitat Information

ONHP developed 9 habitat categories through an assessment and synthesis of various sources. First, they reviewed the forest associations in the Klamath-Lake District's forest stands database. They then added additional habitat types that they expected to be present on the state forest lands, including wetland, riparian, talus/scree/outcrop. ONHP also reviewed the 140 vegetation types found statewide, listed in the Oregon Department of Fish and Wildlife's OSIS database. These vegetation types are described in Kagan and Caicco (1992). After assessing these sources, plus using their own knowledge of state forest lands, ONHP then identified 27 habitat types that occur on state forest lands in Klamath County. Finally, they distilled these 27 types into 8 habitat categories, and added a ninth category for talus, cliffs, and rocky areas. Each category is described briefly below.

Snags, Litter, Duff	Recent timber harvest areas, snags, downed wood.
Talus, Cliffs, Rocky Areas	Caves, quarry operations, talus, scree, outcrops.
Wetland, Riparian Areas	Riparian zones, open water, rivers.
Sagebrush	Low shrub communities dominated by big sagebrush, low sagebrush, or mountain big sagebrush.
Chaparral	Tall shrub community with closed canopy dominated by serviceberry, bitterbrush, bittercherry, snowbrush, or mountain brush.
Pine Forest	Forests dominated by ponderosa or lodgepole pine.
Fir Forest	Fir-dominated forests.
Grasses, Forbs, Meadows	Areas of open grass or forbs.
Mixed forest	Montane forests with canopies ranging from open to closed, with numerous co-dominant conifers.

The habitat listings for each species are based on information from ONHP's VCA database, and the Oregon Department of Fish and Wildlife's OSIS database and Wildlife Diversity Plan. The codes used in the habitat listings are defined below.

X Species breeds and feeds in this habitat.

R Species reproduces in this habitat.

F Species feeds in this habitat.

C Species uses this habitat for cover.

S This category is secondary habitat for this species.

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Northwestern salamander *Ambystoma gracile*		Probable Breeder Present Year Round County Abundance: Common	X		X			X	F	X	F
Long-toed salamander *Ambystoma macrodactylum*		Confirmed Breeder Present Year Round County Abundance: Abundant	X		X	X	X	X	F	X	F
Tiger salamander *Ambystoma tigrinum*	I?	Possible Breeder Present Year Round County Abund: Uncommon	X		X	X					
Ensatina *Ensatina eschscholtzii*		Probable Breeder Present Year Round County Abundance: Common	X	X	X			X	X		X
Roughskin newt *Taricha granulosa*		Confirmed Breeder Present Year Round County Abundance: Abundant	X		X	X		X	F	X	F
Tailed frog *Ascaphus truei*	SV	Probable Breeder Present Year Round County Abund: Uncommon	C		X			X	X		F
Western toad *Bufo borealis*		Confirmed Breeder Present Year Round County Abundance: Common	X		X	X	X	X	X	X	X

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Pacific treefrog *Hyla regilia*	→	Confirmed Breeder Present Year Round County Abundance: Abundant	X	C	X	X	X	X	X	X	X
Foothill yellow-legged frog *Rana boylii*	FC, SU	Probable Breeder Present Year Round County Abund: Uncommon	C		X					S	
Cascade frog *Rana cascadae*	FC, SU	Confirmed Breeder Present Year Round County Abundance: Common			X						
Bullfrog *Rana catesbeiana*	G, I	Confirmed Breeder Present Year Round County Abundance: Common			X						
Spotted frog *Rana pretiosa*	FC, SC	Confirmed Breeder Present Year Round County Abund: Uncommon			X					S	
Northwestern pond turtle *Clemmys marmorata*	FC, SC	Confirmed Breeder Present Year Round County Abund: Uncommon	X		X	X					
Northern alligator lizard *Elgaria coerulea*		Probable Breeder Present Year Round County Abundance: Common	X	X	X		X		X	X	X

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Southern alligator lizard *Elgaria multicarinata*		Probable Breeder Present Year Round County Abund: Uncommon	X	X	X		X			X	X
Short-horned lizard *Phrynosoma douglasi*		Probable Breeder Present Year Round County Abund.: Uncommon	X			X	X				
Sagebrush lizard *Sceloporus graciosus*		Probable Breeder Present Year Round County Abund: Uncommon	X	F		X	X	X	S		S
Western fence lizard *Sceloporus occidentalis*	→	Confirmed Breeder Present Year Round County Abundance: Abundant	X	X	X	X	X	X	X	X	X
Western skink *Eumeces skiltonianus*		Confirmed Breeder Present Year Round County Abundance: Common	X	C	X	X	X	X	X	X	X
Rubber boa *Charina bottae*		Confirmed Breeder Present Year Round County Abundance: Common	S	X	X	X	X	X	X	X	X
Racer *Coluber constrictor*		Confirmed Breeder Present Year Round County Abundance: Abundant	X	X	X	X	X			X	

Species	Status	Breeding Status and Abundance in Klamath County	Habitat Categories								
			Snags, Litter, Duff	Talus, Cliffs, Rocky Areas	Wetland, Riparian Areas	Sage-brush	Cha-parral	Pine Forest	Fir Forest	Grasses, Forbs, Meadows	Mixed Forest
Ringneck snake *Diadophis punctatus*		Confirmed Breeder Present Year Round County Abund: Uncommon	X	F	X		X	X		X	
Striped whipsnake *Masticophis taeniatus*		Probable Breeder Present Year Round County Abund: Uncommon		X		X	X				
Gopher snake *Pituophis melanoleucus*		Confirmed Breeder Present Year Round County Abundance: Common	X	X	X	X	X	X	X	F	
W. terrestrial garter snake *Thamnophis elegans*		Confirmed Breeder Present Year Round County Abundance: Common	X		X					X	
Common garter snake *Thamnophis sirtalis*	→	Confirmed Breeder Present Year Round County Abundance: Abundant	X	C	X	X	X	X	X	X	S
Western rattlesnake *Crotalus viridis*		Confirmed Breeder Present Year Round County Abund: Common	X	X	X	X	X	S	X	F	X

Appendix J

Threatened, Endangered, or Sensitive Predators and Their Vertebrate Prey

The species lists in Appendices F through I include a number of threatened, endangered, or sensitive (TES) animals. Some of the TES animals are predators. The availability of prey animals is important to the survival of predators. This appendix lists the TES predators, and their vertebrate prey species. This information was compiled by the Oregon Natural Heritage Program, for the Oregon Department of Forestry.

For each listing, the predator's name is in boldface. The main categories of its prey are listed below. For example, under the listing for bald eagle on the next page, the main categories of "fish", "birds", and "mammals" are listed. If the predator has specific preferences within these general categories, these are also listed, indented underneath each main category. Comments are given last. Key terms for this appendix are on the next page.

Key Terms

Gallinaceous species — A bird species belonging to *Galliformes*, an order of birds that includes pheasants, turkeys, quail, and partridges, as well as common domestic fowl such as chickens. They are mostly ground birds, with heavy bodies, short wings, and legs adapted to running and scratching for food; they nest on the ground and produce large broods.

Lagomorph — An animal species belonging to *Lagomorpha*, an order of rodent mammals that is characterized by two pairs of upper incisors, one behind the other. Examples are hares, rabbits, pikas, etc.

Passerine — A bird species belonging to a group of small or medium-sized, perching songbirds that have grasping feet with the first toe directed backward. More than half of all bird species belong to this group.

Ungulate — Hoofed mammals, such as deer and elk.

Bald Eagle

Fishes
Birds
  Waterfowl — wood duck, mallard
Mammals
  Small mammals
  Lagomorphs — Nuttall's cottontail, snowshoe hare, white-tailed jackrabbit

Comments: Feeds opportunistically on fishes, injured waterfowl and seabirds, various mammals, and carrion. Hunts live prey, scavenges, and pirates food from other birds (e.g., osprey). In the Columbia River estuary, tidal flats and water less than 4 meters deep were important foraging habitats.

Northern Goshawk

Birds
  Waterfowl — wood duck, mallard
  Gallinaceous birds — blue grouse, ruffed grouse, mountain quail, California quail
Mammals
  Small mammals
  Lagomorphs — Nuttall's cottontail, snowshoe hare, white-tailed jackrabbit
  Squirrels

Comments: Eats mainly lagomorphs, squirrels, ducks, gallinaceous and other birds; local diet partly depends on availability. Tends to hunt low in forest canopy; most hunting from a perch. Favors grouse and pheasant as prey.

Peregrine Falcon

Fishes
Reptiles
  Lizards
Birds
  Medium-sized passerines
  Small waterfowl — wood duck
  Mourning dove
Mammals
  Small mammals
  Bats

Comments: Feeds primarily on birds (medium-size passerines up to small waterfowl); rarely or locally, small mammals (e.g., bats, lemmings), lizards, fishes, and insects (by young birds) may be taken. Prey pursuit initiated from perch or while soaring. May hunt up to several kilometers from nest site.

Greater Sandhill Crane

Fishes
Reptiles
  Snakes
  Lizards
Birds
Mammals
  Small mammals — western harvest mice, deer mice

Comments: Feeds on roots, tubers, seeds, grain, berries, and small vertebrates (mice, lemmings, birds, snakes, lizards, etc.), earthworms and insects. Forages in marshes, meadows, pastures, and fields. Young birds forage for invertebrates during first few weeks of life. Grainfields used extensively during at fall staging areas; flooded ricefields important food source on wintering grounds.

Flammulated Owl

Birds
Mammals
  Small mammals

Comments: Feeds on various insects (e.g. moths, beetles, grasshoppers, crickets, caterpillars); rarely eats small mammals or birds. Foraging tactics include hawk-gleaning, hawking, hover-gleaning, and drop-pouncing.

Northern Pygmy-Owl

Reptiles
Birds
  Passerines
Mammals
  Small mammals — western harvest mice, deer mice
  Rodents

Comments: Feeds mainly on mice and large insects; also eats other small mammals, birds, and reptiles. Glides/dives down from elevated perch to capture prey. Caches food.

Northern Spotted Owl

Reptiles
Birds
Mammals
  Northern flying squirrels
  Bushy-tailed woodrat
  Snowshoe hare
  Pocket gophers — Botta's pocket gopher, northern pocket gopher, western pocket gopher
  Small mammals — voles, deer mice

Comments: Small mammals, particularly nocturnal arboreal or semi-arboreal species, predominate in diet; flying squirrels, woodrats, and lagomorphs are common prey items, with pocket gophers, red tree voles, and deer mice regionally important; flying squirrels are consumed more often at higher latitudes and higher elevations, woodrats more often at lower latitudes and lower elevations. On the Olympic Peninsula, Washington, primary prey included *Glaucomys sabrinus, Neotoma*, and *Lepus americanus*. In Oregon, diet was dominated by *Glaucomys* and *Phenacomys (Arborimus) longicaudus* in Douglas-fir and western hemlock forest; *Neotoma* in mixed coniferous forest; *Thomomys* and *Clethrionomys* at higher elevations. In California, prey was mostly *Glaucomys, Neotoma, and Sciurus*.

Great Gray Owl

Amphibians
  Frogs
Birds
Mammals
  Small mammals — voles, microtine rodents
  Pocket gophers — Botta's pocket gopher, northern pocket gopher, western pocket gopher

Comments: Diet in North America dominated by pocket gophers and voles. Forages usually in open area where scattered trees or forest margin provides suitable sites for visual searching; also uses sound to locate prey under snow cover.

Loggerhead Shrike

Amphibians
Reptiles
  Lizards
Birds
  Passerines
Mammals
  Small mammals

Comments: Feeds primarily on large insects, also small birds, lizards, and rodents. Diet varies with season and location; in parts of the range, most of the food eaten in winter may be vertebrates, which comprise only a small part of the diet in California. In California, the summer diet comprises mainly insects. Captures prey via short flight from perch. Sometimes impales food items on a plant spine or on barbed wire.

Ringtail

Amphibians
Reptiles
  Snakes
Birds
  Passerines
Mammals
  Small mammals — deer mice
  Bushy-tailed woodrat
  Nuttall's cottontail

Comments: Omnivorous, but prefers animal matter. Principal foods are arthropods, small mammals, and fruits; proportions vary seasonally. Also eats various birds, reptiles, amphibians; nectar feeding from agave also reported. Diet varies seasonally: mammals, insects, and juniper berries in spring; insects and fruit in summer; birds, mammals, and fruit of hackberry and mistletoe in winter.

Marten

Birds
Mammals
  Small mammals — shrews, mice, voles
  Bushy-tailed woodrat
  Pika
  Lagomorphs — Nuttall's cottontail, snowshoe hare, black-tailed jackrabbit
  Mountain beaver
  Chipmunks — least chipmunk, yellow-pine chipmunk, Allen's chipmunk
  Squirrels — Douglas' squirrel
  Bats

Comments: Diet mainly small mammals, birds, insects, carrion. Berries and other vegetable matter eaten in season. Forages in trees and on ground (mostly). Tracks prey, ambushes, robs nests, excavates burrows, uses hunting perches.

Pacific Fisher

Birds
- Jays, nuthatches, woodpeckers, chickadees, thrushes, sparrows, quail, grouse, owls

Mammals
- Small mammals — shrews, mice, voles, moles
- Squirrels — northern flying squirrel, Douglas' squirrel
- Lagomorphs — Nuttall's cottontail, snowshoe hare, black-tailed jackrabbit
- Muskrat
- Mountain beaver
- Beaver
- Porcupine
- Raccoon
- Black-tailed deer

Comments: Diet consists primarily of mammals (small rodents, shrews, squirrels, hares, muskrat, beaver, porcupine, raccoon, deer, carrion); also birds and fruit. Quills from porcupines may penetrate internal organs without apparent damage. Feeding is opportunistic.

California Wolverine

Fish

Birds

Mammals
- Marmots
- Pocket gophers — Botta's pocket gopher, northern pocket gopher, western pocket gopher
- Mice
- Black-tailed deer

Comments: Opportunistic. Feeds on a wide variety of roots, berries, small mammals, birds' eggs, fledglings, and fish. May attack moose, caribou, and deer hampered by deep snow. Small and medium-size rodents and carrion (especially ungulate carcasses) often make up a large percentage of the diet. May cache prey in fork of tree branches or under snow.

Pacific Pallid Bat

Reptiles
- Short-horned lizards

Mammals
- Small mammals — Great Basin pocket mice

Comments: Insectivorous. Primarily forages on the ground; may capture some food in flight, within a few meters of ground vegetation. Food items include: flightless arthropods, Jerusalem crickets, moths, beetles, etc. May eat small vertebrates. Most food items are from 25-35 millimeters in body length. Documented to take some vertebrate prey (horned lizards and pocket mice). Skull seems adapted to hard-bodied prey such as large beetles.

Bull Trout

Fish
Amphibians
    Frogs
Reptiles
    Snakes
Birds
    Waterfowl (young)
Mammals
    Mice

Comments: Young bull trout feed heavily on aquatic insects. Adults feed principally on fish, but have also been known to eat other small vertebrates: frogs, snakes, mice, and ducklings, etc.

Northwestern Pond Turtle

Fish
Amphibians
    Frogs and tadpoles
Birds (carrion)

Comments: Scavenger and opportunistic predator with preference for live prey; adults partially herbivorous; food items mostly aquatic. Diet often includes adult and larval insects, worms, crustaceans, carrion, and algae. Seen feeding on a dead mallard duck. A bullfrog was taken from the stomach of a California specimen.

Appendix K

Planning Team Members, Staff, and Technical Advisors

Personnel from State of Oregon Agencies

Glen Ardt, Habitat Biologist

Mr. Ardt is currently the Regional Habitat Biologist for the Central Region, ODFW (Oregon Department of Fish and Wildlife). He has a B.S. degree in Wildlife Science from Oregon State University. Glen has worked for ODFW since 1976 and has held previous positions with the Department as Klamath Wildlife Area Manager and in the habitat program in Northeast and Northwest Oregon.

Ric Balfour, Public Use Coordinator

Mr. Balfour works in the Northwest area of the Oregon Department of Forestry. His responsibilities include recreation management, and forestry education and interpretation on the Tillamook State Forest. He has worked for the New Zealand Forest Service, and holds a degree in Parks, Recreation and Tourism from Lincoln University. He is a member of the Society of American Foresters, New Zealand Institute of Forestry, National Parks Recreation Association, and National Interpretation Association.

Kenneth F. Bierly, Wetland Program Team Leader

Mr. Bierly works primarily on issues related to the management and protection of Oregon's wetlands, as the manager of the wetlands unit at the Division of State Lands. Ken has an undergraduate degree in General Science from Oregon State University and a Master's Degree in Wetland Plant Ecology from Colorado State University. He was recently appointed to the board of directors of the Association of State Wetland Managers.

Jill Bowling, State Lands Program Director

Dr. Bowling is the State Lands Program Director at the Oregon Department of Forestry. She also maintains a close working relationship with the State Land Board and Division of State Lands. She holds a Ph.D. in Human Geography and a BSc (Honors) in Zoology from the Australian National University. She previously worked on the Governor's Forest Planning Team, and as staff for the Legislative Joint Interim Committee on Forest Products Policy. She worked for the Prime Minister's Department in Australia specializing in policy development on natural resource issues.

Melinda L. Bruce, Assistant Attorney General

Ms. Bruce works in the Natural Resources section of the General Counsel Division of the Oregon Department of Justice. She provides legal advice to the Board of Forestry on state land and resource planning and management policy, and assists in developing and implementing state land and resource legislation. She holds a Juris Doctor degree from Lewis and Clark Law School and a Bachelor of Arts in political science from Tulane University.

Elizabeth Budy, Archaeologist

Dr. Budy is the Forest Archaeologist for the Winema National Forest. She has a Ph.D. in Anthropology from the University of Oregon. She previously held positions as anthropology instructor at the University of Nevada; Research Assistant at the Desert Research Institute in Reno, Nevada; Principal Research Scientist for the Intermountain Research Company; and Archaeologist for the Tahoe and Lassen National Forests.

Ed DeBlander, Management Unit Forester

Mr. DeBlander is the Management Unit Forester for the Oregon Department of Forestry on the Klamath-Lake District. His primary responsibilities involve the supervision of the management of the Eastern Region state forest lands. He has a B.S. degree in Forest Science from Penn State University. He has also completed two years of graduate work in Wildlife Management, also at Penn State.

Mike DeLaune, Planning Coordinator

Mr. DeLaune is the Planning Coordinator for the Oregon Department of Forestry. He has a Bachelor's Degree in Forest Management and much Master's level training. He has many years with the Oregon Department of Forestry including eleven years experience in forest planning and seven years experience in field management. His experience in field management included two years on the Elliott State Forest and four years supervision of a forest management unit.

Bruce Hammon, Senior Policy Analyst

Mr. Hammon is a Senior Policy Analyst for the Eastern Region of Oregon's Department of Environmental Quality. He has worked in the field of water quality (point/nonpoint source pollution) for more than twenty years. His educational background includes a B.S. in Biology from Eastern Oregon State College and an M.S. in Environmental Technology from Central College in Nebraska.

John Hector, Program Manager for Air Quality

Mr. Hector is the Oregon Department of Environmental Quality's Program Manager for Air Quality in the Eastern Oregon Region. His work involves drafting and issuing permits, inspecting sources, and compliance. He has a B.S. and M.S. in Mechanical Engineering.

Pam Homer, Land Use Coordinator

Ms. Homer works for the Oregon Water Resources Department in a planning position in interagency coordination. She holds a B.S. in Earth Sciences from the University of Notre Dame and an M.S. in Resource Geography from Oregon State University. She participates on the Governor's Forest Planning Team and the Technical Advisory Committee of the Governor's Watershed Enhancement Board. She represents the Water Resources Department in various interagency projects that may affect water resources.

Jane Hope, Planning Specialist

Ms. Hope holds the position of planning specialist in the planning section of the Department of Forestry. She holds an M.S. in Environmental Studies from The Evergreen State College. She has previously worked for the Washington State Institute for Public Policy, and in researching waste management issues.

Alan Kanaskie, Forest Pathologist

Mr. Kanaskie has been the Forest Pathologist for the Oregon Department of Forestry since 1985. Prior to that he worked as a pathologist for the Weyerhaeuser Western Forestry Research Center, the U.S. Forest Service, Crown Zellerbach, and as an independent contractor. He holds a B.S. from Lebanon Valley College and an M.S. in Forest Pathology from Duke University School of the Environment.

Jeff Kroft, Policy Development Specialist

Dr. Kroft is employed by Oregon's Division of State Lands (DSL) as a Policy Development Specialist. His primary responsibilities include developing operating policies and procedures, and preparing administrative rules for all DSL resource management and permitting programs. He identifies development opportunities and prepares marketing strategies for resources on state lands. Currently, he is developing DSL's asset management strategy and plan. He holds a B.A. in Geology and Political Science and an M.S. in Economic Geology from the University of Washington, and a Ph.D. in Mineral Economics and Applied Earth Sciences from Stanford.

John E. Lilly, Assistant Director Policy and Planning

Mr. Lilly works for the Division of State Lands in the policy and planning section. He has over twenty years of experience in public policy making, natural resource management, and land use planning for state resource agencies. He holds a B.S. in forest management from Oregon State University.

A.K. Majors, Resource Coordinator

Mr. Majors is a Resource Coordinator with the Division of State Lands. He initially specialized in the management of rangelands, and is now responsible for waterways, wetlands, communications sites, and all other DSL activities in Klamath, Lake, Harney, and Malheur Counties. His education includes a B.S. in Rangeland Management from Utah State as well as extensive additional training in rangelands.

David McAllister

Dr. McAllister is the forest and grassland program manager with the Oregon Department of Fish and Wildlife in Portland. He has a Bachelor of Science in Biology from the University of Oregon, an M.S. in Environmental Studies, and a Ph.D. in Forest Ecology from the University of Montana. His professional career has focused on resource and mitigation planning.

Ralph Opp, Wildlife Biologist

Mr. Opp is currently a retired District Wildlife Biologist for ODFW (Oregon Department of Fish and Wildlife) on the Klamath District, a position he held from 1983 until 1994. He has a B.S. degree in Fish and Wildlife Management from Oregon State University. He worked for ODFW for 32 years, 25 of those years on the Klamath District. The remainder of the years were spent on other Eastern Oregon Districts.

David Overhulser, Forest Entomologist

Dr. Overhulser has worked for the Oregon Department of Forestry's Forest Health Management section as an entomologist since 1984. From 1977 to 1983, he was a scientist at Weyerhaeuser Company's Western Forest Research Center. He earned his Ph.D. from the University of Washington in 1980. Currently, he is a member of the National Asian Gypsy Moth Science Advisory Panel and the National Steering Committee on Seed, Cone, and Regeneration Insects.

Rick Quam, Forest Planner

Mr. Quam is a Forest Planner with the Oregon Department of Forestry's State Lands Program. His primary responsibilities are to coordinate the technical planning process for forest management plans, and to carry out analysis associated with plans and other forestry-related issues and policies. Prior to working with the Department, he held positions with Daniels and Associates (Forest Genetics Consultants) and Boise Cascade Corporation. He holds a B.S. in Forest Management from the University of Washington.

Lou Torres, Public Affairs Specialist

Mr. Torres is a public affairs specialist for the Department of Forestry. He is a department spokesperson with the news media, works as a fire information officer, and is involved in a variety of communications and informational projects. Before coming to the department, he worked as an employee communications coordinator at a large Oregon bank, and as a reporter and editor for newspapers in Oregon, California, and Colorado.

Carol Tyson, Botanist

Ms. Tyson is the Botanist and Threatened and Endangered Species Biologist for the Winema National Forest. She holds a B.S. degree in Wildlife Biology from Humboldt State University and an M.S. in Natural Resources-Range Plant Ecology, also from Humboldt. She previously was a botanist for the BLM in California.

Beth Waterbury, Wildlife Biologist

Ms. Waterbury is currently the Assistant District Wildlife Biologist for ODFW (Oregon Department of Fish and Wildlife) on the Klamath District. Beth holds two B.S. degrees from California Polytechnic State University, one in Environmental and Systematic Biology and one in Ornamental Horticulture. She previously worked as a Wildlife Biologist for the California Department of Fish and Game.

Roy Woo, District Forester

Mr. Woo is currently the District Forester on the Klamath-Lake District, where he is responsible for the supervision of all programs administered by the Department of Forestry. Roy has worked for the Department of Forestry for over 20 years. In addition to his current position, Roy has also been Assistant Area Director in Prineville, Protection Unit Forester in Tillamook, and Assistant Personnel Director in Salem. Roy holds a B.S. degree in Forest Management from Washington State University.

Consultants

Val Rapp, Writer

Ms. Rapp is a professional natural resource writer and writing consultant. Her writing projects in the last several years have included environmental impact statements, resource management plans, a joint wild and scenic river/state scenic waterway plan, a children's book on old growth forests, and many smaller projects. She has worked in natural resource management for eighteen years. She has a B.A. in English literature from the State University of New York at Buffalo.

Appendix L

Scattered Tracts Plan

This appendix outlines the plan for the scattered tracts of northeast and central Oregon that are Common School Forest Lands (listed). The State Forester, under a contract with the State Land Board and the Division of State Lands, is responsible for the management of these lands according to the general policies and objectives of the State Land Board. The State Land Board (SLB) is comprised of the Governor, the Secretary of State, and the State Treasurer. The management objectives for these lands are directed by the Oregon Constitution (Article VII, Section 5). The primary objective of the Common School Forest Lands is to generate income for the Common School Fund consistent with sound land and timber management policies. In addition to the Oregon Department of Forestry's (ODF) Scattered Tracts Plan, the Division of State Lands (DSL) is developing an Asset Management Plan that will provide policy guidance for determining retention, sales, and exchange strategies for all its properties. DSL's plan will include the Common School Forest Lands currently managed by ODF under contract with the SLB and DSL.

Situation

Klamath-Lake District has management responsibility for 42,020 acres of state-owned land. Of this total, 33,225 acres are located in Klamath County. The remaining acres are broken into 53 smaller parcels of Common School Forest Land. These parcels are commonly referred to as the Eastern Region scattered tracts. These parcels are located in 12 counties in central and northeast Oregon, and total 8,755 acres. The table on the next page summarizes information about the location of the scattered tracts.

Table L-1. Summary of the Scattered Tracts

County	Number of Parcels	Acres
Baker	2	120
Deschutes	4	520
Grant	5	2,120
Harney	5	1,520
Hood River	7	1,343
Jefferson	1	80
Morrow	2	64
Umatilla	2	297
Union	5	927
Wallowa	4	764
Wasco	3	240
Wheeler	13	760
Total	**53 parcels**	**8,755 acres**

Land Base Goal

One of the Eastern Region's long range "Land Base" goals is to increase the efficiency and economic feasibility of intensive forest management. Land exchanges and removing lands from the list of Common School Forest Lands are both considered when making land base decisions. Because the scattered tracts are difficult to manage, ODF has decided to make the exchange of these lands a high priority. The objective of an exchange is to trade the scattered tracts for land on districts with state forest management staff. The first priority will be to acquire land in the Klamath-Lake District. However, lands on other districts may be considered. The priorities for acquiring land within the Klamath-Lake District are listed below.

1. Adjacent to the North Block
2. Adjacent to the Southwest Block
3. Adjacent to the East Block

The Department of Forestry's goal is to review and pursue exchange opportunities for these scattered tracts. Lands that don't have any potential exchange partners will be recommended for de-listing back to DSL by December 1995. On the parcels that do have exchange

opportunities, the Klamath-Lake District's goal will be to accomplish the exchanges within 10 years. Any exchanges will be for equal-aggregate value of the land traded by ODF. Land appraisal values will be determined by a licensed real estate appraiser, will be cost-shared by parties involved, and will comply with ODF's exchange policy.

Interim Management

In the interim period, ODF will not be actively managing these scattered tracts. The Department of Forestry will take management action whenever forest health problems threaten to cause a significant loss in the asset value of a parcel of forest land. The Department's Insect and Disease section has reviewed the scattered tracts for forest health problems and will continue to monitor them through the annual insect and disease surveys. The Insect and Disease section used the following review criteria: any parcels in danger of losing their forest value before the end of the ten year exchange window would receive management treatment.

As a result of this review, two parcels have been actively managed. Part of one parcel was treated with precommercial thinning in 1993, and part of another parcel is being treated by a salvage harvest. The Department of Forestry will continue to monitor these parcels for forest health problems.

ODF and DSL Coordination on Exchange Criteria

The Department of Forestry is currently coordinating with DSL on land exchange opportunities that will consolidate our forest land management areas in the Klamath-Lake District. ODF will review each parcel that could potentially be exchanged, using the following criteria provided by DSL. It would be desirable to exchange parcels that meet these criteria.

- Small parcel (less than or equal to 640 acres)
- Surrounded by non-state owned land
- Isolated from other tracts of state-owned land
- Uneconomical to manage as single tract
- Impaired access for management purposes
- Low forest product value
- Low value for other income-producing uses (i.e. grazing)
- Management of parcel strongly influenced by actions of adjacent owners/managers
- Local government and public opinion likely to support exchange plan
- Public values on site (i.e. recreation use, special features) not likely to be significantly affected

DSL has stated that from a forest management viewpoint, it is desirable to exchange these parcels in order to add to the Sun Pass or other State Forests. However, according to the July 24, 1992 Attorney General's opinion (No. 8223), the primary objective of Common School Lands is the "production of income for the Common School Fund." (See Appendix C for a detailed discussion of policies on Common School Lands.) Therefore, these lands need to be fully evaluated for all uses and income potential before exchange. To ensure this is done, the Department of Forestry and DSL will coordinate their review of each parcel.

Summary of Exchange Opportunities

Klamath-Lake District / Hood River County

The Klamath-Lake District is currently involved in a three-way exchange between the U.S. Forest Service (Columbia River Gorge Scenic Area and Winema National Forest), Hood River County, and the State of Oregon. In this exchange, Hood River County's land that lies within the Columbia River Gorge National Scenic Area Boundary will go to the Forest Service, Hood River County will get Common School Forest Land along with acquisition of some land from the Mt. Hood National Forest, and the State will get Winema National Forest land adjacent to Sun Pass State Forest. This exchange opportunity meets our long range goals and objectives. It is an optimum exchange for the Department of Forestry, because ODF is able to meet its management goal of exchanging the land, while receiving land in the preferred area of acquisition adjacent to the North Block.

Klamath-Lake District / Boise Cascade

The Klamath-Lake District is also involved in an exchange with Boise Cascade. Boise Cascade could potentially acquire 1,384 acres of Common School Forest Land in northeast Oregon. The Department of Forestry would acquire land of equal aggregate value in Klamath County adjacent to the Southwest Block.

These two exchange opportunities have been pre-approved in concept by DSL. The Klamath-Lake District has assigned staff to review exchange potential on all parcels. ODF staff will coordinate with DSL on the identification of parcels with disposal potential, either in land exchanges or a recommendation for de-listing (return to DSL management).

Appendix M

Seven-Year History of Timber Harvest

The table on the next page shows the acres, volume, and value of timber harvested on Klamath-Lake District state forests from 1987-1993.

Table M-1. Seven-Year Harvest History on Klamath-Lake District State Forests

Year	Acres Harvested		Volume Harvested (MBF)		Value Harvested	
	BOF	CSFL	BOF	CSFL	BOF	CSFL
1993	676	8	4,870	54	$1,665,262	$20,034
1992	0	26	0	1,166	0	$379,874
1991	688	0	3,579	0	$645,750	0
1990	318	0	5,357	0	$962,541	0
1989	872	692	3,509	4,587	$391,209	$283,979
1988	40	314	1,154	1,957	$175,077	$89,813
1987	0	314	0	4,167	0	$628,284

Acronyms used in the table:

BOF	Board of Forestry Lands
CSFL	Common School Fund Lands
MBF	Thousand board-feet

Appendix N

Special Forest Products

Between 1990 and 1992, Winema National Forest completed an inventory of 43 botanicals used for an assortment of products (USDA Forest Service 1992). Because of the proximity and similar landscape, it can be assumed that most of these products are also available on state forest lands in the Klamath-Lake District. The 43 products and their uses are listed in the following table.

Table N-1. Special Forest Products Likely to be Found on the Klamath-Lake District

Common Name	Scientific Name	Common Uses
Shasta Red Fir	*Abies magnifica var. shastensis*	Human consumables and craft materials
Noble Fir	*Abies procera*	Human consumables and craft materials
Lodgepole Pine	*Pinus contorta var. latifolia*	Human consumables, craft materials, and propagartive and landscape materials.
Sugar Pine	*Pinus lambertiana*	Human consumables and craft materials
Western White Pine	*Pinus Monticola*	Human consumables and craft materials, and propagative and landscape materials
Ponderosa Pine	*Pinus ponderosa*	Human consumables and craft materials
Mountain Hemlock	*Tsuga mertensiana*	Craft materials and propagative and landscape materials

Common Name	Scientific Name	Common Uses
Pussypaws	*Spraguea umbellata var. caudicefera*	Propagative and landscape materials
Candystick	*Allotropa virgata*	Research
Pinedrops	*Pterospora andromedea*	Human consumables and research
Yarrow	*Achillea millefolium*	Human consumables, craft materials, and propagative and landscape materials
Western Pasqueflower	*Anemone occidentalis*	Propagative and landscape materials
Perennial Buckwheats	*Eriogonum spp.*	Propagative and landscape materials
Wild Strawberries	*Fragaria spp.*	Human consumables and propagative and landscape materials
Klamath-weed or St. John's-Wort	*Hypericum perforatum*	Human consumables and craft materials
Perennial Lupines	*Lupinus spp.*	Propagative and landscape materials
Pinemat	*Arctostaphylos nevadensis*	Human consumable, craft materials, and propagative and landscape materials
Greenleaf Manzanita	*Arctostaphylos patula*	Human consumables, craft materials, and propagative and landscape materials
Bearberry or Kinnikinnik	*Arctostaphylos uva-ursi*	Human consumables, craft materials, and propagative and landscape materials
Shrubby Golden Chinquapin	*Castanopsis chrysophylla*	Fuels/energy, craft materials, and propagative and landscape materials

Common Name	Scientific Name	Common Uses
Mahalamat	*Ceanothus prostratus*	Craft materials and propagative and landscape materials
Snowbrush	*Ceanothus velutinus var. velutinus*	Human consumables, fuels/energy, craft materials, and propagative and landscape materials
Rabbitbrush	*Chrysothamnus nauseosus*	Craft materials and propagative and landscape materials
Pipsissewa or Prince's Pine	*Chimaphila umbellata*	Human consumable and propagative and landscape materials
Broom-Snakeweed or Matchbrush	*Gutierrezia sarothrae*	Propagative and landscape materials
Rabbitbrush-goldenweed	*Haplopappus bloomeri*	Human consumables
Davidson's Penstemon	*Penstemon davidsonii var. davidsonii*	Propagative and landscape materials
Antelope-brush or Bitterbrush	*Purshia tridentata*	Craft material and propagative and landscape materials
Squaw Currant	*Ribes cereum*	Human consumables, craft materials, and propagative and landscape materials
Willows	*Salix spp.*	Craft materials
Douglas' Spiraea	*Spiraea douglasii*	Craft materials and propagative and landscape materials
Quaking Aspen	*Populus tremuloides*	Human consumables and propagative and landscape materials
Edible Morel	*Morchella esculenta*	Human consumables
California Truffle	*Tuber californicum*	Human consumables

Common Name	Scientific Name	Common Uses
False-Truffle or Root-balls	*Rhizopogon subcaerulescens*	Human consumables
Common Root-balls	*Rhizopogon vulgaris*	Human consumables
Matsutake or Pine Mushrooms	*Tricholoma magnivelare*	Human consumables
Black Lichen	*Bryoria fremontii*	Craft materials
Yellow Wolf Lichen		Craft materials
Sand-lily	*Leucocrinum montanum*	Propagative and landscape materials
Spreading Phlox	*Phlox diffusa*	Propagative and landscape materials
Perennial Violets	*Viola spp.*	Propagative and landscape materials
Dwarf Monkey-flower	*Mimulus nanus*	Propagative and landscape materials